Journal of Elementary Education
Volume 27, No. 2, pp. 139-145

Improving Students Mathematics Scores: A Comparison of Collaborative and Single Teachers Teaching

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Abstract

In Pakistan traditional teaching is kind of teaching approach in which a single Mathematics teacher teaches the students mostly with deductive method of teaching. Collaborative teaching (CT) has several advantageous over the single teacher's teaching. It has proved its effectiveness in many countries like USA, UK, and China etc (Mcduffe, Scruggs, & Mastropieri, 2007). The present study was aimed at comparison of the effectiveness of CT over single teacher's teaching in improving students' Mathematics scores. An experiment was conducted on 118 public school Mathematics students of 8th grade in the District of Sargodha by using Solomon Four-Group experimental design. A collaborative Mathematics teaching module was developed by the researchers in algebra and geometry to apply the CT intervention to see its effectiveness as compare to the traditional approach to teaching. An experimental group with CT and a controlled group with traditional teaching were selected for this study. It was consisted of 20 lessons, and each lesson was carried out in 60minutes. The teaching module was validated by two subject matter experts. Achievement of students was measured by using an achievement test of Mathematics. A national institute NEAS had developed the items of the test. The statistical techniques like average, standard deviation, and t-test were applied to analyze the data. CT was found to be more effective than single teacher's teaching in enhancing students' achievement score in algebra and geometry.

Keywords: Algebra, collaborative teaching, geometry, students' achievement, mathematics

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Introduction

The change in societies is directly associated with the outcome of education and its systems. Every new era has different needs and demands from the previous ones according to National Curriculum for Mathematics (2006), there is need to change the teaching from transmission of knowledge to understanding of Mathematical concepts with the focus on active involvement of learners. In general, if a system of education does not meet the challenges of particular society, that society most probably cease to exist from the world's map. So, understanding of emerging demands is very important and actions should be taken accordingly. After Pakistan's independence, education system needed restructuring and greater emphasizes on subjects like Mathematics. Traditionally, Pakistani Mathematics teachers teach Mathematics using deductive method of teaching by a single teacher. This kind of teaching is focusing on memorization of Mathematics formulae to solve Mathematical problems with passive involvement of students. The students are supposed to note down the answers on their note books by coping from the black board. On the other hand new emerging approach to Mathematics teaching is collaborative teaching (CT). According to Sperling (1994), it involves collaborative settings. The teachers who take part in collaborative settings are co-equal individuals having different roles. They work together to achieve common goals.

According to the explanation of Free Dictionary, "the subject of Mathematics is divided into Arithmetic, which studies numbers; Geometry, which studies space; Algebra, which studies structures; and calculus." The subject of Mathematics is different from other subjects because of its characteristics for example language, symbols, and abstraction in its concepts. Difficulty in Mathematics learning is being faced by many students. Russell (2006) attributed students' Mathematics learning problems to teaching. Generally, a single Mathematics teacher can't cope with all glitches of student in learning of mathematical concepts. It was reported by Maeroff (1993) that in contrast to single teacher's teaching an approach of CT was one to work in schools. Researchers had recommended team teaching a better alternative in contrast with single teacher teaching (Wadkins, Wozniak, & Miller, 2004).

Predominantly, Pakistani Mathematics teachers are transmitting the Mathematics knowledge rather than concepts construction (National Curriculum for Mathematics, 2006; Amirali & Halai, 2010; Mohammad, 2002). They use text books to teach Mathematics. In order to solve mathematical exercise questions students need to memorize the formulae dictated by the teachers in the start of lesson. There is little or no sharing and discussion on Mathematics teaching methods or mathematical concepts understanding among Mathematics teachers. Consequently, their teaching quality is not improving, and consequently the problem of low achievement persists.

A teaching approach i.e. CT is in practice in countries for example United States, China, United Kingdom, Canada, and Australia (Mcduffe, Scruggs, & Mastropieri, 2007). Cook and Friend (1995) described teaching in collaborative setting as "a style of interaction between at least two co-equal parties voluntarily engaged in shared decision making as they work toward a common goal". The various roles of teachers depend on the strengths of teachers. Many research studies conducted by various researchers in these countries for example Jang (2006), Mcduffe, Scruggs, and Mastropieri (2007), Olverson and Ritchey (2007), Parker (2010), Rigdon (2010), Almon and Feng (2012) showed positive effects of CT on academic scores of students.

So, students' problems such unclear handwriting of teachers of Mathematics, fatigue due to copying long questions, Speedy writing of teachers on black board due to which students cannot note down the answers correctly, Mathematics anxiety, lack of concentration in understanding of concepts due to large class size, and one teaching style boredom in Mathematics learning can be coped using CT. In the perspective of CT, fewer researches had been conducted in Pakistan. For example the studies conducted by Haider (2008) and Abbas & Lu (2013). Teachers' attitudes were explored by Abbas and Lu in 2013. Additionally, in 208, Haider identified pre-service collaborative teaching problems confronted by teachers. Therefore, it was the necessity of the time to conduct a research that explores the effectiveness of CT in enhancing students' Mathematics' achievement scores in Pakistan.

The study was based on exploring the following research questions:

1. Which teaching is more effective in enhancing students' achievement scores on Mathematics, CT or single teacher teaching?
2. Which one is more effective CT or single teacher teaching for enhancing students' achievement scores in algebra and geometry at 8^{th} grade?

Methods and Procedures

The design of the study was experimental. An experiment was conducted on 118 public school Mathematics students of 8^{th} grade in district Sargodha by using Solomon Four-Group experimental design. It was completed in thirty seven days. According to Best and Kahn (2008), Gay (2000), Creswell (2002), threats to experimental internal validity can be best controlled by using this design. A public school having two Mathematics teachers with M.Sc. Mathematics, and professional qualification of B.Ed. were selected on convenient bases. Researchers randomly assigned the sample of all 118 students at grade 8^{th}, into four groups One researcher, having same qualification, and also two volunteer teachers were selected for teaching the students. One out of two Mathematics teachers of the school and one researcher participated as co-teachers. Two days training sessions, two hours each day, were held by the researcher for sampled Mathematics teachers.

Mathematics students' achievement was measured through a multiple choice items test. Three mathematical proficiencies were measured understanding of concepts, knowledge about mathematical procedures, and problem solving. The ratio of items in the test on these proficiencies was 30 %, 40%, and 30% respectively. The selection of test items from the pool of items was based on learning outcomes ratio in national curriculum 2000 i.e. 66.6% algebra and 33.3% geometry and correlation coefficient i.e. point-biserial. Mathematics Achievement Test was consisted of 32 MCQs items (21 items from algebra and 11 items from geometry) with one mark for each correct item. Items were originally developed in Urdu, national language of Pakistan. Two Mathematics and an English language experts translated those items into English to validate them for local context.

A teaching module of Mathematics was developed by the researchers to teach algebra and geometry at 8^{th} grade in collaborative settings. The collaborative settings i.e. one is teaching and other is assisting, teaming, and parallel teaching were used in the teaching module. The lessons of the module used teaching methods i.e. activity, inductive, problem solving, and assignment with some techniques of assessment i.e. asking verbal questions to the students, classroom tests, worksheets for homework, or drill of exercise questions during lecture. Duration for one lesson was sixty minutes.

Findings

Due to short attendance i.e. less than 75 % and outliers, fifteen students' scores were not included in the final analysis. The criterion for attendance was a pre-experiment decision. Factorial ANOVA was applied to examine the difference in students' achievement scores. The summary is presented in table 1.

Table 1
Difference between Groups Mean Scores

	Sum of Squares	df	Mean Square	F	P
Groups (Ex & Co)	180.86	1	180.86	19.504	.000
Groups (with and without pre-test)	1.78	1	1.78	.191	.663
Groups *Conditions	16.19	1	16.19	1.75	.190

Table 1 showed that significant value 0.000<0.05, hence students' means scores of groups i.e. experimental and control were significantly different. Scores of students' taught through CT were higher than other group students' scores i.e. 12.80 and 10.07 respectively.

Table 2
Comparison in experimental and control groups Students' scores on Algebra items

Group	n	Mean	SD	d f	t	Sig.
Experimental	45	8.6	2.63	96	-4.13	.000
Control	53	6.6	2.15			

p = .05 (df = 96)

Significant difference in mean scores was found between the groups of students taught through single teacher teaching and CT on algebra items with significant value 0.000< 0.05 as shown in table 2. The mean scores of both groups i.e. experimental and control on algebra items were 8.6 and 6.6 respectively.

Table 3
Comparison in experimental and control groups Students' scores on Geometry items

Groups	n	Mean	SD	d f	t	Sig.
Experimental	45	3.91	1.29	96	-2.68	.01
Control	53	3.18	1.35			

It was also found that mean scores of students in collaborative settings and single teacher teaching setting on geometry items were significantly different with significance value 0.01< 0.05. The mean students' scores of both groups on geometry items were 3.91 and 3.18 respectively. Hence students taught through CT performed better on geometry items.

Conclusions

Based on findings following conclusions were made:

- It was concluded that CT is better Mathematics teaching approach as compared to single teachers' teaching in improving students' achievement scores in Mathematics.
- CT is more effective as compared to Single teachers teaching in improving 8th grade Mathematics students' achievement in both mathematical content strands i.e. Algebra and Geometry.

Recommendations and Suggestions

Following were the suggestions and recommendations of the study:

1. It was found that CT is an effective approach to teach Mathematics. So in order to aware pre-service teachers about CT. A pre-service teachers training course i.e. Methods of Teaching may include some topics related to CT for example significance and importance of CT, development of collaborative lessons and how it works in classroom.

2. In this study collaborative Mathematics teaching module was developed in the content strands of Algera and Measurement Geometry only. It is suggested that a Mathematics teaching module may be developed for in-service Mathematics teachers that includes all the content strands of Mathematics i.e. Arithmetic, Algebra, Geometry, and Data analysis & Probability.
3. In future, research may be done on female students, and on different grade levels.

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