

The Role of Cooperative Learning Method in Teaching of Science Subject at Elementary School Level: An Experimental Study

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Abstract

The current study aims to report the effects of cooperative learning method on students' academic performance in the subject of Science and to identify the challenges if any while implementing cooperative learning in Pakistani classroom. The Researchers adopted quantitative approach and Quasi-experimental research design was employed. Experiment was conducted in a government girls' elementary school and lasted for 13 weeks. Experimental group received treatment and was taught with cooperative learning whereas control group left untreated and was taught with traditional lecture method. The findings of the research study suggested that use of cooperative learning significantly affected students' test scores in the subject of science. Data analysis revealed that students of experimental group performed significantly better than control group in posttest. During experiment few challenges were observed such as teachers' belief, classroom furniture, lack of learning resources etc. Study strongly recommends the use of cooperative learning in classrooms to increase students' academic performance and orientation of innovative teaching methods in pre-service and in-service teachers training programs.

Keywords: Diversity, cooperative learning, academic achievement, social skills, cooperation

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Introduction

Cooperative Learning (CL) is an instructional method, which suggests learning in small, heterogeneous groups to achieve a shared learning goal. It facilitates the learning needs of diverse learners (Nuntrakune, Nason, & Kidman, 2006; Stainbank, 2009; Hossain, & Ahmad, 2013; Altun, 2015; Chai, Tay, & Lim, 2015; Buchs, & Butera, 2015 ; Casey, Goodyear, & Dyson, 2015; Lirola, 2016; Phiwpong, & Dennis, 2016; Rajab, & Ibrahim, 2017).“Pakistan is a multiethnic, multicultural society comprising a population that is diverse in terms of ethnicity/race, language and religion”(Syed, 2006, P. 1 as cited Najmonnisa, Haq, & Saad, 2015) . These findings are also reinforced by Hamid (2010), Shah and Amjad (2011). Since school is a mirror of society, so diversity is a distinguished characteristic of each classroom.

In a culturally diverse classroom, if students get an opportunity to interact and learn together, this diversity adds colors to classroom life , students appreciate diversity and respect each other (Johnson, Johnson, Stanne, & Garibaldi, 1990; Schwieger, Gros, & Barberan, 2010; Hossain, & Ahmad, 2013).Similarly, in a class of diverse ability learners, in which a teacher divides students in small heterogeneous groups, these group members not only interact with each other but together they achieve a shared academic goal. This collective group performances improve their content understanding and academic grades (Aronson; 2014; Çiğdemoğlu, Kapusuz & Kara, 2015 ; Hosseini, 2017 ;Rajab & Ibrahim, 2017). Regrettably, in Pakistan, lecture method is a predominantly used teaching method (Sarwar, 2001; Hussain, Inamullah & Naseeruddin, 2008; Jan, 2013). Lecture based teaching promotes individualistic learning style and competitive learning environment, competition for grades, teacher recognition and praise (Khan, 2008). The current classroom culture in Pakistan does not favor collaboration and students’ participation (Ahmad & Mahmood, 2010; Ali, 2011; Parveen, & Batool, 2012; Sultana, & Zaki, 2015). Worldwide literature also confirms this statement. Slavin (1996) states that, “Traditional classrooms expect students to work independently and to compete for good grades, teachers’ approval, and recognition” (p.1). This statement is congruent with other studies (Gillies & Ashman, 2003; Baghcheghi, Koohestani, & Rezaei, 2011; Khan & Inamullah, 2011; Ning & Hornby, 2014).

It is reported in various studies that the innovative teaching methods are not comprehended and appreciated by the teachers in Pakistan (Sarwar, 2001; Jacobs & Loh, 2003; Hussain et al., 2008 ; Naseer, Patnam & Raza, 2009; Arif, Mahmood, Mahmood, & Parveen, 2011; Najmonnisa, & Haroon, 2014). Traditional methods of teaching are practiced even in teaching science in majority of Pakistani schools; resultant rote memorization promotes among students (Halai, & Khan, 2011; Ali, 2012; Ahmadpanah, Soheili, Jahangard, Bajoghili, Haghghi, Holsboer-trachsler, Keikhavandi, 2014).

Various researches were conducted to investigate factors influencing students' academic achievement, cooperative learning was found one of the most effective (Walberg, 1986). It is the requirement of 21st century teacher to equip herself with all prescribed teaching tools, in order to improve learning outcomes. For addressing the needs of diverse learners, cooperative learning method facilitates interaction among learners and promotes social skills for better collective performance (Rajab & Ibrahim, 2017).

Cooperative learning is deep rooted in social constructivism, social cohesion and motivational theories (Alzahrani, 2016). Social constructivism emphasizes on dialogues or the shared (social) activities that emerge among/from people. Constructivist theorists perceive that knowledge is socially constructed and cognitive conflict is the beginning of new learning (Slavin, 2015). The theory of motivation endorses that the collective efforts of students allow them to set their objectives to achieve their goals, as in CL, they do not only support each other but also encourage them to maximize their efforts (Ning, & Hornby, 2014). The bonding among the group members also enable them to achieve well, as supported by social cohesion theory which endorses "they care about one another to succeed" (Slavin, 1996, p 536).

Cooperative learning task allows heterogeneous grouping to accomplish a shared goal by working together (Reza, Abozar, Ali & Akbar, 2013). Several researches endorsed that interaction among students improve their learning that does not only sharpen their intellectual skills but also their interpersonal skills (Kuri, 2013; Lau, Chong, & Wong, 2014; Paul, & Ray, 2014; Inuwa, Abdullah, & Hassan, 2015; Garcha, & Kumar, 2015; Mashhadi, & Gazorkhani, 2015; Phiwpong, & Dennis, 2016; Alzahrani, 2016; Liu, Ba, Huang, Wu & Lao, 2017).

This current research aims to study the influence of cooperative learning methods on students' academic achievements and to identify challenges that can be anticipated while implementing CL in school.

Research Questions

Following are the research questions:

- i. How does cooperative learning can be helpful in improving students` academic achievement?
- ii. What are the challenges that can be anticipated while implementing cooperative learning in school?

Hypotheses:

H₁: There is a statistical difference between the average post and pre-test scores of students of VII standard taught by cooperative learning and the students of grade VII taught by traditional lecture method.

Methodology

The present research study focused upon measuring the effectiveness of cooperative learning Students Team Achievement Division (STAD) model in contrast with the lecture based teaching method and its relevant effectiveness on academic performance of students. This study also focuses upon analyzing the different challenges that may occur during integrating cooperative learning practices in school. The Quasi-experimental research design was employed by the researcher in which "Pre-test-Post-test Control Group Design (Campbell, & Stanley, 1963) were incorporated to examine the extent to which cooperative learning could be applied as a substitute to traditional lecture based teaching method in treatment group classroom and to quantify the effectiveness of cooperative learning on students` academic performance.

Research design

The Pre- Test, Post- Test Control Group Model is explained by:

E	O1	X	O2
<hr/>			
C	O3		O4

E = Experimental group,

C = Control group

X = Treatment

_____ = non randomization of experiment and control groups

O1 and O3 = Pre-test scores of experimental and control groups

The academic performances of both groups were assessed before and after the intervention through achievement test. There were two sections of grade VII of a government school in which there were 128 total number of students. The school administration did not allow rearrangement of the groups; therefore quasi experimental design was applied. One group was given treatment and in the other class, lesson was taught by lecture based teaching method. The application of treatment was not shared with students; therefore they remained uninformed about the experiment.

Measures

Achievement Test

A classroom test was used to measure the academic performance of students of both the group before the experimental design for equating their performance. The same test was administered as a post-test to quantify the difference between experimental and control group. The piloting of the achievement test was done on ten students of same grade level. The test consisted of objective and subjective sections. The objective part was composed of 20 MCQs, five true & false and five matching and ten fill in the blanks items, whereas subjective section constituted of 12 items. Scientific skills were focused in constituting the items such as matching, labeling, inferring, prediction, explanation, drawing, identification, judgmental and reasoning, differentiating, observation and classification.

The reliability of the test was calculated by using the Cronbach's alpha (Hopkins, 1998). The test was found to be attaining reliability level of 0.774. While piloting the test the value of Cronbach's alpha reliability coefficient was of 0.84 (N=30). As it was above 0.7, so the instrument was considered to be reliable and can be utilized to make accurate group inferences.

Validity

The external validity was ensured by maximizing the variation in sampling technique. The sample was drawn from the multiethnic city of Karachi, where people from all over Pakistan are settled for various reasons. Similarly, a diversified bunch of students are present in schools of Karachi.

Creswell (2003) stated the following threats to internal validity: history, maturation, statistical regression, selection, mortality, diffusion of treatments, compensatory equalization, compensatory rivalry, pretesting, and instrumentation. The researcher critically analyzed each of the threats and ensured efforts to control them.

Data Analysis Technique:

For comparing means of experimental and control group, independent sample t-test was applied to test the hypothesis. Pre and post test scores of both of the groups were tested at 0.05 level. Data was presented in tabular form.

Procedure of Data Collection:

For the collection of data a school was identified to start off the experiment. A meeting was arranged with the school head and concerned teachers to share the understanding about methodology, purpose and possible outcomes of the research in order to have them on board with full confidence and support. Two different sections of class VII were selected; one as an “Experimental Group” and other one as “Control Group”. Since random assignment of participants was not possible.

One teacher was found more enthusiastic and confident and willing to be a part of the experiment was taken on board. Before starting off the experiment all the details of different stages of the experiment were discussed in order to be on one page and leaving no room for any misunderstanding between the researcher and the participant teacher. It was attempted not to change the teaching schedule and follow everything as it was planned syllabus or topic wise and time table wise before the research experiment. The only change that was introduced was to teach experimental group with cooperative learning method and the control group continued with traditional method. The techniques to be used for cooperative learning were selected with mutual understanding for each topic/ lesson.

Once every detail was made clear between the researcher and the participant teacher, the next move was made by conducting a pretest in both the sections so that the students’ pre experiment understanding level of general science subject of both the groups can be obtained. Since the students of both the groups were not familiar with the content used in pretest, the results therefore were not much different (see table1). There was no significant difference between the mean academic achievement scores of both the groups.

For the effective performance of the participant teacher in applying cooperative learning techniques with the experimental group, a training module was developed and a number of workshops were arranged. The duration of the experiment was three months with seventy eight working days. There were total sixty classes during this period each class consisting on forty minutes, amounting to forty contact hours. A complete plan was designed for this much time.

Training of teachers was allocated five days, and administration of pre-test and post-test was given two days, the remaining days were kept as substitute days for any unexpected event so that activities may be carried on as per set plan.

To bring teaching conditions at par for the experimental and the controlled groups the experiment was conducted with same teacher using same teaching materials for same time period and days. The only change that was allowed to play its role was the teaching methodologies adopted by the teacher the traditional method in controlled group classroom and cooperative learning method in experimental group classroom.

Data Analysis

Table 1

Group Statistics

Test Group		Std. Error			
		N	Mean	Std. Deviation	Mean
Scores of Pre-Test	Control Group	63	11.9206	3.38069	.42593
	Experimental Group	65	12.3692	2.85356	.35394

The above table 1, shows descriptive statistics of achievement scores for experimental and control group. As per the results, the mean achievement scores of grade VII students of experimental group (12.36) are slightly higher than the control group (11.92). Moreover, the standard deviation of control group is little higher than experimental group. Data analysis explains that there may be no significant difference between the mean test scores of both the groups.

Table 2
Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means							
	f	Sig.	t	df	Sig. (2- tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		
								Lower	Upper	
Scores of Pre Test	Equal variances assumed	2.959	.088	-.812	126	.418	-.44860	.55233	-1.54164	.64445
	Equal variances not assumed			-.810	121.203	.420	-.44860	.55379	-1.54496	.64777

In table 2, Levene`s test of equality of variance “F” value is “2.959” with significant value of “0.088” which is greater than 0.05 so it can be assumed that the variance of the two populations is equal. In t-test for equality of variance “t” value is 0.418, which is more than the 0.05. Based on pre-test scores it can be concluded that in the beginning of the experiment both the groups were equal in terms of scores at confidence level of 95%.

H₁ (b): There is significant difference in the mean post-test achievement scores of the grade VII students taught by cooperative learning methodology and the students of Grade VII taught by traditional lecture based methodology.

Table 3

	Test Group	N	Mean	Std. Deviation	Std. Error Mean
Post Test Scores	Control Group	63	55.10	12.755	1.607
	Experimental Group	65	74.45	10.540	1.307

The above table 3 shows mean achievement scores of grade VII students of experiment (74.45) and control group (55.10). Data analysis explains that there is a significant difference between the post test scores of both the groups. Experimental group performed significantly well in posttest.

Table 4
Levene's Test for Equality of Variances

	Levene's Test for Equality of Variances		t-test for Equality of Means							
	F	Sig.	t	df	Sig. (2- tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		
								Lower	Upper	
Scores of Post Test	Equal variances assumed	.917	.340	-9.369	126	.000	-19.351	2.066	-23.438	-15.263
	Equal variances not assumed			-9.341	120.213	.000	-19.351	2.072	-23.453	-15.249

In table 4, In Levene`s test of equality of variance “F” value is “0.917” with significant value of “0.340” which is greater than 0.05 so it can be assumed that the variance of the two populations is equal. In t test for equality of variance “t” value is 0.000, which means alpha is not committed. Based on pre-test scores it can be concluded that in the post test experiment group performed significantly well than control group at confidence level 95%. Therefore, H2 is accepted and it is concluded that there is a significant difference in the mean post-test achievement scores of the grade VII students taught by cooperative learning methodology and the students of Grade VII taught by traditional lecture based methodology.

Discussion on Findings

The results of post-test confirms the superiority of CL method over traditional lecture method, the post test scores of the experimental group reached comparatively higher level than the level of control group. The experiment produced the results that confirm the effectiveness of cooperative learning in the improvement of scientific knowledge and skills such as matching, labeling, inferring, prediction, explanation, drawing, identification, judgmental and reasoning, differentiating, observation and classification. The findings of the study were consistent with the findings of Johnson (1998); McMaster & Fuchs (2002); Chiang (2012) Hosseini (2017)) that proved significant difference in cooperative learning strategy and traditional method Cooperative learning techniques helped teacher to involve students in learning activity and made them to interact with each other as the activities are designed in a way that any individual may not be able to complete the activity

without other members` cooperation. The teacher used well designed teaching materials in the classroom that might promote CL among the students; the instructions were made clear that there might be no room for any misunderstanding or confusion among the group members regarding the task to be accomplished and their roles and responsibilities. Once the students were engaged in classroom activities the teacher took care of proceedings that each group and each member of the group played their roles accordingly. Whenever there was need, the teacher was available and ready to offer his or her expertise and guidance to any individual and a group to complete the task and achieve set goal. The current study proves the finding of Liu et al. (2017). According to him cooperative learning produces more significant result than traditional method because in lecture method “teacher focuses on putting information on a theoretical narrative without regulation, integration and arrangement for the concepts and scientific principles, incomplete tools and disorganized steps of the experiment, which contributes greatly to the low level of students' achievement (p.19)”.

Challenges Faced During the Experiment of Integrating Cooperative Learning Method

Following are the challenges that occurred during the experiment regarding the integration of cooperative learning method with traditional lecture based teaching method:

- (1) *Classroom furnishings:* There is heavy and fixed furniture in classrooms that makes the formation of groups, with face to face seating arrangements, difficult. Others have noted similar problems (Panitz (n.d.); Herreid, 2007; Ferguson-Patrick, 2008).
- (2) *Physical Environment:* The seating arrangement for students in all observed classrooms was seating on dual desks. Ahmed (2010) notes that this type of seating arrangement occurs in 99% of public schools in Pakistan.
- (3) *Learning Resources:* There is a lack of quality learning resources for group-work activities and head teachers have no budget to obtain these. In such situations, the teacher tried to generate some learning resources with the help of the students and this allowed some progress. Practice increased teacher confidence. However, this is an major issue in Pakistan (Khatoon, 2008).

- (4) *Large classes*: The average population in the observed classrooms was forty five. Managing large numbers of groups is not easy and one study suggested having about 15 to 20 students was better (Dahley, 1994).
- (5) *Discipline*: The concept of discipline generally reflects silence and total teacher control in classrooms in Pakistan. Group-work with large classes makes teachers feel uneasy in relation to discipline.
- (6) *Lack of training*: Teacher universally lacked skills and strategies to integrate cooperative learning methods in large size classroom. Although professionally trained and appropriately qualified, it was observed that teachers do not use innovative teaching methods such as cooperative learning; this is reflecting major defects in their own training.
- (7) *Curriculum*: In Pakistan, the curriculum is defined in terms of content to be covered using standardised textbooks. An analysis of the textbooks of General Science from grade III-VIII of S.T.B.B. shows that the activities of the textbooks do not encourage cooperative learning methods. Only 4.7% of the total exercises encourage cooperative learning.
- (8) *Group dynamics*: It was observed that, in some activities, more able students tended to dominate other group members. The aim was sharing and cooperation but there is a danger that these students can use such groups to show their own abilities, leaving other group members out of the discussion. (Tanha, 2011)

With reference to the results of the study, following recommendations have been made:

1. Teachers may learn classroom management technique in order to overcome the existing challenges such as furniture, space, light, air, classroom size etc. with in classroom to be able to integrate CL in their existing teaching practices.
2. Teachers may be given ample time and a proper space for planning and preparation of cooperative learning activities, lessons and materials.
3. Teachers may assure that each group member must take active part in the group activity to eradicate the possibility of dominance of one student on other group members.

4. The findings of the research study suggest that there may be a close link among teacher educators, textbook writers and curriculum developer. Therefore, the textbooks of General Science may be revised and the follow up exercises should be redesigned that may encourage cooperative learning. Language of the instructions may be made clear and specific about conduct of the activity.

It can be concluded that the implementation of CL method requires real changes at conceptual, institutional and policy level in Pakistan.

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