



EFFECT OF JIGSAW COOPERATIVE LEARNING STRATEGY ON ACHIEVEMENT IN PHYSICS AND LIFE-SKILLS AMONG SECONDARY SCHOOL STUDENTS

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Abstract

The aim of the study was to explore the effect of cooperative learning strategies on achievement and life skills among secondary school students. The pretest-posttest control group design was chosen for the present experimental work. The study sample consisted of 160 students of secondary class who were randomly assigned to experimental group (N=80) and control group (N=80), matched on the basis of their pretest scores in achievement test. The experimental group was taught through cooperative learning strategy namely, jigsaw while control group was taught through traditional teaching method. Both the groups were taught simultaneously on the topic "force and friction". Results indicated that the group taught through jigsaw cooperative learning strategy outperformed the control group on various levels (knowledge, understanding and application) of achievement test.

Keywords: Cooperative learning, Jigsaw, Academic achievement.



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Introduction

Jigsaw is a cooperative learning strategy that enables each student of a "home" group to specialize in one aspect of a topic (for example, one group studies habitats of rainforest animals, another group studies predators of rainforest animals). Students meet with members from other groups who are assigned the same aspect, and after mastering the material, return to the "home" group and teach the material to their group members. With this strategy, each student in the "home" group serves as a piece of the topic's puzzle and when they work together as a whole, they create the complete Jigsaw puzzle. The Jigsaw technique is a method of organizing classroom activity that makes students dependent on each other to succeed. It breaks

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classes into groups that each assemble a piece of an assignment and synthesize their work when finished. It was designed by social psychologist Elliot Aronson to help weaken racial cliques in forcibly integrated schools. The jigsaw technique is a cooperative learning method that brings about both individual accountability and achievement of the team goals. The process derives its name from the jigsaw puzzle because it involves putting the parts of the assignment together to form a whole picture. The assignment is divided into parts and the class is also divided into the same number of groups as that of the assignment. Each of these group is given a different topic and allowed to learn about it. These groups are shuffled to form new groups consisting of members from each group.

Cooperative learning is the process of breaking a classroom of students into small groups so they can discover a new concept together and help each other learn. Cooperative learning is an educational approach which aims to organize classroom activities into academic and social learning experiences. There is much more to cooperative learning than merely arranging students into groups, and it has been described as ‘structuring positive interdependence.’”

Review of Literature

Several terms are being used interchangeably to define cooperative learning such as collaborative learning, teamwork and group work. But the most widely used definition of cooperative learning in higher education is probably that of **Johnson, Johnson & Holubec (1998)**. According to them, cooperative learning is the instructional use of small groups so that students work together to maximize their own and each other’s learning.

Cooperative learning exists when students work together to achieve joint learning goals (**Johnson et al., 1992,1993**).

This review, therefore, will examine the effects of different structures of cooperative learning on academic achievement and the effects of cooperative learning on social interaction, behaviour, and effect on secondary level students. **Slavin (1980)** reported positive effects for cooperative learning on achievement, self-esteem, social skills, and liking for school subjects among young adolescents as well. He found that friendships with students of other ethnic groups and mainstreamed students with special needs increased when cooperative learning was used.

Cooperative learning is the instructional use of small groups so that students work together to maximize their own and each other's learning. Cooperative learning is the instructional use of small groups so that students work together to maximize their own and each other's learning. Cooperative learning is the instructional use of small groups so that students work together to maximize their own and each other's learning. Cooperative learning is the instructional use of small groups so that students worktogether to maximize their own and each other's learning.

In a Meta-analysis of 158 studies Johnson & Johnson reported that cooperative learning methods are likely to produce positive results in achievement along with developing social and higher order thinking skills (**Johnson et al., 2000**). The studies have been conducted across all the levels of education viz primary, middle, secondary and higher education (Dasan, 2007). The studies have been conducted across all the levels of education viz primary, middle, secondary and higher education (Dasan, 2007) Many studies on specific cooperative learning methods were found. The studies have been conducted across all the levels of education viz primary, middle, secondary and higher education (**Dasan, 2007**).

Although a number of Cooperative learning methods are applied in classroom teaching, a well-known and highly accepted method is Jigsaw. Dialog between students who were working together cooperatively was much greater than with students who were not using this strategy (**Topping et al., 2011**). The interactions between students in cooperative learning groups have been found to be more positive if specific guidelines are established for the group (**Kuester & Zentall, 2012**). Thus, in cooperative learning tasks group members not only help each other but motivate each other to put maximum efforts, "since they are clear that their contribution to teamwork can be individually identified and assessed" (**Ning & Hornby, 2014**). **Garcha and Kumar (2015)** reported that cooperative learning (Jigsaw strategy) is effective for critical thinking dispositions of secondary school students. Researcher employed Control group pretest-posttest design and 116 students of grade 9th were taken as sample. The researcher employed ANOVA technique to analyze the data and data analysis showed that students taught by cooperative learning strategy (Jigsaw) (Mean=27.12, N=57) achieved significantly higher critical thinking dispositions as compared to students taught by traditional method of teaching (Mean=22.39, N=59). Moreover, mutual understanding among team members decreased task conflicts among them.

Similarly, **Mutlu (2017)** concluded that the jigsaw technique results in positive outcomes such as increasing academic achievement, building trust amongst students, increased student interest level and motivation, and greater support and encouragement amongst students. **Sangeeta and Sunita (2015)** found similar results and concluded that when the classroom atmosphere is not competitive, but rather cooperative, students motivate and help each other to learn more effectively. Cooperative learning can positively impact all learners whether they are low-achievers, high-achievers, or have learning disabilities.

Furthermore, **Rivera-Perez et. Al. (2020)** concluded that the cooperative learning did help increase their emotional control and regulations, and empathy based on significant increases in post-tests.

Suhendi et al. (2017) concluded that application of cooperative learning model in developing life skills in aquatic learning activities in elementary school gave positive effect on improving the affective/social abilities and the students' life skills (communication, effort and teamwork/cooperation).

Sonia (2019) concluded that students taught through cooperative learning reduced their academic stress significantly to a higher extent than those instructed through conventional method of teaching.

Tools Used

The tools used for the present study was the Science Achievement Test (prepared by the Investigator). The achievement test was developed in accordance with the purpose i.e., to determine the effect of the cooperative learning on achievement in science among CBSE secondary school students. The content of the test was chosen from CBSE NCERT science books of 9th and 10th class students. Overall, 2 chapters namely, Force and Friction were selected. The final draft consisted of 50 questions 25 items from each unit. The achievement test comprised of four options of multiple-choice objective test items. The students were instructed properly to select the correct answer out of four options.

The achievement test was validated by three secondary school science teachers. The contents of the entire tests were thoroughly inspected by various teachers and comment on whether each item approximately matched to the content area specified. The contents were then carefully compared with the objective of the course of instruction. Since, there was

conformity between the table of specification and test items, the achievement tests were found to possess content validity. The blue print of the science achievement test is as follows:

Units	Dimension Wise Number Of Test Items (Achievement Test)			
	Knowledge	Understanding	Application	Total
Force	10	9	6	25
Friction	10	8	7	25

Variables Used in the Study

For the present study, independent variables are – Teaching through cooperative learning strategy (Jigsaw) and Teaching through traditional method. Academic Achievement is the Dependent variable.

Objectives

This study aimed to examine the effect of Jigsaw cooperative learning strategies on achievement in physics of students at secondary school level.

- To study the academic achievement of the students.
- To study the effect of cooperative learning strategy on achievement of CBSE school students with respect to gender & group.

Hypotheses

The following hypotheses were proposed to achieve the above stated objectives:

- There is no significant mean scores difference in the gain achievement scores at different levels viz knowledge, understanding and application between students taught in control group and experimental group.
- There is no significant difference in the mean scores of academic achievement of boys and girls.
- There is no significant effect of interaction between treatment and gender on the mean gain scores of academic achievement.

Sample

The study was conducted on 160 students of 9th and 10th class taken from four CBSE based secondary schools selected randomly in Amritsar district. Each school consisted of one experiment and one control group with twenty participants assigned to each group. Therefore, overall, four experimental and four control groups were formulated in the study. However, to ensure the validity of the experiment, the students in the control group (N=80) and experimental

group (N=80) were assigned using simple random sampling technique based on the pretest achievement scores.

The participants were divided into subgroups with scores ranging from 28-36, 19-27 and 10-18 in achievement pretest. Half the participants from each subgroup were randomly assigned to the experimental group and half to the control group to make the two groups homogeneous.

The sample consisting randomly selected containing 80 boys and 80 girls students from four different CBSE secondary schools on the basis of pre-test scores as follows –

Pretest Scores	Experimental Group		Control Group	
	Boys	Girls	Boys	Girls
10-18	24	20	22	20
19-27	15	18	17	18
28-36	1	2	1	2
TOTAL	40	40	40	40
	80		80	

Design & Procedure of the Study

The design of the study has following sketch –

Sr. No.	Experimental Group	Control Group
1	Pretest (Achievement and Life-skills)	
2	Taught through cooperative learning strategy i.e., Jigsaw	Taught through traditional method.
3	Posttest (Achievement and Life-skills)	

In order to deal with the potential pre-existing differences in overall ability between the treatment and control groups a pre-test was conducted. Then, students were divided into two groups on the basis of these scores. For controlling the effect of teacher quality both the groups were taught by the researcher herself. Both groups were taught two units using the same content outline as per given in the NCERT book of science (physics). However, the students in cooperative learning group completed learning activities in small heterogeneous groups while the students in the control group were taught through traditional method over a period of six weeks.

The experiment was done within one and half month by the investigator in five CBSE secondary schools of the Amritsar district spending eleven days in each school.

Jigsaw Puzzle

- Five groups were formulated with 4 students in each group.
- Topic 'Force' was divided into 5 sub-topics: Concept, Types, Nature, Uses in daily life, Advantages and Disadvantages. Every group was assigned one sub-topic. Students were asked to discuss the sub-topic assigned to them in their respective group.
- Similarly, 'Friction' topic was divided into 5 sub-topics : Concept, Types, Nature, Uses in daily life, Advantages and Disadvantages of force.
- Now, one member from each group was chosen and a new group was formulated and they discuss their respective sub-topic with each other.
- Each group member returns to their home group and discusses the other sub-topics.

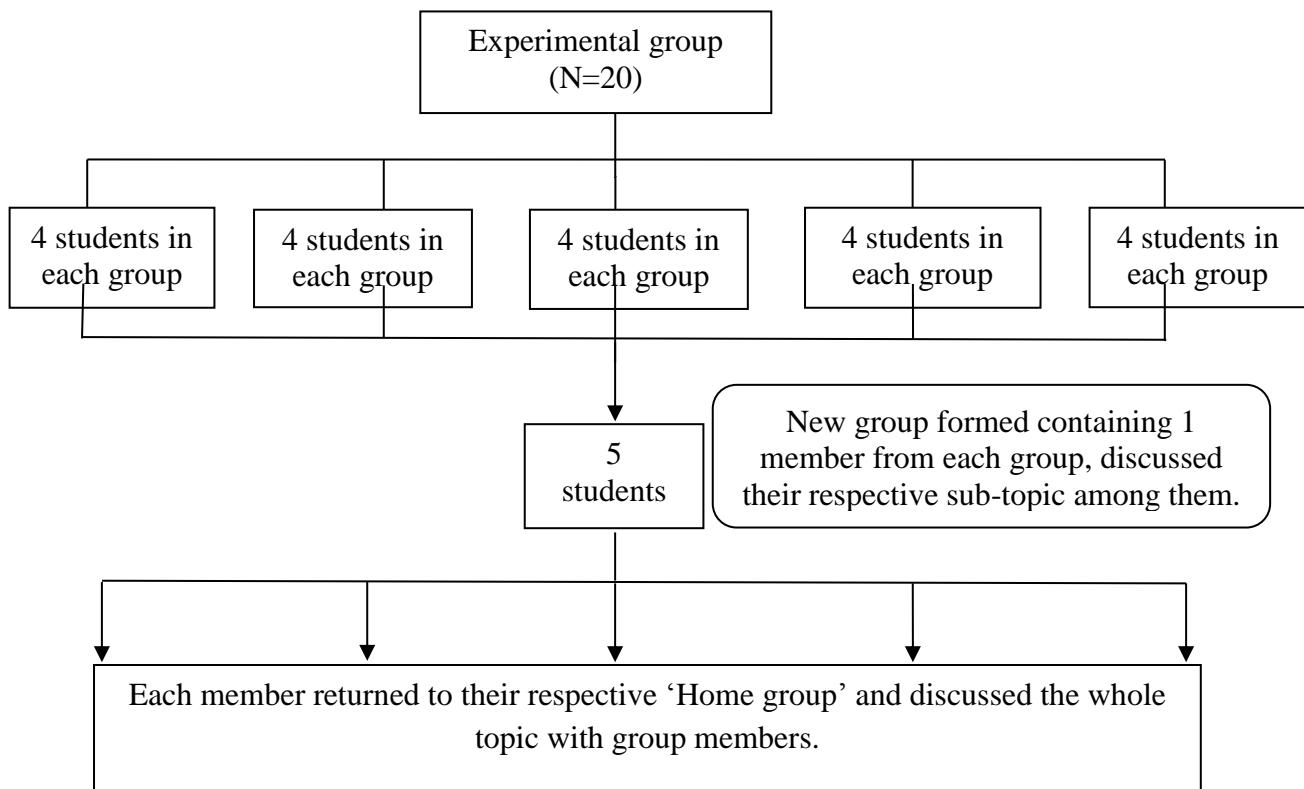


Fig.1.1 The figure showing the procedure of conducting jigsaw puzzle between experimental group students

Analysis and Interpretation of Data

ANOVA was employed to find out the significant difference in the mean gain scores of achievement at various levels namely, Knowledge, Understanding and Application dimension between students taught in experimental and control group and Gender of students.

2x2 Anova on the Scores of Academic Achievement in Different Domains In Relation To Treatment and Gender Of students

Table 1.1: Dimension Wise Mean and S.D.of Academic Achievement Gain Scores in Knowledge, Understanding & Applications Domains

Group	Gender	Academic Achievement			Total
		Knowledge	Understanding	Application	
Experimental Group	Boys	N = 40	N = 40	N = 40	N = 120
		Gain = 268	Gain = 332	Gain = 170	Gain = 770
		SD = 4.077	SD = 4.751	SD = 2.528	SD = 11.356
	Girls	N = 40	N = 40	N = 40	N = 120
		Gain = 278	Gain = 359	Gain = 177	Gain = 814
		SD = 3.998	SD = 5.182	SD = 2.732	SD = 11.912
Control Group	Boys	N = 40	N = 40	N = 40	N = 120
		Gain = 172	Gain = 196	Gain = 142	Gain = 510
		SD = 3.015	SD = 3.068	SD = 2.111	SD = 7.194
	Girls	N = 40	N = 40	N = 40	N = 120
		Gain = 208	Gain = 172	Gain = 118	Gain = 498
		SD = 3.500	SD = 3.113	SD = 2.026	SD = 8.639
Total	Boys	N = 80	N = 80	N = 80	N = 240
		Gain = 440	Gain = 528	Gain = 312	Gain = 1280
		SD = 7.092	SD = 7.819	SD = 4.639	SD = 19.540
	Girls	N = 80	N = 80	N = 80	N = 240
		Gain = 486	Gain = 531	Gain = 295	Gain = 1312
		SD = 7.498	SD = 8.295	SD = 4.758	SD = 20.551

In order to analyse the analysis of the variance, 2X2 ANOVA has planned and are presented in the table 2 below –

Table 1.2: Summary of 2x2 Factorial Design ANOVA of Academic Achievement Gain Scores (Dimension Wise)

Source of Validation	Knowledge				Understanding				Application				Total				
	d f	SS	Mean SS	F-ratio Value	p-Value	SS	Mean SS	F-ratio Value	p-Value	SS	Mean SS	F-ratio Value	p-Value	SS	Mean SS	F-ratio Value	p-Value
Main Effect (A) Group	1																
	7	17	28.17	28.243	0.001	65.05	65.05	92.530	0.001	47.30	14.105	0.024	87.58	87.58	44.959	0.008	
	2	25	**	**	**	7	7	**	**	0	7	**	**	9	9	**	**
	5																
	1	3	13	2.169	0.143	0.057	0.057	0.080	0.929	1.772	0.528	0.469	4.054	4.054	0.902	0.344	
Main Effect (B) Group	1																
	2	25	0.693	0.406	0.525	16.255	16.255	2.307	0.131	6.043	1.793	0.183	26.523	26.523	1.598	0.208	
	5																
	1	5	6.098			10.937	7.047			3.31	3.354		25.766	16.499			
	6																
Interaction Group (AxB)	4																
	1	2	4.225	0.693	0.406	16.255	16.255	2.307	0.131	6.043	1.793	0.183	26.523	26.523	1.598	0.208	
	5																
	1	5	6.098			10.937	7.047			3.31	3.354		25.766	16.499			
	6																
Within Group (Errors)	9																
	1	5	6.098			10.937	7.047			3.31	3.354		25.766	16.499			
	5																
	1	5	6.098			10.937	7.047			3.31	3.354		25.766	16.499			
	6																
0																	

* Significant at the 0.05 level of confidence

Results & Discussion

Main Effects

Treatment (A)

Knowledge dimension of Achievement Gain Scores

It may be observed from table 4.2 that the F-ratio 28.243 for the difference in knowledge dimension of Achievement gain scores between experimental group and control group has been found to be significant at the 0.05 and 0.01 level of confidence. This means that there is significant difference in the knowledge dimension of achievement gain scores of secondary school student exposed to cooperative learning strategies than students who were not taught through cooperative learning strategies because mean gain of experimental group is 6.825 and mean gain of control group is 4.75.

Understanding dimension of Achievement Gain Scores

It may be observed from table 4.2 that the F-ratio 92.530 for the difference in understanding dimension of Achievement gain scores between experimental group and control group has been found to be significant at the 0.05 and 0.01 level of confidence. This means that there is significant difference in the understanding dimension of achievement gain scores of secondary school student exposed to cooperative learning strategies than students who were not taught through cooperative learning strategies because mean gain of experimental group is 8.638 and mean gain of control group is 4.6.

Application dimension of Achievement Gain Scores

It may be observed from table 4.2 that the F-ratio 14.105 for the difference in application dimension of Achievement gain scores between experimental group and control group has been found to be significant at the 0.05 and 0.01 level of confidence. This means that there is significant difference in the application dimension of achievement gain scores of secondary school student exposed to cooperative learning strategies than students who were not taught through cooperative learning strategies because mean gain of experimental group is 4.338 and mean gain of control group is 3.25.

Total Achievement Gain Scores

It may be observed from table 4.2 that the F-ratio 44.959 for the difference in Total achievement gain scores between experimental group and control group has been found to be significant at the 0.05 and 0.01 level of confidence. *Hence the null hypothesis "There is no significant mean scores difference between the gain achievement scores at different levels viz knowledge, understanding and application of control and experimental groups after intervention."* This means that experimental group (N = 80) taught through cooperative learning strategies attained higher academic gain scores than control group (N = 80).

The mean of achievement gain scores of experimental group is 6.6 and mean of achievement gain scores of control group is 4.2.

Gender (B)

Knowledge dimension of Achievement Gain Scores

It is seen from the table 4.2 that F-ratio is 2.169 for difference in Knowledge Achievement gain scores between Boys and Girls belonging to Secondary CBSE School has not been found significant at 0.05 and 0.01 level of confidence.

It suggests that secondary school students on the basis of gender do not contribute to the achievement gain scores.

Understanding dimension of Achievement Gain Scores

Similarly, it is seen from the table 4.2 that F-ratio is 0.008 for difference in Understanding Achievement gain scores between Boys and Girls belonging to Secondary CBSE School has not been found significant at 0.05 and 0.01 level of confidence.

It suggests that secondary school students on the basis of gender do not contribute to the achievement gain scores.

Application dimension of Achievement Gain Scores

Also, it is seen from the table 4.2 that F-ratio is 0.528 for difference in Application Achievement gain scores between Boys and Girls belonging to Secondary CBSE School has not been found significant at 0.05 and 0.01 level of confidence.

It suggests that secondary school students on the basis of gender do not contribute to the achievement gain scores.

Total Achievement Gain Scores

It is seen from the table 4.2 that F-ratio is 0.902 for difference in Total Achievement gain scores between Boys and Girls belonging to Secondary CBSE School has not been found significant at 0.05 and 0.01 level of confidence.

It suggests that secondary school students on the basis of gender do not contribute to the achievement gain scores.

Hence the null hypothesis "There is no significant difference in the gain scores of academic achievement at different levels viz. knowledge, understanding and application of boys and girls" has been accepted.

Two-Order Interaction

Treatment X Gender (A X B)

Knowledge dimension of Achievement Gain scores

It is seen from table 4.2 that F-ratio is 0.406 for the interaction between Treatment and Gender has not been found significant at 0.05 and 0.01 level of confidence.

This means that effect of cooperative learning strategies on the knowledge gain score is independent of gender of secondary school students.

Understanding dimension of Academic Gain scores

It is seen from table 4.2 that F-ratio is 0.131 for the interaction between Treatment and Gender has not been found significant at 0.05 and 0.01 level of confidence.

This means that effect of cooperative learning strategies on the understanding gain score is independent of gender of secondary school students.

Application dimension of Academic Gain scores

It is seen from table 4.2 that F-ratio is 0.183 for the interaction between Treatment and Gender has not been found significant at 0.05 and 0.01 level of confidence.

This means that effect of cooperative learning strategies on the application gain score is independent of gender of secondary school students.

Total Achievement Gain scores

It is seen from table 4.2 that F-ratio is 0.208 for the interaction between Treatment and Gender has not been found significant at 0.05 and 0.01 level of confidence.

This means that effect of cooperative learning strategies on the total gain score is independent of gender of secondary school students.

Hence the null hypothesis "There is no significant effect of interaction between treatment and gender on the adjusted mean scores of academic achievement" has been accepted.

Findings of the Study

The major findings of the study are as follows:

- Experimental group taught through cooperative learning strategy attained higher academic achievement gain scores than control group taught through traditional method.
- The secondary school students on the basis of gender do not contribute to the significant achievement gain scores.
- The effect of cooperative learning strategies on the total achievement gain scores is independent of gender of secondary school students.

Discussion on the Findings

This literature review reveals that there are multiple different benefits to students when cooperative learning is implemented correctly, such as increased academic achievement.

All in all, mathematics achievement increases significantly when the cooperative learning technique is used.

This is because students are able to correct their mistakes and understand their weaknesses by working together with other students to improve themselves in mathematics. The incorporation of cooperative learning in education should be done correctly for positive results to be achieved hence teachers should be trained on cooperative learning implementation techniques within their classrooms. Cooperative learning also helped to increase the confidence of the students and make them develop a more positive attitude towards the learning process in general. Students who were more participative and involved in cooperative learning improved their mathematics scores with no significant differences observed in terms of gender.

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However, there is no significant difference in the gain achievement scores in science at different levels viz knowledge, understanding and application of boys and girls. This indicates boys and girls belonging to control and experimental group have no significant effect on the science achievement.

Similarly, there is no significant effect of interaction between treatment and gender on the mean scores of academic achievement found. This means boys and girls belonging to control and experimental group have no significant effect with respect to treatment on the science achievement.

At the same time, several limitations of the study require cautious interpretations of the findings. Firstly, the generalizability of the findings are restricted to CBSE secondary school students of Amritsar district only. Moreover, it is limited to only physics as a subject area. Second, the experiment was conducted for a short duration of time i.e only eleven days in each of four schools. Therefore, an area of future research is to investigate the effect of jigsaw

cooperative learning strategy to the higher secondary students and with longer duration of time to wear off the novelty effect.

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