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Cooperative Learning Effects on Secondary Level Mathematics Students' Academic Achievement: A Multiple Testing Based Comparison

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ABSTRACT

Education plays an important role to build a country, nation, and a society. The subject of mathematics demands creative and critical thinking of students. The study aimed to investigate the effects of cooperative learning method on students' achievements in the subjects of mathematics in algebraic expression i.e. identification of algebraic expression, addition and subtraction of algebraic expression, verify and use of algebraic expression etc. In this experimental study a test was conducted for the pre-test and post-test. The sample of this study was 123 students of the 9th graders divided into two groups (Control group and Experimental group). The Control group was treated as the traditional method of teaching and the Experimental group was treated as the cooperative teaching methods. It was hypothesized that there is no significantly difference between the students mathematical achievements taught through cooperative method and traditional method. The achievement test consisted 20 MCQs, 10 Short Answer and 6 Subjective Questions. Paired sample t-test was used to interpret the data. It was concluded that cooperative learning increase the students achievements in Short Answers and Subjective Questions. In MCQs there is no significant difference of Control and Experimental group.

Introduction

Education plays an important role to build a country, nation, and society. The importance of education cannot be denied. In various fields, mathematics is extensively used and covers a broad range of activities. Moreover, the decline in achievement in mathematics needs to give special attention. One of the reasons for the decline in the achievement of mathematics in an educational institution is that learners do not find any interest in the subject of mathematics. In the opinion of Keefe (1997), the fact of desperation among educators and learners needs to be addressed for achieving the best in the subject of mathematics. So, it's the teacher's responsibility to take care of students' needs. If learners are given lucid ideas and the opportunity to ask questions to make their ideas clearer, they will be able to get more success (Burns, 1990; Johnson and Johnson, 1990). One of the ways through cooperative learning is this can be done. When the approach of cooperative learning is used in the classrooms, students work in groups, communicate with one another and every member of the group gives its maximum to attain the common goal of the group. It has been proved by various studies that when cooperative learning is used in the classroom students' confidence level, social skills, long-term memory, performance and positive attitude towards the subject of mathematics get increase. It has been shown in various studies also that when learners work by adopting a cooperative learning approach, they have more interest in the subject and their inclination to achieve maximum, memory span and positive attitude towards subject improves. Students should be given maximum opportunities to discuss with each other and with students for the gain solution to the problem.

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Educators have done various studies and conducted various experiments on learners for knowing the impact of cooperative learning and they have found that learners' achievements in the subject of mathematics can be increased by using the cooperative learning approach (Tarimand Akdeniz, 2008). The findings and conclusion of the study show that the satisfaction level of learners and their learning can be increased by using the approach of cooperative learning. The merits of the cooperative learning approach are sharing ideas by learners with each other, learning of members of the groups from other members, and improved skills of communication and leadership.

A cooperative learning approach of learning is also useful for learning languages. As in this approach, learners' interaction with each other and their positive dependency on each other is at its optimum level and thus proves fruitful for learning. Mathematics makes our life orderly and prevents chaos. In Pakistan math has been taught through traditional methods of teaching. Traditionally trained teachers are reluctant to adopt new strategies of teaching as a cooperative learning strategy. In this strategy students and teachers mutually cooperates to make the learning effective. There are few studies available that describe the impact of cooperative learning on mathematics achievements. Therefore, the researcher has to experiment with accessing the impact of cooperative learning on mathematics teaching. For the teachers of Pakistan, a noteworthy method of teaching shall be given to adopting. The study will demonstrate any impact of cooperative learning on learners' achievements in mathematics (Algebraic expression). Learners will find the approach of cooperative learning a simple and easy approach to learning mathematics.

The study will also be helpful for teachers and they will be able to know what type of teaching methods is being used to teach their students.

Purpose of the Study

The purpose of this study was to investigate whether the cooperative learning technique has any effect on secondary level students' achievement in the subject of mathematics. For this purpose, the students were pre-tested and post-tested to determine the effect of cooperative learning.

Hypothesis

$H_0$1: There does not exist any difference in the students' mathematical achievements in MCQs test taught through the cooperative method and the traditional method.
$H_0$2: There does not exist any difference in the students' mathematical achievements in the Short Answer test taught through the cooperative method and traditional method.
$H_0$3: There does not exist any difference in the students' mathematical achievements in the Subjective Questions test taught through the cooperative and the traditional method.
$H_0$4: There does not exist any difference between the students' mathematical achievements taught through the cooperative method and the traditional method.

Literature review

Awofala, Fatade& Ola-Oluwa, (2012) investigates the cooperative learning effects in the subject of mathematics for secondary school learners. The sample consisted of 80 students 40 students were in the control group and 40 were in the experimental group. In the experiment, taught the experimental group through cooperative methods of learning, and the control group through the traditional method of learning. The researcher took the Pre-test and post-test from both groups.

After analyzing the data a positive result was found in the students' motivation and attitude toward mathematics. In the same way, Zakaria, Chin &Daud (2010) states that cooperative learning affect the subject of mathematics achievement and also. In the experimental study, the sample consisted of 82 students. The average age of these students was 13 years. 32 students were in the control group and 44 were included in the experimental group. In the experiment, taught the experimental group through cooperative methods of learning, and the control group through the traditional method of learning. Positive results were found in cooperative learning.

Ozsoy and yields (2004) investigate the learning together technique effects of cooperative learning on students' achievements in mathematics subjects. In this experimental study, two groups were made. One of the groups taught through the cooperative methods of learning and the other one taught through the traditional methods of learning. The sample consisted of 70 students in ninth grade. Those students were qualified by the same trainer. 34 students were in the control group and 36 were in the experimental group. The experiment duration was thirty-five days. After the experiment, it is concluded that cooperative learning methods are better as compared to the traditional method of learning.

Flynn (2013) investigated the cooperative learning effects on students' academic achievements, and mathematics students. After that experiment, it is concluded that for the students' achievements cooperative learning methods were performed and also developed the students' behavior in the classroom in the subject of mathematics.

Similarly, cooperative learning enables students to study in a more active and enjoyable environment. Through cooperative learning students' attitude and their achievements in mathematics are also increased (Vaughan, 2002). After conducting the Pre-test and post-test. Results showed a positive result was found on the students' attitude and achievements in mathematics.

Moreover, Aziz (2010) also supports the cooperative learning methods as such type of learning environment provides the students an opportunity to improve their achievements in mathematics. The researcher compared the effects of cooperative learning (CL) and conventional technique (TC) on Mathematics achievement in the secondary classroom. A quasi-experimental design was used for this experiment. Two groups were made. Both the groups were taught by the same teacher. The experimental duration was 15 weeks. In the results, the researcher found a positive change in the achievements of mathematics.

THE PROCEDURE OF THE STUDY

This experimental study was conducted to find out the effect of cooperative learning on students' academic achievements in the subject of mathematics (Algebraic expression) at the secondary level in the comparison with traditional methods of learning. For this purpose, this study was designed on an experimental approach and the experiment was continuous for two months with the participant of 7^{th} graders mathematics students. The study continued for two months.

Research Design

In this experimental study pre-test and post-test were conducted on the control group and experimental group.For the observation of the effects of cooperative learning (CL) on the

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students' academic achievements in mathematics (Algebraic expression) at the secondary level, following design was adopted.

Previous achievements of Control Group = Previous achievements of Experimental Group

Control group	R	O_1	X_1	O_2
Experimental group	R	O_1	X_2	O_2

R = Random Assignment

X = Treatment Occurs for X_2 Only

O_1 = Pre-test Observation

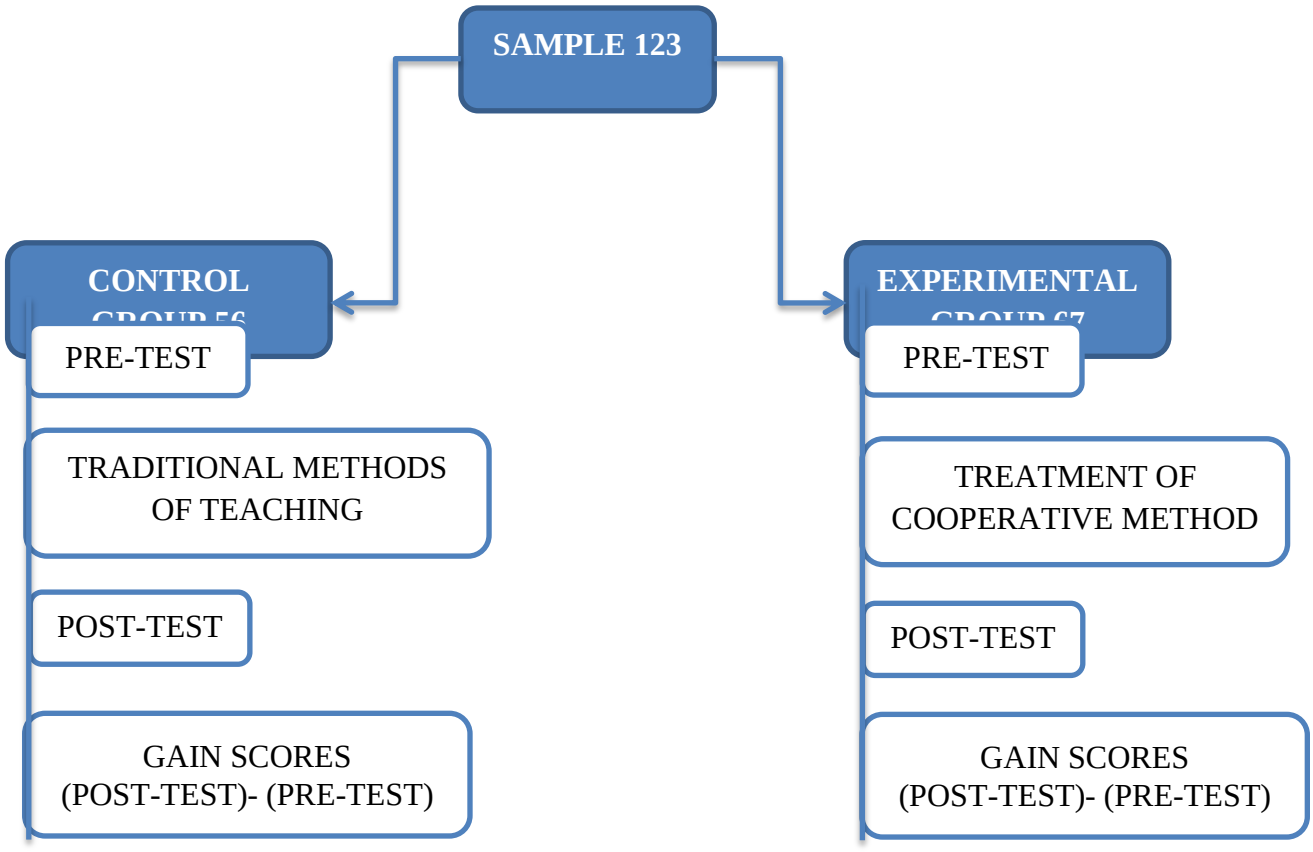
O_2 = ost-test Observation, same as pre-test just change the sequence of the items)

Participants of the Study

The population of the study comprised all the secondary level students in public schools from the District of Punjab Province during the academic year (2019-20). As far as sampling is concerned randomly selected public sector school was chosen. From the selected school two sections of the 9th grade session (2018-19) were randomly chosen from a total of eight sections in the school. One section was treated as the experimental group and the other as the control group. There were 56 students in the control group and 67 in the experimental group.

Conceptual Framework:

Figure below represents the conceptual framework of the study.



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Results

Analysis of data in the following section leads to the described results of the study **Table 4.1:**

Table: 1
Pre-experiment mathematics achievement

Group	N	Mean
Control	56	2.98
Experimental	67	3.01

Table 4.1 shows the pre-experiment mathematics achievements of the control group and the experimental group. Before the experiment, the achievement test was conducted. The mean scores of the students' mathematics achievements for the control group ($\bar{X} = 2.90$) and the experimental group ($\bar{X} = 3.01$).

Table **2:**
Comparison of pre-test and post-test results

Group	N	Mean	SD	t	df	*p*
Control	56	8.99	3.91	-3.96	121	.000
Experimental	67	11.57	3.31			

p=.000<.05
Analysis in the above table shows that a significant difference exists in the mathematics achievements of the control group and experimental group (*p*=.000<.05). Moreover, the experimental group is achieving relatively high scores as compared to the control group ($\bar{X} = 8.99 \& \bar{X} = 11.57$). Thus it is revealed that experiment group performed better than the control group.

Table 3:
Comparison of mathematical achievements in MCQs test

Group	N	Mean	SD	t	df	*p*
Control	56	5.09	3.33	.08	121	.05
Experimental	67	5.04	2.86			

p=.05
Analysis in the above table shows that there is no significant difference (*p*=.05) in the achievements of the control group and experimental group in the MCQs test. Thus it is again found that experiment group performed better than the control group.

Table 4:

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Comparison of mathematical achievements through Short Answer

Group	N	Mean	SD	t	Df	*p*
Control	56	5.02	4.12	-4.09	121	.000
Experimental	67	7.72	3.19			

p=.000<.05

Analysis in the above table reflects that a significant difference exists in the achievements in the Short Answer test of the control group and experimental group (*p*=.000<.05). Moreover, the experimental group is achieving relatively high scores as compared to the control group ($\bar{X} = 7.72$) & ($\bar{X} = 5.02$). Thus it is shown once more that experiment group performed better than the control group.

Table 5:

Comparison of mathematical achievements in Subjective Questions

Group	N	Mean	SD	t	df	*p*
Control	56	8.23	5.57	-3.89	121	.000
Experimental	67	12.33	5.79			

p=.000<.05

Analysis in the above table reflects that a significant difference exists in the achievements in the Subjective Questions test for the control group and experimental group (*p*=.000<.05). Moreover, the experimental group is achieving relatively high scores as compared to the control group ($\bar{X} = 12.33$ & $\bar{X} = 8.23$). Thus it is again reflected that the experiment group performed better than the control group.

Table .6:
Comparison of mathematical achievements between control and experimental group

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Group	N	Mean	SD	t	df	*p*
Control	56	6.14	3.66	-3.74	121	.000
Experimental	67	8.36	2.93			

p=.000<.05

Analysis in the above table shows that a significant difference exists in the achievements of the control group and experimental group (p=.000<.05). Moreover,the experimental group is achieving relatively high scores as compared to the control group ($\bar{X} = 8.36$ & $\bar{X} = 6.14$). Thus it is found that performance of experiment group is better than the control group.

Conclusion

From the above analysis, it is clear that there is a significant difference in the students' achievement In mathematics before and after the treatment i.e. cooperative learning. It was concluded that cooperative learning improves the mathematics achievements of students. Far the validation of the results different testing techniques was used including the MCQs, short answers, and subjective testing methods.

The students' performance judged through the MCQs test was not significantly different. Hence students taught through the cooperative method and traditional method showed similar performance in MCQs. Moreover, The students' performance judged through the Short Answers Test was significantly different for the experimental and control group. Hence the students who were taught through the Cooperative methods of teaching performed better than the students who were taught through traditional methods in the Short Answers Test. Finally, the students' performance judged through the Subjective Questions test was also significantly different for the experimental and control group. The students taught through the Cooperative methods of teaching performed better than the students taught through traditional methods in the Subjective Questions Test.

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