Cooperative Learning
An Effective Teaching Learning Strategy for Mathematics

ROOHI FATHIMA*

ABSTRACT

Cooperative learning represents a shift in educational paradigm from teacher-centered approach to student-centered learning in small groups. It is a strategy in which the learning takes place in small groups where students share ideas and work collaboratively to complete a given task. The present study attempted to learn the effect of cooperative system of learning on the achievement in mathematics of Class X students. Two sections of Class X, with 30 and 32 female students, respectively, were randomly selected to participate in the study over a period of three weeks. Both qualitative and quantitative methods were used that focussed on examining students' participation while working on in-class cooperative learning activities in two different seating arrangements — rows and columns, and circles — as well as its impact on their achievement. Results show that cooperative learning helps to improve not only the understanding of the students but also motivate them to discuss the difficulties during the study, helped all students alike in terms of classroom participation and thereby improved their performance. The study underlines the fact that students should be encouraged to work in groups and to depend more on each other rather than the teacher to learn more efficiently.

सार

सहकारी शिक्षा शैक्षिक प्रतिमान में बदलाव की बात करती है जो शिक्षक-केंद्रित दृष्टिकोण से छोटे समूह में छात्र-केंद्रित सीखने की प्रक्रिया पर बल देती है। यह एक प्रक्रिया है जिसमें छोटे समूहों में सीखने की क्रिया प्रतिपादित होती है, जहाँ छात्र विचारों को साझा करते हैं और

* *Assistant Professor, Faculty of Education, Jamia Millia Islamia, New Delhi-110025 (e-mail: drroohiazam@yahoo.co.in).*

किसी दिए गए कार्य को पूरा करने के लिए सहयोग करते हैं। वर्तमान अध्ययन में कक्षा 10 के छात्रों की गणित में उपलब्धियों पर सीखने की सहकारी प्रणाली के प्रभाव को जानने का प्रयास किया गया है। इसके लिए कक्षा 10 के दो वर्गों से, क्रमशः 30 और 32 महिला छात्रों का यादृच्छिक रूप में चयन किया गया, जिन्होंने तीन सप्ताह तक अध्ययन में भाग लिया। अध्ययन में गुणात्मक और मात्रात्मक दोनों तरीकों का इस्तेमाल किया गया। अध्ययन में छात्रों को दो अलग-अलग तरीको से बैठने की व्यवस्था की गई — पंक्तियों और स्तंभों, और वृत्तों में तथा उनसे कक्षा-सहकारी सीखने की गतिविधियों पर काम कराया गया। अध्ययन से पता चलता है कि वृत्तों में बैठकर सहकारी शिक्षण न केवल छात्रों की समझ को बेहतर बनाने में मदद करता है, बल्कि उन्हें अध्ययन के दौरान आने वाली कठिनाइयों पर चर्चा करने के लिए भी प्रेरित करता है, जिससे सभी छात्रों को कक्षा-कक्ष भागीदारी के मामले में समान रूप से मदद मिली और इससे उनके प्रदर्शन में सुधार हुआ। अध्ययन इस तथ्य को रेखांकित करता है कि छात्रों को समूहों में काम करने और अधिक कुशलता से सीखने के लिए शिक्षक की बजाय एक-दूसरे पर निर्भर रहने के लिए प्रोत्साहित किया जाना चाहिए।।

Introduction

Lev Vygotsky was the one who introduced the idea of social interaction to child learning (Minnick, 1999). Learning is the act, process, or experience of acquiring new or modifying and reinforcing existing knowledge and may involve synthesizing different types of information. Learning is not one simple activity. It takes place at different levels of consciousness, and in different ways, in everything we do. Moreover, an individual learns in different ways and has his/her preferred learning styles. It may occur as part of education, personal development, schooling, or training. Learning results in formative effect on the mind, character or physical ability of an individual. In its technical sense, learning is the process by which society deliberately transmits its accumulated knowledge, skill and values from one generation to another. The term learning is quite common and frequently used in our day-to-day conversation. The level of learning can be groomed by various ways; one of those is the cooperative system of learning (Caspi et al., 2006).

Co-operative Learning

Most of our knowledge attitudes and values are formed by discussing and sharing what we know or think about our physical (concrete as well as abstract) and social environment. Initially the use of cooperative learning strategies began in the Western countries in the early 20th century as part of John Dewey's social studies project,

which has contributed greatly to the improving of learning in general, and helped to achieve the main objectives of the curriculum with great success and high accuracy. Thereafter, work on cooperative learning strategies for use in the classroom was carried out by different researchers. Brown (2007) proposed a simple definition of classes based on cooperative learning saying that they are 'learner-centered' classes that encourage students to work together, and to talk to each other in order to achieve specific goals. Slavin (1980), on the other hand, offers a more specific definition of cooperative learning. She describes it as a set of 'classroom techniques' where students work in small groups on certain activities. Co-operative learning is an instructional strategy involving use of small groups in which student's works together to learn and gain from each other. Co-operative learning method provides students an opportunity to utilise the limited resources.

Slavin (1983) identified 46 field experiments on co-operative learning conducted in elementary and secondary classes (Classes II-IX). He observed that the effect of co-operative learning on student's achievement was clearly positive. Not only in mathematics, but there are several studies conducted in other subjects as well. For example, research (Ahuja, 1995; Pandey et al., 2004; Towns & Grant, 1997; Yager, 1985) has reported greater effectiveness of co-operative learning for science achievement over traditional method. Hence, we can say that cooperative learning system is the best solution to achieve the maximum goals in educational life of a student. The first thing to realize about interactive teaching is that it is not something new or mysterious. If you are a teacher and you ask questions in class, assign and check homework, or hold class or group discussions, then you already teach interactively. Basically then, cooperative teaching is just giving students something to do, getting back what they have done, and then assimilating it yourself, so that you can decide what would be best to do next.

The teaching of mathematics is not about dispensing rules, definition and procedures for students to memorise, but engaging students as active participants through discussion and collaboration (Posamentier, 2006). Thus, the teaching of mathematics requires active participation of students through discussion and collaboration, but in most of the schools, we find that it is being taught through lecture methods. The learning of mathematics will be more successful if students are given the opportunity to explain or clarify their ideas. The quality of education

that teachers provide to student is highly dependent upon what teachers do in the classroom. Thus, in preparing the students of today to become successful individuals of tomorrow, science and mathematics teachers need to ensure that their teaching is effective. Teachers should have the knowledge of how students learn mathematics and how best to teach. Efforts should be taken now to direct the presentation of mathematics lessons away from the traditional methods to a more student-centered approach. One of such method is cooperative learning. Brown (2007) proposes a simple definition of classes based on co-operative learning saying that they are 'learner-centered' classes that encourage students to work together, and to talk to each other in order to achieve specific goals.

Expected Educational Outcomes of the Cooperative Learning

The main goals of the cooperative learning in mathematics education are — enhancement of achievement, problem-solving skills, and attitudes and inculcate values among the learners. Studies have shown that co-operative learning can improve performance, long-term memory and positive attitudes towards mathematics, self-concept and social skills. Cooperative learning is a strategy where learning takes place in small groups where students share ideas and work collaboratively to complete a given task. Worldwide several models of cooperative learning have been tried that vary considerably from each other (Slavin, 1995). For example, in STAD (Student Teams-Achievement Divisions), students are grouped according to mixed ability, sex and ethnicity (Slavin, 1994). The teachers present materials in the same way they always have, and then students work within their groups to make sure all of them mastered the content. Finally, all students take individual quizzes. Students earn team points based on how well they scored on the quiz compared to past performance. Another method is TGT (Teams-Games- Tournament) in which, unlike STAD, quizzes are replaced by tournaments (Slavin, 1990). Students compete at tournaments table against students from other teams who are equal to them in terms of past performance. Students earn team points based on how well they do at their tournament tables. Another model is known as JIGSAW, in which students are given the responsibility for teaching the material to each other (Slavin, 1990). The Assignment is divided into several expert areas, and each student is assigned with one area. Experts from different groups meet together and

discuss their expert areas. Students then return to their groups and take turns teaching.

The cooperative learning is used as both an instructional method and as a learning tool at various levels of education and in various subject areas. Johnson and Holubec (1994) proposed five essential elements of the cooperative learning:

1. **Positive Interdependence**: The success of one learner is dependent on the success of the other learners.
2. **Promotive Interaction**: Individual can achieve promotive interaction by helping each other, exchanging resources, questioning each other's conclusions, providing feedback, encouraging and endeavouring for mutual benefits.
3. **Individual Accountability**: Teachers should evaluate the efforts that each member is contributing. These can be performed by giving an individual test to each student and randomly calling students to present their group's work.
4. **Interpersonal and Small-group Skills**: Teachers must provide opportunities for group members to know each other, accept and support each other, communicate accurately and resolve differences constructively.
5. **Group Processing**: Teachers should also provide opportunities for the class to assess group progress. Group processing enables group to focus on good working relationship, facilitates the learning of cooperative skills and ensures that members receive feedback.

Several studies have been conducted employing different methods of co-operative learning. For example, Effandi (2003) reported positive effect of co-operative learning on achievement and problem-solving skills amongst Malaysian students. In this study, the experimental group was taught using co-operative learning methods and the control group using the traditional lecture method. Slavin (1983) identified 46 field experiments on co-operative learning, conducted in elementary and secondary classes (Classes II-IX). He observed that the effect of co-operative learning on student's achievement was clearly positive. Not only in mathematics, but there are several studies showing positive effects on other subjects such as science education (Ahuja, 1995; Pandey et al. 2004; Yager, 1985).

However, when exploring about the researches based on classroom furniture arrangements that match this framework of

co-operative learning in mathematics classrooms, one finds a limited number of studies. It should be mentioned though that textbooks or articles dealing with teacher training or classroom management usually affirm that how furniture arranged inside the classroom should match the activity being done (Brown, 2007; Emmer et al 2006; Hill & Cohen, 2005; Jones, 2000; Thornbury & Watkins, 2007). Harmer (2007) reviewed different seating arrangements in terms of pros and cons in relation to certain activities and interaction patterns. For example, he explained that the rows and columns of seating arrangement could suit formal classrooms where the teacher could take a front position for a lecture format while the circular seating arrangement would enable students to face each other while giving the teacher an opportunity to move around students. In other words, it is believed that if students are asked to work on individual activities, it would be better for them to sit in rows and columns in order to avoid student-student interaction. On the other hand, if group work activities are being used in a class, it would then be better to seat students in clusters or circles. As defined by Cornell (2002), 'furniture is both tool and environment'. He explains that thinking of furniture and seating arrangements is important in creating a suitable learning environment for students.

Thus, cooperative learning has been widely researched and used in classrooms in many countries since 1970's. The present study examined the use of co-operative learning, as one of the innovative and encouraging methods, in order to find out its impact on student's achievements.

Rationale of the Study

In the Indian context, several students do not like to take a mathematics course. These students sometimes find that mathematics is boring and believe that it will be of no use to them after they pass out of school. Many students think that mathematics is something that causes stress and is unpleasant. Such students have high anxiety about learning mathematics. Second, students have difficulty expressing their thoughts on paper or in their mathematics class. This occurs because many traditional mathematics classrooms foster a competitive atmosphere among students. Third, the students are not adapted to take an active role in learning mathematics. In light of these points, the author wanted to find a method of teaching

Secondary mathematics classes that would help students understand and enjoy mathematics. The research question was: Would students understand and enjoy mathematics more if co-operative learning approach through circle classroom arrangement would be applied rather than the traditional rows and columns seats-based classrooms taught by the teacher-centered method?

This study was limited to the Indian context. The educational institution where this study took place, followed the traditional rows and columns seating arrangement in all of its classes. At the same time, the education administration urges teachers to use more co-operative learning activities. At this point, it appears that the physical classroom environment contradicts the methodology they are trying to foster. This study aimed to explore whether this contradiction really existed or not as it examined whether the co-operative learning activities by modifying classroom seating arrangement, i.e., the circular seating arrangement, contributed to student's achievement over the traditional rows and columns seating arrangement

Research Questions

This study attempted answers to the questions:

1. Does classroom-seating arrangement affect students' participation in co-operative learning activities in Indian secondary classrooms?
2. In what ways do classroom-seating arrangements affect student's participation in co-operative learning activities in Indian secondary classrooms?
3. What preferences do students have for classroom seating arrangements? And why?
4. Are student's preferences for different seating arrangements related to their self-report of how shy/interactive they are in class?

Objective of the Study

To study the effect of co-operative system of learning on the achievements of Class X students in mathematics.

Method

This study employed both qualitative and quantitative method that focused on examining student's participation while working

on in-class co-operative learning activities in two different seating arrangements — rows and columns, and circles — as well as its impact on their achievement. It looked at the quality of students' comments to see whether different seating arrangements contributed to their completion of task or not.

Sample

The study was conducted in a Government Girls School of Department of Education, Delhi, India. Two sections of Class X were selected randomly to participate in the study over a period of three weeks. Section A had 30 female students, while Section B had 32 female students.

Experimental Design and Procedure

Before the start of the study, the students were asked to respond to a short free-form questionnaire. The questionnaire had three questions. The first one asked students to rate themselves on a Scale of 1 – 5 as to whether they considered themselves shy or interactive inside the class. This question aimed to collect data about student's perceptions about their personal attributes that could affect participation rate inside the class. The second question provided the option of two seating arrangements being examined; the rows and columns and the circular layout, and asked students to choose which one they would prefer to have in their classes. The last question asked students to state the reasons for their choices in the second question.

The experiment was set up according to the non-randomized pre-test, post-test quasi experiment control group design. The design was follows as—

Purposively/ Assigned Group	Pre-Test	Treatment	Post-Test
Control group (Section A)	A1	Teaching in traditional rows and column in seating arrangement	A2
Experimental Group (Section B)	A3	Teaching through co-operative learning by modifying the seating arrangement to circular pattern	A4

A1, A3 - pre-test scores in of mathematics test paper
A2, A4 - post-test scores in mathematics achievement test

Before start of the course, the researcher collected the student's previous year's Mathematics score for both the groups (i.e., Section A and Section B), to ensure that the two groups had achieved the same levels of mathematics performance.

Both classes were asked to attempt the mathematics test paper before the co-operative method of learning by changing the classroom seating arrangement. As the treatment component of the study, participating students had their classes in two different settings; the regular rows-and-columns in classroom for the control group (Section A) and a meeting room where the students could sit in circles around the tables in the experimental group (Section B) (Figures 1 and 2).

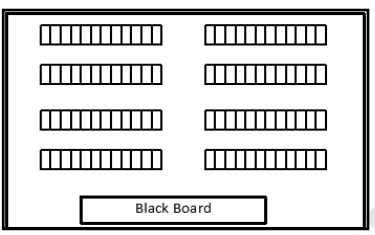

Figure 1: Rows and Columns

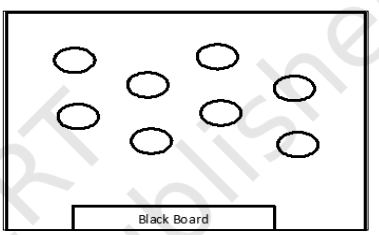

Figure 2: Meeting Room (circles)

Mathematics Achievement Test (30 Minutes Paper)

The researcher taught the students in row & column (control group) and circular seating (experimental group) arrangement classroom, respectively. They were taught the topic 'Polynomials and Pair of Linear Equations in two Variables' for three times a week for a total of three weeks. During the last week, students were asked to attempt a thirty-minute achievement test paper. This 20 marks question paper had two sets of questions of 10 marks each. Further, each question was subdivided into five short questions containing two marks each.

Results

To answer the research questions, descriptive statistics and qualitative analysis of student's responses to the questionnaire and the thirty-minute mathematics achievement test paper were used. The element of personality differences, as expressed by students' self-report about how shy or interactive they were in class was also taken into consideration while analysing the data especially in comparison to the actual performance of students.

Marks scored by the students in the mathematics test attempted before and after the experiment (termed as pre-test and post-test respectively) were recorded. The data were then compared between the groups as well as between pre-test and post-test. The data was analysed for individual students as well as an average for each of the classes. Data were analysed and presented using bar graphs of student's responses to the shy or interactive question, their preferences for seating arrangements before and after experiencing both of them. Comparison between students' responses to both the questionnaire and the reflective paper was also done in order to be able to closely see whether classroom-seating arrangements affected their achievement and, if they did, what the effects really were.

Questionnaire

Students' responses to the first question show that, in Section A, five students considered themselves shy students in class where they chose one on the scale. Eight other students chose Point 2 while 10 students chose Point 3 on the scale. Five and two students from Section A chose Point 4 and 5 respectively on the scale (Figure 3).

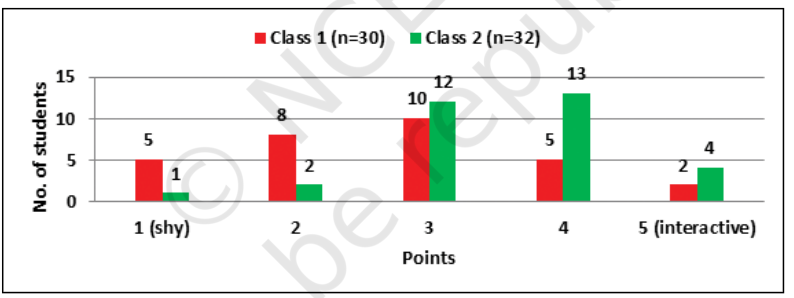

Figure 3: Student's responses to Question 1 about interaction (number of students)

Responses from Section B showed that one student considered herself shy in class, while two other students chose Point 2 on the scale. Twelve students chose Point 3 on the scale. Thirteen other students chose Point 4 while the rest, four students reported they were interactive students by choosing Point 5 in the class (Figure 3).

Student's Preference of the Cooperative Learning

In response to the second question, 20 out of 30 students (66.7%) in Section A said they would prefer the regular rows and

columns in seating arrangement for their classes, while the rest 10 students (33.3%) said they would like to have their class seating to be arranged in circles. In contrast to Section A, 27 out of 32 students (84.4%) of the Section B said they would like to be seated in circles during classes and only 5 students (15.6%) were in favour of sitting in rows and columns (Figure 4). On comparison, it was observed that Section B favoured interaction in the class while most of the students in Section A were shy and preferred to study alone.

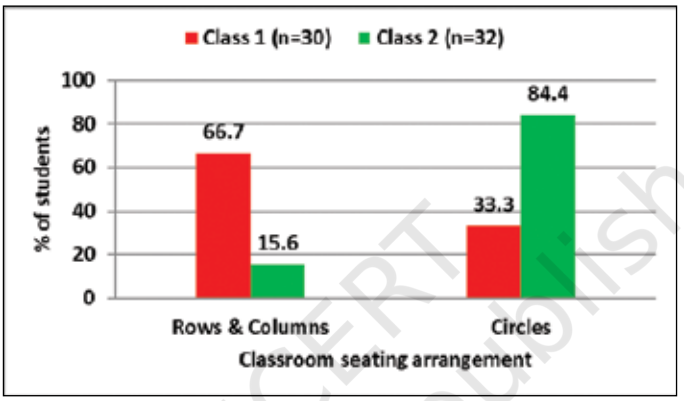

Figure 4: Student's responses to Question 2 about seating arrangement preferences in questionnaire (in percentage)

Table 1 shows the main reasons for choosing the rows and columns or the circles seating arrangements as reported by the students in both classes. Responses of students included reasons like sitting in circles would make it easier for them to communicate and talk together. In Section A, four students said they preferred the circles seating arrangement for better communication among group members and three of them said it helped them maintain eye contact with the rest of the group. One student chose the circles seating arrangement because 'sitting in rows and columns is boring' and because the circles would motivate him more. Two students reported that sitting in circles meant having a smaller number of students in class while two students said that the circles seating arrangement would help them understand more in class. Ten students who chose the rows and columns seating arrangement said that it was more organised and nine of them said that it was more comfortable to them. Another six students chose the rows and columns because they were used to it as it looks more

academic, five of these said they can see the blackboard easily and teacher can also see all the students. Three students reported that the rows and columns seating arrangement help to learn better, while two students said that it is eye relieving.

Table 1

Reasons for Choosing Rows and Columns or the Circulars Seating Arrangements as Reported by the Students

Seating arrangement	Reason	No. of students	
		Section A	Section B
Circular	Better communication among group members	4	18
	Concentrate more	1	6
	Easier to share ideas	1	8
	Less number of students in the class	2	1
	Helps to understand more	2	6
	Attractive	1	1
	Helps to maintain eye contact	3	10
	Helps to motivate	1	6
	Sitting in rows and columns is boring	1	5
	More active	1	1
	More comfortable	1	4
	More friendly	2	4
Rows and Columns	More organized	10	8
	Concentrate more	12	7
	Enables the class discussions	2	1
	No one can feel rejected	1	1
	Many students in the class	5	1
	Sit among friends	1	1
	Comfortable	9	3
	See the board	5	2
	Communicate easily	1	1
	Easy to share ideas	1	1
	I am used to it	6	1
	Teacher can see all students	5	2
	Eye relieving	2	1
	Learn better	3	1
	More academic	6	2

Reasons for choosing the circular seating arrangement in Section B included this arrangement being better for communication and eye contact among group members. Eighteen students said that the circular seating arrangement enabled communication among all group members and maintain eye contact easily with the group members as reported by 10 students from Section B. Six students said the circular seating arrangement helped them concentrate more in class while eight students said it was easier to share ideas in this arrangement. Four students reported that the circular seating arrangement was more comfortable and friendly while one student said that having the class furniture arranged in circles meant having less number of students in the class. On the other hand, seven of the students who preferred the rows and columns seating arrangement said that it helped them concentrate more while eight students said it was more organized. Three students said it was more comfortable for them to sit in rows and columns, two said this seating arrangement enabled the teacher to see all students in the class and was more academic.

Mathematics Achievement Test (Thirty-Minute Paper)

Students from Section A studied in the rows and columns seating arrangement, while Section B studied in circle for three weeks. During the last week, students from both the classes were asked to attempt 30-minute mathematics achievement test paper. The data on the marks obtained in the achievement test paper are given below. Based on the marks scored in the pre-test and post-test: the students were grouped into Seven Categories: A–G. Students, score in: Category A: >85 per cent, Category B: 75–85 per cent, Category C: 65–74 per cent, Category D: 55–64 per cent, Category E: 45–54 per cent, Category F: 33–44 per cent and Category G: <33 per cent (failed).

Section A: (Control Group)

All the 30 students from the control group (Section A) attempted the test paper before and after the experiment. On evaluation it was found that one student (3.3%) could not pass in the pre-test as she scored <33 per cent marks (Cat. G), however she qualified in the post-test (Figure 5). In contrast, one student was able to score >85 per cent (Cat. A) marks in post-test as compared to none in the pre-test. No difference was observed for the number of students in categories B, C and D. Further, the number of students in Category E increased from 20 per cent in pre-test to 33.3 per cent in post-test.

However, it was reversed for Category F, where the number of students dropped down from 30 per cent in pre-test to 16.7 per cent in post-test.

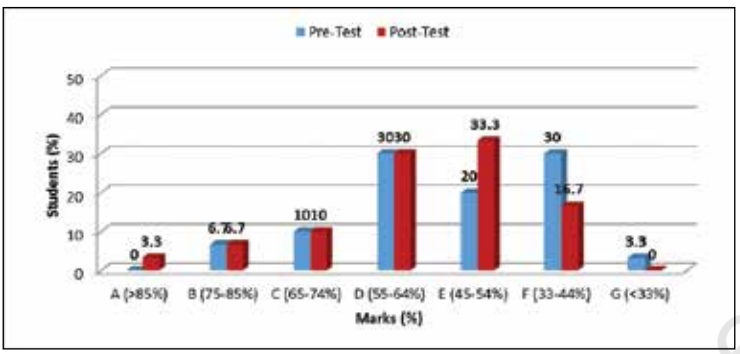

Figure 5: Percentage of Section A students (control group) placed in various groups categorized based on the marks obtained in pre and post-test mathematics achievement test paper

The mean of the marks obtained by the students in the pre-test and post-test mathematics achievement test for Section A showed a marginal increase from 51.0 to 55.67 per cent. However, this difference was not found to be significant. It was noticed that 95 per cent confidence interval of the mean was lesser for the post-test as compared to that for the pre-test. The range of the marks for both pre-test and post-test was found to be quite broad and showed no difference.

Section B (Experimental Group

Like Section A, all 32 students from the Class II (experimental group) attempted the pre-test and post-test mathematics achievement test paper. Although, pre-test scores of Section B students were similar to that of the Section A, the post-test scores of the students were significantly higher (Figure 7). For example, while 3 students (12.5%) were not able to score the pass percentage (<33 per cent, Cat. G) and one student was in the Category F with 33–44 per cent in the pre-test, it was found that every student scored >45 per cent in the post-test. Similarly, the number of students in Category D and E reduced from 41.6 per cent and 21.9 per cent respectively in pre-test to 9.5 per cent and 12.5 per cent respectively in the post-test. However, the post-test scores of the students were better than pre-test as evidenced by the post-test increased frequency of students in categories A, B and C as compared to that for the pre-test achievement test paper.

For example, 10 students (31.2%) each scored between 65–74 per cent (Cat C) and 75 per cent–84 per cent (Cat B) in post-test as compared to 3 students (9.4%) each in the pre-test. Surprisingly, 5 students (15.7 per cent) scored >85 per cent (Cat. A) in post-test as compared to only one student (3.1 per cent) in pre-test.

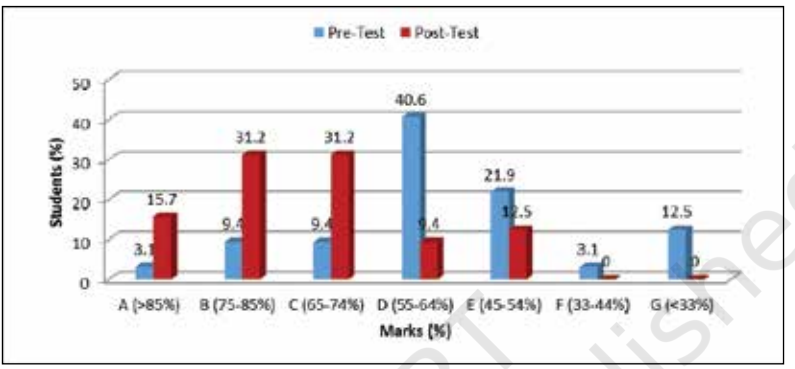

Figure 7: Percentage of Section B students (experimental group) placed in various groups categorised based on the marks obtained in pre and post-test mathematics achievement test paper

Comparative Analysis of Scores of the Students of Section A (Control Group) and Section B (Experimental Group)

Only one student (3.3%) failed from Section A as compared to 4 students of Section B in the pre-test mathematics test. Therefore, the pre-test passing percentage of the Section B was lesser (87.5%) as compared to Section A (96.7%). However, post-test passing percentage was reached to 100 per cent for both the classes (Figure 8).

On comparison of the mean scores in pre-test between Section A and Section B, it was observed that the mean score of the Section B was 55.5 per cent as compared to 51.0 per cent of Section A. When the post-test means were compared with that of the pre-test mean scores for both the classes, a significant increase ($p<0.0001$) in the mean score was observed only for Section B and not for Section A. Although, there was an increase in the post-test mean score for Section A, but the difference was not significant ($p=0.16$).

Effect of the Co-Operative Learning through Circular Classroom Seating Arrangement on Student's Learning

The Section B underwent the change in the seating arrangement from rows and columns to circular pattern as an experimental

treatment and thus constituted the experimental group. The pre-test scores in the mathematics test paper for both the classes were comparable, rather the number of students failing in this test was higher for Section B as compared to that of the Section A. However, the mean score of Section B students was more than that of the Section A suggesting that the individual students who passed from the Section B scored better than that of the Section A. This is because the higher number of students' found place in Category A (>95 per cent), B (84–95 per cent) and Category D (55–64 per cent) as compared to that of the Section A. However, post-test evaluation revealed that one student from the Section A scored >95 per cent marks as compared to none in the pre-test. Further, the number of students scoring 45–54 per cent (Cat. E) in post-test was higher than that in the pre-test and it was reversed for the Category F (33–44 per cent). This might be attributed because some student who scored lesser in the pre-test but performed better in the post-test resulting in the shift from Category F to E. Although there was an improvement in the post-test score as compared to that of the pre-test score in the control group, the means of the scores of the pre-test and post-test were not significantly different. This can be attributed to their second attempt of the mathematics test paper and not the effect of the experimental set up as no change was used for the seating arrangement of this group.

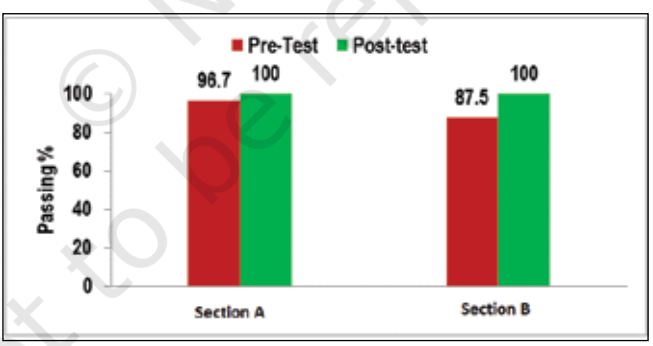

Figure 8: Passing percentage in mathematics achievement test paper of both classes

On the other hand, students of Section B experienced the change in the seating arrangement from row and columns to circular pattern as an experimental design for three weeks during the course of this research. In contrast to Section A (Control group), the student of the Section B (Experimental group) performed

significantly better in their post-test as compared to the pre-test. The passing percentage of the Section B was lesser than that of the Section A in pre-test, however 100 per cent of the students from both the classes qualified in the post-test. The passing difference between for the Section B was higher than that of the Section A. This improvement was not only in terms of the number of students who passed in post-test but also the students got the better grade as most of the students from Category D (55-64%) in pre-test jumped to either of the Category A, B and C. When we analysed for the mean difference of the marks obtained by both the classes between pre-test and post-test mathematics test, the significant increase was observed for the Section B and not for the Section A. These results highlight the influence of the co-operative learning by changing the traditional rows and columns classroom seating arrangement to circular on the passing percentage as well as the grades of the students of the Section B. These results show that, according to the students, the co-operative learning is very helpful in understanding the subject and share their doubts to each other. It also helped them to discuss the difficulties and find out the solution of the problem. In contrast studying alone in the rows and columns gave them a feeling of un-cooperation and affect their learning capability. Therefore, circular seating arrangement is a priority to them. Students care for where and how they feel comfortable. Comfort, being part of the Ehran et al.'s (2003) affective factors, is what helps students learn more efficiently. It can then be argued that classroom seating arrangement is directly related to student's participation while working on co-operative learning activities since it has to do with student's feeling comfortable in class. Student's comments thus agree with Cornell's (2002) argument that furniture arrangement should be functional. By functional, he means that seating arrangements should help both the students and the instructor equally to achieve the course goals. They also agree with what Chambers (2004) said about the importance of classroom seating arrangements being 'comfortable to use' for both the teacher and the student.

Conclusion

In this study, it was observed that the co-operative learning by modifying the classroom seating arrangement from the traditional rows and columns to circular arrangement improved the students' learning capability, and understanding of mathematics

significantly. This interpretation is mainly based on the comparison of improvement in the passing percentage and the marks obtained by the students of the experimental group (Section B) in the post-test mathematics achievement test paper.

Results of this study show that co-operative learning helps to improve not only the understanding of the students but also motivate them to discuss the difficulties during study. There are different ways of co-operative learning and one way of that is to transform the classroom seating arrangement in a way which suites the most to the requirement of the student's performance. Here the study shows the modification of the rows and columns into circular seating arrangement, but there can be many more ways to do so. Some of the students who considered themselves shy but when seated in a circle, their performance in the achievement test was very good. This means that it could be claimed that co-operative learning through class seating arrangements, not only affect the highly interactive students in class, but could also help shy students to be more active and participate in the discussion which in turns improve their performance in the subject.

Implications for the Teaching

Data obtained from this study highlights a number of points concerning the beliefs of the educational institution. The way seats are arranged inside classes reflect the beliefs that the teacher is still the main source of information. Although there has been a call directed to all teachers to encourage co-operative learning activities and group work among students, the way classes are laid out does not encourage this teaching method.

Students should be encouraged to work in groups and to depend more on each other rather than the teacher in order to learn more efficiently.

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