



## **EXPLORING STUDENTS' EXPERIENCES WITH CO-OPERATIVE LEARNING IN MATHEMATICS**

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#### **Introduction**

With the progressively interactive global environment, co-operation is looked upon as a vital concern in education around the world. Many studies related to co-operative learning and its effect on students' achievement and other outcomes have been conducted in recent years (Slavin 1991, 1995, 1996; Hämäläinen, 2008; Panitz, 1999; Watkins, et al., 2007; Johnson & Johnson 1999, Johnson et al., 2007). Positive effects of co-operative learning have been found to be of help to students in deepening thoughts, improving critical thinking, being creative, building healthy relationship with group members (Johnson & Johnson, 1999) as well as gaining tolerance and appreciation of differences among diverse individuals (Slavin, 1996; Johnson & Johnson 2007; Watkins, et al., 2007). Hence, co-operative learning is seen as an effective instructional approach that not only helps students academically, but socially and psychologically as well.

#### **Rationale of the Study**

Students' perceptions and mutual interactions are frequently neglected aspects of classroom instruction and research in the Indian context. Providing appropriate interactions with materials (such as textbooks and computers) and opportunities for appropriate interactions with the teacher is the responsibility of the teacher, but in the traditional teaching-learning context, comparatively less emphasis is placed on organizing opportunities for students for meaningful and appropriate interactions with each other. Thus, in a traditional mathematics class in India, interpersonal interaction is a neglected component. However, interpersonal interaction amongst students is of paramount importance as it promotes

cognitive and social development and besides influencing the quality of peer relationships. The rationale for exploring students' experiences with co-operative learning approach in mathematics is to find out how they learn the subject especially when the class size in Indian classroom often exceeds 75 students and therefore, implementation of co-operative learning could be a challenging task for both students and teachers.

### **Definition of the Term**

**Co-operative Learning** : It refers to the face-to-face interaction by students in small, heterogeneous teams, planned goal interdependence including a group goal and group recognition, individual accountability, an emphasis on group performance and on practicing social skills.

### **Research Questions**

1. How did you experience the co-operative learning approach in your mathematics class?
2. What value, if any, has been derived from the co-operative learning effort?

### **Materials and Method**

**Intervention Programme** :In the present research, I developed an instructional programme based on Co-operative Learning Approach. In the present research, instructional programme on chapters on linear equations in two variables, graphs, ratio and statistics was developed. The techniques used under Co-operative Learning Approach in the present investigation included Jigsaw Technique and Think-Pair-Share. I obtained permission from a selected school for implementing the intervention programme. I first administered the pre-test on students' Mathematics Achievement Test the experimental group. After the pre-test, the experimental group was taught using the Co-operative Learning Approach. At the end of this, the post-test on Mathematics Achievement Test and Co-operative Learning Implementation Opinionnaire were administered on the students and data were analyzed using statistical techniques and analytical induction. I used this design as it was the most feasible one and the interpretation of the results has been cautiously done. The students of standard IX were taught selected topics in Mathematics subject. The treatment was given on the basis of content from the text books prescribed by Maharashtra state text book production and

curriculum research, Pune. In the experimental group, I taught the content matter using the Co-operative Learning Approach. Twenty-two periods from the school time table were taken up to teach the content. It was spread over twelve working days. Five days per week were taken up for three weeks, teaching one to two school periods a day of thirty-five minutes duration each. The content was taught in the mornings.

**Procedure of the Study:** Based on students' responses to the Co-operative Learning Implementation Opinionnaire, students who had either very high or very low score on this opinionnaire were identified and invited to participate in a follow-up interview for this study. Four students were thus willingly included to participate in this qualitative study out of a total 78 students on whom the pre-test, post-test quasi-experiment was conducted. All the four students were given fictitious names such as A1, A2, B1 and B2.

**Participants of the Study :** All the four students belonged to the experimental group taught through co-operative learning approach. They were asked various questions and follow-up questions about their performance, positive and frustrating experiences they have had with their peers, their goals, study and learning approach and their feelings about the intervention programme along with other questions that resulted from the conversations with the students. They were very sincere with their comments and the researcher felt that they were candid and did not hold anything back. Students met the researcher during the course of one school day in a quiet room. The interviews were conducted in February end, so the students' answers are felt to fairly represent their entire duration of the intervention programme. Two students with the highest score on co-operative learning implementation and two with the lowest score co-operative learning implementation were identified.

**Data Collection :** After implementing the co-operative learning approach in the class, I conducted unstructured in-depth interviews with four students for the purpose of soliciting additional information about their personal experiences of co-operative learning. The remainder of this paragraph explains how these interviews were conducted. My questions were "directed to the participant's experiences, feelings, beliefs and convictions about co-operative learning". I focused on "what goes on within" the participants and got the participants to "describe the lived experience in a language as free from the constructs of the intellect and society as possible". I either talked directly to the programme participants or

asked them to write essays with the following request: Write down your viewpoint, perspectives or feelings of the co-operative learning you have just completed. You need not give your name. You need not concern yourself with grammar or spelling. If possible, compare this co-operative learning with others classes with traditional method of teaching you are accustomed to, which are not offered through co-operative learning.

I audio-recorded the detailed interviews with the permission of interviewees. Each interview was assigned a code, for example "Participant A1, 21 January 2015." Where more than one interview took place on a specific date, the different interviews were identified by an alphabet character, (Participant-B2, 1 February 2015). I recorded each interview on a separate piece of paper. I filed each paper with the assigned interview code. As soon as possible after each interview I listened to the recording and made notes. I transcribed key words, phrases and statements in order to allow the voices of research participants/informants to speak.

## Data Analysis

### Participants' Profile

This part describes each participant's details from the interview. In order to respect each participant's privacy, all students' names are pseudonyms.

**A1.** A1 is a 14-year-old female student. Her prior academic achievement level is high and has scored 85.93% in standard eighth examination. She enjoys watching Hindi serials on TV, likes cricket and school activities. She is active on WhatsApp, Facebook and twitter. She plans to become computer professional in future. A1 had never heard of the term "co-operative learning," but she is aware of the use of technology in teaching and learning. She sometimes takes part in some group discussions and group project work in the school. The daily classroom activities for her before being exposed to co-operative learning approach was to pay attention to the teacher, do exercise in her notebook, answer teacher's questions in the class, do home assignments and do the work assigned to the tuition teacher.

**A2.** A2 is a 14-year old female student. Her prior academic achievement level is average and has scored 52.88% in standard eighth examination. She enjoys watching English movies,

shopping and western music. She is active on WhatsApp, Facebook and twitter. She plans to become a model in future. A2 had never heard of the term “cooperative learning,” but she is excited to use technology in teaching and learning whenever possible. She enjoys taking part in some group discussions and group project work in the school. The daily classroom activities for her before being exposed to co-operative learning approach was to pay attention to the teacher, do exercise in her notebook, answer teacher’s questions in the class, do home assignments and do the work assigned to the tuition teacher - the same as A1.

**B1.** B1 is a 14-year- old male student. His prior academic achievement in standard eighth was 87.51% and the teacher calls him a bright student. He is active in sports and cultural activities in the school. He joined this school in standard seventh. Before that, he was in another school. In the other school, he had heard of co-operative learning because a B.Ed. student there had used it in her practice teaching once. However, he did not recall much about it as he had exposure to it very briefly once. He enjoys taking part in debates and quizzes. He does not prefer studying in a group at the time of examination. He does his homework on his own and is regular about it. He wants to go to USA or Australia for further studies in business administration if it is financially feasible. He enjoys challenging work.

**B2.** B2 is a 15- year- old male student. His prior academic performance was 46.72% in standard eighth and the teacher finds him a below average student. He had failed once in standard sixth and his performance in mathematics was found to be poor by his teacher. He likes cricket but apart from that he does not have any specific interests though he has a big group of friends from his school as well as outside. However, he does not like asking for help when he faces difficulty in solving mathematics problems. He had not heard of co-operative learning before the experiment. He wishes to take up a Government job when he grows up. He is interested in taking up Commerce stream for higher education. He prefers to solve easy questions but gets very nervous when it comes to solve difficult problems. However, he also said that after attending the co-operative learning class, he felt at ease with mathematics.

The steps of data analysis of the unstructured interview were as follows:

- (1) Exploring the data by listening to interview records and reading through the interview transcripts
- (2) Coding sentences or phrases relevant to research questions
- (3) Categorising similar codes together and
- (4) Developing themes based on the participants' responses.

The data analysis focussed on the research question "What are the views of the students regarding the process of learning through co-operative learning approach?".

### Prominent Themes from the Interviews

Two themes were identified, namely, (a) "Group Benefits" and (b) "Individual benefits" as a result of the analysis of the data acquired from the individual face-to-face interviews with the students.

The categories of each theme are as follows :

No.	Theme	Category
1	Group Benefits	Peer Support
		Synergy
		Creation of a Co-operative Milieu
		Effect of Leadership
		Negative Implications of Group Learning
2	Individual Benefits	Academic Efficacy
		Student Engagement
		Cohesive Conception of Mathematics
		Multitude of Abilities
		Improved Performance

These are given in detail in the following paragraphs. The following code indicates which citation belongs to which student: The students are coded as first student (A1), second student (A2), third student (B1) and fourth student (B2).

**I. GROUP BENEFITS :** This theme comprises of five categories, namely, (a) Peer Support, (b) Synergy, (c) Creation of a Co-operative Milieu, (d) Effect of Leadership and (e) Negative Implications of Group Learning. Students benefit due to the academic and emotional support from their peers, they find it more comfortable to ask their queries to their peers rather than the teacher especially if the student is not a high achiever. Students feel that the synergy created due to team work enables them to achieve those goals which cannot be attained through individual efforts. This in turn is expected to create a team spirit which is very essential in the Indian context as Indian culture essentially needs this. Students also learn to take up their responsibility and perform their respective role so as to ensure better performance. They also learn to manage their conflicts. On account of peer support and team work, the psycho-social climate of the classroom improves which can have a bearing on student performance. Students are also able to see the hidden qualities in their peers and appreciate these. However, in achieving this, a strong leader and encouragement and motivation provided by him/her to the other team members in the group is very important. At the same time, the teacher and the group members must ensure that no student is blamed for the poor performance of the group as this would reduce the effectiveness of the co-operative learning approach.

Each of these categories have been discussed in detail in the following paragraphs.

**a) Peer Support**

**A1 :** “.... *I was not ready enough for group work in mathematics and basically, I am scared of mathematics. But, my group members helped out and I contributed in increasing my group’s score ultimately by solving problems, participating in the*

group project and answering the questions in the class. I don't think I could have got over my fear of mathematics if I had worked alone and if my friends did not help me."

**B2** : "...Learning maths from the teacher sometimes makes it more difficult. At times, we are scared to ask the teacher if we don't understand something as we are worried about what she will think of us or whether the class will make fun of me. But asking help from a friend to clear a doubt is much easier."

**B1**: "...I realized that it is not sufficient to know a subject well but also important to present it well and justify what you have done. Due to support given to each other, my group gave a very good presentation the way they show on TV. Everyone liked it. No one was nervous or scared. We gave examples, handled the ppt, spoke confidently and were smiling. The teacher also praised us."

**A2**: "...At first, when we solved problems individually, some of us got it wrong. But later on, I was shocked to see our work. We discussed the steps, tried to see whether the formula was correct, the calculations were correct and then solved problems together. I now understood about how the work should be started and progressed. It was superb now. Our group project was much superior then I had thought and I would not have been able to do it so well if I had worked on it alone. It was so good because everyone contributed to it."

**B1** "...We had the opportunity to learn maths more permanently as we did a lot of revision of the subject, had a lot of practice examples helping each other repeatedly. This really helped."

#### **b) Synergy**

**A1** : "...Everyone had a role. I performed my role so that in the end I am not blamed for bad performance of the group initially. Later on, I started enjoying the class and so I fulfilled my responsibility so that my group becomes successful and we as a group do well."

**A2:**“...Not only our teachers but also our group members got angry with us when we did not fulfill our responsibilities. So we had to do our share of work and also help others.”

**B2** “...*We all had roles from beginning to the end. The teacher reminded us about our responsibilities often. We had to fulfill our responsibilities in order to understand the topic, be successful in solving problems in mathematics and do individual and group exercises as well as give joint presentations.*”

**A2 :** “...*We all had an opportunity to do different activities and show our abilities and skills. Like, Vrushali is good in drawing graphs, Ravish’s English is good, Yash is good in calculations. These different abilities were used in our group work and presentation for making our group successful.*”

**A1:**“....*I observed that my friends were successful in different aspects. I also saw that those who generally good marks in the exams were less successful in the other areas such as making presentations, discussing issues with others or giving moral support to others. I felt good to see that all my friends could be successful at any time.*”

**B1 :** “...*I was initially absent for one week when this class began as I was not well. Friends in my group helped me study and cope with the missed classes in order to be successful in learning maths. I felt good that I am not alone.*”

**B2:**“....*There were different activities to be carried out in this class. For example, one of the group members was writing well, one was good at browsing the internet and get latest information very well, another was preparing very good graphs and charts, another was good in giving explanations and thus all of us were successful.*”

**A1 :** “...*Once I was preparing a project with my team mates. We were confused about how to start writing the project in the beginning. But one of us knew about the subject. The other opened internet and found good material on the internet. Because of these two members, we got a rich idea of how to progress. Then, we decided to distribute the work into four parts, each one of us took that work which we were comfortable with. This included getting material from the internet, drawing graphs, solving*

*problems and making power-point presentation. Now all of us were actively involved, we all were satisfied and presented a good quality work at last.”*

#### **c) Creation of a Co-operative Milieu**

**B2** : *“...I think the quarrels among students in my class have reduced now. I feel I have more friends on whom I can rely in my group and also the class.”*

**A2**: *“...I have realized that some groups had less tension. They got more marks and their presentation was more confident. So, I also tried to ensure that my group is relaxed, gives a good presentation with good communication skills as these are as important as studying.”*

#### **d) Effect of Leadership**

**A1**: *“...The most important factor in becoming a successful group was our group leader. She encouraged us, ensured that all fulfilled their responsibility. Sometimes she also guided a group member who did not fulfill his responsibilities and most importantly she created a feeling in all of us that we were going to be successful. The groups without such a leader were not successful.”*

**B2**: *“...My group leader did not encourage us. I don't think anyone can teach as well as our teacher. After all, we are all students and still learning. So I think for teaching mathematics, a teacher is the best option and not group learning. It could be useful for teaching mother tongue. I don't mind that. But not mathematics.”*

#### **e) Negative Implications of Group Learning**

**B2**: *“...This method is nice but if all in the group don't work, we can't be successful. This may not work in all situations because there always a few students who are either lazy or diffident or good in studies but don't like to help others. Therefore, if I have a choice, I would want all clever students from my class in my group so that the*

*group succeeds. Otherwise, other people's lack of success will give failure to me and I will get less marks."*

**A1** *"...I had studied hard in order to get good marks. But I got nervous at the time of answering questions during a presentation. This made my group members angry with me. I think the usual method used by our teacher is better. At least my classmates don't blame me for their unsuccessful performance. If I fail, I will be the only one who has to cope with the situation rather than your entire group getting angry with you."*

**B2:** *"...I feel the teacher needs to ensure that a few students do not dominate all the discussions in the group."*

**II. INDIVIDUAL BENEFITS** : This theme comprises of four categories, namely, (a) Academic Efficacy, (b) Student Engagement, (c) Cohesive Conception of Mathematics, (d) Multitude of Abilities and (e) Improved Performance. Co-operative learning approach increases the academic efficacy in students in terms of a positive feeling towards the subject, reducing anxiety, developing positive attitude towards the school itself, enhancing confidence about future learning and feeling at ease in social interactions with peers. Co-operative learning approach enhances cognitive, affective and behavioural engagement amongst students in terms of remaining active in the classroom as well as through WhatsApp and helping each other with solving mathematical problems. The approach has benefits the students in developing a cohesive conception of mathematics in terms of being able to handle accounts through the knowledge of mathematics and being able to learn other related subjects such Physics and Chemistry. The approach gives other benefits to students as they feel that apart from their performance in examinations, their abilities such as drawing graphs, making ppt and justifying group work. The approach also enables students to make friends with different personalities, skills and abilities. In other words, the co-operative learning approach has been found to enhance cognitive and affective outcomes of learning.

Each of these categories have been discussed in detail in the following paragraphs.

**a) Academic Efficacy**

**A2** : *“...Now I feel I am okay with mathematics – in fact good in it. In future also I can do well in mathematics if the same method of teaching is used.”*

**B2** : *“...Now I feel like coming to school as I think I am also capable.”*

**A1** : *“...I think more than intelligence, how you learn, how much support you get from teacher and friends is more important.”*

**B1** : *“... My parents wanted me to take up science after SSC but I was not ready as I was scared of maths. But now I think I can cope with it with support from peers. I have also become more confident of making friends. I no longer feel horrible about myself regarding maths.”*

**A1** : *“...I was not at all familiar with co-operative learning initially when we began. I did not know what to say or do in the group because I was not accustomed to study in a group or speaking in a group. I could neither argue nor justify my statements. I think now I am comfortable with it. Now if I find a difficult problem, I discuss it face-to-face when in the class or on WhatsApp if we are at home. Similarly, if someone else has a difficulty, I take initiative in solving it if I know it.”*

**B1** : *“...In the past, I very rarely spoke to my classmates except saying hello to two members of my group. But now I can say that apart from my close friends, I have more opportunities with two friends for co-operation from my work team in mathematics. Moreover, asking these two friends for help or being able to help them made me feel glad. Besides, I find it easier to seek my group member’s help for solving a problem rather than the teacher”.*

**b) Student Engagement**

**A2** : *“...In order to be successful in presentation and getting good marks in mathematics, we asked questions to each other and showed each other how to solve a problem and the steps of it. We even asked questions to each other on WhatsApp and Facebook. We have made a WhatsApp group too”.*

**B2** : *“...For the first time, all my group members were active throughout the maths class. We studied the subject, told our friends about it, prepared a presentation and had a competition with other groups. I think being active helped us to learn. This has never happened earlier.”*

**A1** : *“...As compared to our regular class, we were mentally more alert, felt good about learning, were more comfortable and active in this class. What I learnt was enjoyable. Now my mind does not wonder in the maths class. In fact, I feel like volunteering for helping others in mathematics. I also understand how what I had learnt in the past fits with what I learn new.”*

**B1** : *“...Usually, I explain the subject to myself very well at home, but when the teacher asks me I get tense. In this practice, explaining the subject in the group did not make me tense. My friends like the way I talk and I am also at ease with them. This study increased my motivation.”*

### **c) Cohesive Conception of Mathematics**

**A1** : *“...Earlier, I thought that mathematics is a subject which needed rote learning of formulae and tables. But now I understand how it affects our real life. It helps me in my daily life, all ‘hisabs’ (accounts) and also learning other subjects like Physics and Chemistry.”*

**B2** : *“ .... Though I have been studying this subject since standard I, I neither enjoyed it nor learnt it properly. I dreaded maths exam and felt attending the maths class very stressful. My friend illustrated the maths problems so well that now I understand it better. Besides, now I am also comfortable with Physics as it also involves formulae and calculations.”*

**d) Multitude of Abilities**

**B1** : *"...Earlier, only some students got praise and importance in the class. Those who got higher marks in the exams were favourites of the teacher and got importance from the class. But now, we observed in this new approach that those who were leaders and encouraged us had important skills. They were important for our success. The best thing was that these students were different. Their qualities are important."*

**A1** : *"...My opinion about Prajakta was changed. I was thinking that she was very quiet in the classroom and never took any part in the classroom activities. I was surprised to see how good she was in giving illustrations and examples in our group and how patiently she explained how to solve a problem in the group. She really impressed me."*

**B2** : *"...Actually, I have been taught at home to co-operate with everyone. I enjoy about co-operating and discussing with others. But this is my first time I am experiencing co-operative learning in the real sense in the classroom. I found that every group member has his or her unique idea. Paying attention to everyone's idea is enriching to me. Besides, the teacher in between changed our groups. This enabled us to get fresh ideas every time. It was also useful in having less competition between groups when we are not in the mathematics class. It is an effective way of learning because even if the teacher is the best, in today's times, it is impossible that one person knows everything. Besides, now we have many friends with different personalities, skills and abilities."*

**e) Improved Performance**

**A2** : *"...I who never put in any extra effort and doesn't complete homework on time, actually stayed up late working for hours to finish an assignment early so I could review it and can revise it. I got B1 on this assignment as opposed to C grade earlier. My group's performance was also good."*

**B2:** *“...Actually, I was performing far below my classmates. During the past several weeks, I feel like voluntarily asking for extra help from my classmates and even teacher so that I can improve my performance in mathematics. I feel that my marks drastically improved from failing to 63% in the recent exam. I also feel more confident about mathematics now”.*

**A1 :** *“...I feel that I have begun to work hard on a consistent basis in maths. I also value maths more now”.*

### Results and Discussion

These students' perceptions of the co-operative learning approach suggest that in such a class they experience positive academic and affective rewards that facilitate mathematics learning through and increase in academic efficacy, student engagement and cohesive conceptions on mathematics, enhancement of motivation focused on performance goals and reduction in fear of mathematics which can subsequently influence their academic achievement.

These findings are supported by the study conducted by Philips (2010) who conducted descriptive case study and found that “students showed a more positive feeling toward cooperative learning, stated an increased appreciation for cooperative learning, developed trust in their group members, and were able to analyze what they were doing well and what areas needed work. Mathlearning occurred when the students demonstrated how they solved problems by communicating using mathematical concepts and language”. Similarly, Webb (1991) analysed research on co-operative learning in mathematics for indicators of effectiveness based upon student interactions. Webb concluded that “the most effective small groups are those where students were free to talk about what they understand and don't understand, gave each other detailed responses on problems, and gave each other a chance to discuss”. Jacobs, Power, and Inn (2002) declared, “Interaction among students, whether spoken or written, builds competence. This interaction is missing in classrooms where students spend the majority of their time listening to the teacher or to the one student selected by the teacher. This is why simultaneous interaction is such an important cooperative learning principle” (p. 58).

**Conclusions** : Co-operative learning leads to group benefits in terms of providing peer support, synergy, development of a co-operative milieu in the class and positive effects of group leadership on the students. These in turn provide opportunities to students for enhancing their academic efficacy, cognitive, affective and behavioural engagement, cohesive conceptions of mathematics development and emphasis on a multitude of abilities rather than only academic performance in the classroom and ultimately improved performance in mathematics through higher levels of confidence, reduced anxiety and positive attitude towards the subject. Academic and social support as well as revision of the subject with the peers help in reducing or eliminating fear of mathematics from a student. Students' self-concept also improves as different abilities in students – apart from marks in examination – is appreciated by the class. This boosts their confidence. However, if the group leader does not encourage all the team-mates, the benefits of co-operative learning will not ensue. Appreciation from peers acts boosts students' confidence and acts as a motivating factor. However, the teacher needs to ensure and train students to refrain from blaming any individual for poor performance and from dominating discussions in the group. He/she also need to ensure that each member in a group contributes to group performance. This is very challenging for a teacher in a large class of 75 or more students in a class which is very common in an Indian classroom. It needs to be mentioned here that in spite of such a challenge, co-operative learning is perceived by students as a beneficial approach for teaching and learning of mathematics. The findings of the present study are of immense importance in an examination-oriented educational system in India where students understand the importance of appreciating qualities in their peers which are beyond academic performance.

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