A STUDY ON THE EFFECTIVENESS OF A STRATEGY BASED ON COOPERATIVE LEARNING FOR SCIENCE TEACHING IN CLASS VII

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Certificate

This is to certify that the work contained in this thesis entitled 'A Study on the Effectiveness of a Strategy based on Cooperative Learning for Science Teaching in Class VII' submitted by Ms. Mary Vineetha Thomas to The Maharaja Sayajirao University of Baroda, Vadodara, India for the Degree of Doctor of Philosophy (Ph.D) in Education is a record of bonafide original research work carried out by her under my supervision and guidance. The results embodied in the same have not been submitted elsewhere for the award of any degree or diploma. It is further stated that the doctoral research was carried out fulfilling the requisite attendance criteria as per O. Ph.D.: 3 of The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat, India. I find it fit for submission and evaluation.

March, 2013
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INTRODUCTION

1.0 INTRODUCTION

For the achievement of human security, it is essential to uphold and respect the dignity of human beings and the same is possible, only if one understands about the human rights of every other human being. This is possible only when one is literate enough to learn, which means when he or she is educated. Education comprises not only higher and technical education but also primary education. It is only with good primary education that, one can have the edge to go in for higher education. The necessity of primary education is always there and is sure to remain. It is the backbone of the education system of any country and India is no exception. Good primary education means not only universal education but also education in its entirety which includes quality education which is value-based. The task of execution of primary education is non-negotiable and resolute efforts are necessary to solve the emerging challenges affecting the accomplishment of primary education. The government has come up with many initiatives since the National Policy on Education (NPE) of 1986 and the Programme of Action (POA) in 1992 to promote primary education in our country. Since 1987, initiatives have been taken by the government in the nature of Operation Blackboard Scheme, Scheme of Restructuring and Reorganization of Teacher Education, Learning Without Burden, Joyful Learning, Programme for Mass Orientation of School teachers (PMOST),District Primary Education Programme (DPEP), Special Orientation Programme for primary Teachers (SOPT), Minimum Levels of Learning (MLL), Mid-day Meal Programme, the Janashala Programme, Sarva Shiksha Abhiyan (SSA), Hoshangabad Science Teaching Programme (Madhya Pradesh), Lok Jumbish Programme (Rajasthan) and Tarang. But while there has been a continuous upsurge in the number of schools established at the primary level, thus increasing physical access to schools, the low quality of education provided in these schools remains a critical issue in India's educational system. Low quality education implies that even those children who have completed primary schooling may not be functionally literate and numerate. According to

the Annual Status of Education Report (ASER,2006) by Pratham, in the tests of reading ability given thirty five percent of children aged seven- fourteen could not pass and sixty percent could not read a simple story also at grade two level. Forty one percent of children in the age group seven- fourteen were unable to do two digit subtraction problems or division problems. The ASER states that while children have access to schools and are going to schools, the negative point is that they are not learning well. Thus this aspect needs some serious thinking. Also, for some children in our country primary education will be terminal. It is, therefore, important that it equips them fully to face the challenges of life ahead. Besides this, primary education lays the foundation of all subsequent education, i.e. secondary and university education. The quality of secondary or university education cannot be high unless the quality of primary education improves. Thus, with the quantitative development of the educational system, qualitative development is also essential. An important factor that affects the quality of education is the teaching- learning process. So it is high time that we give up the traditional methods of teaching and come up with innovative and effective teaching strategies in order to help and motivate our students to learn efficiently. One such strategy which is being largely supported and promoted today is group work. According to the National Curriculum Framework (NCF, 2000), at the upper primary stage children endeavor to establish an identity of their own. The process of identity formation requires taking into account one's own view as well as the views of others and of the society. Thus, the importance of peer group increases considerably. It also stresses on promoting constructivist approach in classrooms which leads to learners having autonomy for their own learning and opportunities for peer collaboration and support. The core ideas expressed in constructivism have been advocated by John Dewey. For Dewey (1966), knowledge emerges only from situations in which learners have to draw them out of meaningful experiences. Further, these situations have to be embedded in a social context, such as a classroom, where students can take part in manipulating materials and, thus, forming a community of learners who construct their knowledge together. Students cannot learn by means of rote memorization; they can only learn by "directed living", whereby concrete activities are combined with theory. There are different approaches to constructivism among which the often heard ones are cognitive and social. Formalization of the theory

of cognitive constructivism is generally attributed to Piaget (1967), who articulated mechanisms by which knowledge is internalized by learners. He suggested that through processes of accommodation and assimilation, individuals construct new knowledge from their experiences. In 1978, Vygtosky came up with his view that for learning to be effective it has to take place in a social context. And this led to the evolution of Social constructivism. According to social constructivism learning is a social activity: our learning is intimately associated with our connection with other human beings, our teachers, our peers, our family as well as casual acquaintances, including the people before us or next to us at the exhibit. Constructivists have developed a number of teaching strategies, which, though varied and often subject specified, have many common elements. One such element is collaboration. This clearly comes from the social side of the constructivist movement, which stresses the ways in which children can learn from each other when they collaborate with one another or with the teacher. According to Schunk (2000), a key concept in constructivist collaboration is that of 'purposeful talk', talk that allows opportunities for pupils to examine, elaborate, assess and build their knowledge in a social context. Constructivist approaches to collaboration include peer collaboration, reciprocal teaching, problem based instruction, cooperative learning and other methods that involve learning with others.

Group work can be used for teaching all subjects and science is no exception. NCF (2005) has also stressed on making group activities and discussion with peers and teachers important components in science pedagogy. Unlike many subjects of primary curriculum, science provides the opportunity for working as a group rather than working independently within a group situation. On the basis of Tara Devi Report (1956), Report of Education Commission (1964-66) and observations of NPE (1986), Joshi (2005) has given the objectives of teaching science at upper primary level as follows:

1) To provide knowledge about the basic primary facts, principles and theories related with science.
2) To help students to get acquainted with the impact of science over the environment surrounding them and to develop their interest in the study of science.
3) To develop scientific attitude among children.

4) To cultivate the habit of systematic and logical thinking.
5) To develop the habit and ability of drawing correct inferences out of the available facts and evidences.
6) To provide essential base for further studies in the higher classes.
7) To acquaint the students with the history of the development of science and help them to understand and appreciate the progress and development made in this sphere.

But unfortunately these objectives are not being achieved in our schools today. Umasree (1999) reports that lecture method is used in most of the science classes and teachers feel that if textbook content is completely learnt, objectives can be taken as achieved. According to Ramkumar (2003), lecture method is seen in classes IV to VII and teachers stress on textbook learning and do not use any innovative strategies. This is because in our schools the primary school teacher, due to his own educational background and the curriculum load that is brought to bear on him, places almost total emphasis on memorization of certain facts and principles of science just to pass the class examination even though understanding of the concept memorized may generally be lacking. Primary school teachers tend to teach as they were taught. As a result science has become one of the subjects which most of the students find difficulty with from the primary level itself. Considering these aspects of the environment for the teaching and learning of science that prevail in some primary schools, especially in rural areas, one wonders what might be done to the nature of the primary science education to bring about a desirable change in this existing situation. For this, Kalra (2007) has mentioned three important elements that need to be included in primary science teaching:

(a) Encouragement for participatory teaching learning process in such a way that every child gets opportunity to actively interact with the teacher and with the classmates.

(b) Promotion of creative activities in classroom in such a manner that students are encouraged to express themselves through writing and art activities.

(c) Promotion of collective activities of children in such a way that children develop team spirit, collective cooperation and productive project work.

According to the National Curriculum Framework (2005), science teaching at upper primary level should include group activities and discussion with peers and teachers.

Thus, primary science teachers need to develop new methods of teaching keeping in mind the above points. By doing so they can provide effective science education experiences to the students and thus encourage them to find in themselves the ability to discover knowledge and develop skills which may help them to produce a better way of life for themselves, their families and their communities. Some of the innovative strategies that are being promoted in science teaching are experiential learning, blended learning, virtual learning, collaborative learning and cooperative learning. The UNESCO (1996) states that one of the tasks of education is to teach pupils and students about human diversity and to instill in them an awareness of the similarities and interdependence of all people. From early childhood, it should focus on the discovery of other people in the first stage of education. In the second stage it should encourage involvement in common projects. Thus one of the essential tools for education in the twenty first century must be a suitable forum for dialogue and discussion. One such strategy promoting this aspect is cooperative learning. Cooperative learning is grounded in the belief that learning is most effective when students are actively involved in sharing ideas and work cooperatively to complete academic tasks.

1.1 COOPERATIVE LEARNING

Cooperative learning involves students working together in small groups to accomplish shared goals. It is widely recognized as a teaching strategy that promotes socialization and learning among students from kindergarten through college and across different subjects. One can see that several definitions of cooperative learning have been formulated. Some of them are as given.

According to McCulloch (1985), Cooperative learning refers to students working together to achieve a common goal. In addition to the usual learning goals, it includes the goal of establishing a collaborative/helping relationship among participants.

Balkcom (1992) has defined Cooperative learning as a successful teaching strategy in which small teams, each with students of different levels of ability, use a variety of learning activities to improve their understanding of a subject. Each member of a team is responsible not only for learning what is taught but also for helping teammates learn, thus creating an atmosphere of achievement.

According to Johnson, Johnson, & Holubec (1993), Cooperative learning is the instructional use of small groups so that students work together to maximize their own and each other's learning.

Felder & Brent (2007) says that the term cooperative learning (CL) refers to students working in teams on an assignment or project under conditions in which certain criteria are satisfied, including that the team members be held individually accountable for the complete content of the assignment or project.

But the most widely used definition of cooperative learning in education is probably that of Johnson & Johnson (1994). According to them, cooperative learning is an instruction that involves students working in teams to accomplish a common goal, under conditions that include the following five essential elements:

1. **Positive interdependence**- team members are obliged to rely on one another to achieve the goal. If any team members fail to do their part, everyone suffers consequences.
2. **Individual Accountability**- All students in a group are held accountable for doing their share of the work and for mastery of all of the material to be learned.
3. **Face-to-face promotive interaction**- Although some of the group work may be parceled out and done individually, some must be done interactively, with group members providing one another with feedback, challenging reasoning and conclusions, and perhaps most importantly, teaching and encouraging one another.
4. **Appropriate use of collaborative skills**- Students are encouraged and helped to develop and practice trust-building, leadership, decision-making, communication, and conflict management skills.
5. **Group processing**- Team members set group goals, periodically assess what they are doing well as a team, and identify changes they will make to function more effectively in the future.

   Cooperative learning is not simply a synonym for students working in groups. Learning exercise only qualifies as cooperative learning to the extent that the five listed elements are present.

1.2 THEORY OF COOPERATIVE LEARNING

According to Johnson & Johnson (1998), there are at least three general theoretical perspectives that have guided research on cooperation--cognitive-developmental, behavioral, and social interdependence. The cognitive developmental perspective is largely based on the theories of Piaget and Vygotsky. The work of Piaget and related theorists is based on the premise that when individuals co-operate on the environment, socio-cognitive conflict occurs that creates cognitive disequilibrium, which in turn stimulates perspective-taking ability and cognitive development. The work of Vygotsky and related theorists is based on the premise that knowledge is social, constructed from cooperative efforts to learn, understand, and solve problems. The behavioral theory perspective focuses on the impact of group reinforces and rewards on learning. Skinner focused on group contingencies, Bandura focused on imitation, and Homans as well as Thibaut and Kelley focused on the balance of rewards and costs in social exchange among interdependent individuals. While the cognitive-developmental and behavioral theoretical orientations have their followings, by far the most important theory dealing with cooperation is social interdependence theory.

Theorizing on social interdependence began in the early 1900s, when one of the founders of the Gestalt School of Psychology, Kurt Koffka, proposed that groups were dynamic wholes in which the interdependence among members could vary. One of his colleagues, Kurt Lewin refined Koffka's notions in the 1920s and 1930s while stating that (a) the essence of a group is the interdependence among members (created by common goals) which results in the group being a "dynamic whole" so that a change in the state of any member or subgroup changes the state of any other member or subgroup, and (b) an intrinsic state of tension within group members motivates movement towards the accomplishment of the desired common goals. In the late 1940s, one of Lewin's graduate students, Morton Deutsch, extended Lewin's reasoning about social interdependence and formulated a theory of cooperation and competition. Deutsch identified three goal structures: cooperative, where each individual’s goal-oriented efforts contribute to others’ goal attainment; competitive, where each individual’s goal-oriented efforts frustrate others’ goal attainment; and individualistic, where individual’s goal-oriented efforts have no consequences for others’ goal attainment. The basic premise of social interdependence

theory is that the type of interdependence structured in a situation determines how individuals interact with each other which, in turn, determine outcomes. Positive interdependence tends to result in promotive interaction which tends to result in a wide variety of outcomes that may be subsumed into the categories of high effort to achieve, positive relationships, and mental health. Negative interdependence tends to result in oppositional interaction which results in low effort to achieve by most students, negative relationships, and low mental health. And no interdependence results in an absence of interaction which ends to result in low effort to achieve, an absence of relationships, and psychological problems.

Social interdependence has numerous outcomes that may be subsumed within three broad categories- (1) efforts to achieve (2) positive relationships and (3) mental health. According to Johnson & Johnson (1989), along with high efforts to achieve, cooperation tends to result in long term retention, willingness to take on difficult tasks, creative thinking and positive attitude towards tasks. Johnson & Johnson (1998) reports that generally the more positive the relationships among group members, the lower the absenteeism, the more students commit effort to achieve educational goals, take on difficult tasks, be motivated to learn , commit to each other's learning and success and achieve and produce. Commenting on mental health, Johnson & Heibsen (cited in Johnson & Johnson, 1998) says that working cooperatively with peer results in greater mental health than working independently or competing with peers. Thus each of these outcomes influences the others and therefore is likely to be found together. And together they induce positive interdependence and promotive interaction. So we can see that the social interdependence perspective of cooperative learning presupposes that the way social interdependence is structured determines the way persons interact with each other. Moreover, outcomes are the consequence of person's interactions. Therefore Johnson, Johnson & Holubec (1994) says that one of the important cooperative elements that have to be structured in the classroom is positive interdependence or cooperation. When this is done, cooperation results in promotive interaction as group members encourage and ease each other's efforts to learn.

Slavin (1995), however, has categorized the theories into two major categories: (1) motivational and (2) cognitive.

(1) Motivational perspectives on cooperative learning focus primarily on the reward or goal structures under which students operate. From a motivational perspective (such as those of Johnson et al., 1981, and Slavin, 1983), cooperative goal structures create a situation in which the only way group members can attain their own personal goals is if the group is successful. Therefore, to meet their personal goals, group members must help their group mates to do whatever helps the group to succeed, and, perhaps more important, encourage their group mates to exert maximum effort. The critique of traditional classroom organization made by motivational theorists is that the competitive grading and informal reward system of the classroom create peer norms that oppose academic efforts (Coleman, 1961). Since one student's success decreases the chances that others will succeed, students are likely to express norms that high achievement is for "nerds" or teacher's pets. But when students work together towards a common goal, as they do when a cooperative reward structure is in place, their learning efforts help their group mates succeed. Students therefore encourage one another's learning, reinforce one another's academic efforts, and express norms favoring academic achievement.

(2) As motivational theories of cooperative learning degree emphasize the degree to which cooperative goals change students' incentives to do academic work, cognitive theories emphasize the effects of working together in itself (whether or not groups are trying to achieve a group goal). There are several different cognitive theories, which fall into two major categories: (a) developmental theories and (b) cognitive elaboration theories.

   (a) The fundamental assumption of the developmental theories is that interaction among children around appropriate tasks increases their mastery of critical concepts (Damon, 1984; Murray, 1982). Vygotsky (1978) defines the zone of proximal development as the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers. In his view, collaborative activity among children

promotes growth because children of similar ages are likely to be operating within one another's proximal zones of development, modeling in the collaborating group, behaviours more advanced than those they could perform as individuals.

(b) The cognitive elaboration perspective is quite different form this. Research in cognitive psychology has found that if information is to be retained in memory and related to information already in memory, the learner must engage in some sort of cognitive restructuring, or elaboration, of the material (Wittrock, 1978) and one of the most effective means of elaboration is explaining the material to someone else, that is, learning in groups.

1.3 COOPERATIVE LEARNING AND EDUCATION

According to Slavin (1995), there are many reasons for CL to enter the mainstream of educational practice.

- First, the overwhelming amount of research showing the use of CL to improve pupil achievement and such other outcomes as intergroup relations, acceptance of handicapped classmates and increased self-esteem.
- Secondly, there is a growing realization that pupils must learn to think, solve problems, integrate their knowledge and apply their skills; CL is an excellent means for doing this.
- Thirdly, CL can help make diversity in heterogeneous classes a resource rather than a problem. As schools are moving away from homogeneous ability grouping with its negative effects on pupil achievement towards more heterogeneous grouping, CL is growing in importance.
- Fourthly, CL has been found positively to influence the social relations with pupils of different ethnic backgrounds and mainstreamed special education pupils and their classmates.

1.3.1 THE BENEFITS OF COOPERATIVE LEARNING

A review of researches on CL has shown that by participating in CL, students can benefit in the following areas (Johnson & Johnson (1983), Slavin (1991), Jacobs et al., (2002),

Battistich & Watson (2003), Ryan, Reid & Epstein (2004) & Ballantine & Larres (2009)):

- Improved academic achievement
- More active involvement in learning by students, regardless of past achievement level or individual learning needs
- Increased motivation to learn
- Increased student responsibility for their own learning
- Improved interethnic relations and acceptance of academically challenged students
- Improved time on task (sometimes dramatically improved, compared to whole-class, teacher-led instruction)
- Improved collaborative skills
- Enhanced interpersonal and communication skills
- Increased self-esteem
- Increased liking for school
- Development of positive attitudes toward learning, school, peers, and self
- Development of positive social attitudes toward other group members in students with emotional and behavioral disorders
- Increased ability to appreciate and consider a variety of perspectives
- Greater opportunities for the teacher to observe and assess student learning

1.4 COLLABORATIVE LEARNING AND COOPERATIVE LEARNING

While discussing on cooperative learning there is another one term that often comes into everyone's mind- collaborative learning. There is a lot of confusion on whether these both are the same. According to Panitz (1999), collaborative learning is a personal philosophy, not just a classroom technique. It suggests a way of dealing with people which respects and highlights individual group members' abilities and contributions. There is a sharing of authority and acceptance of responsibility among group members for the group actions. Cooperative learning on the other hand, is a set of processes which help people interact together in order to accomplish a specific goal or develop a content specific end product. It is closely controlled by the teacher and therefore more directive than a collaborative system of governance. In collaborative learning, students team

together to explore a significant question or create a meaningful project. Groups would assume almost total responsibility for answering the question. The students determine if they have enough information to answer the question. If not they identify other sources, such as journals, books, videos, the internet, to name a few. The work of obtaining the extra source material would be distributed among the group members by the group members. The group would decide how many reasons they could identify. The collaborative teacher would not specify a number, but would assess the progress of each group and provide suggestions about each group's approach and the data generated. The teacher would be available for consultations and would facilitate the process by asking for frequent progress reports from the groups, facilitate group discussions about group dynamics, help with conflict resolution, etc. The final product is determined by each group, after consultation with the teacher. A group of students discussing a lecture or students from different schools working together over the internet on a shared assignment are both examples of collaborative learning. In cooperative learning, students work together in small groups on a structured activity. Cooperative groups work face-to-face and learn to work as a team. They are individually accountable for their work, and the work of the group as a whole is also assessed. Here the teacher maintains complete control of the class, even though the students work in groups to accomplish a goal of a course. The cooperative teacher asks specific questions and provides additional articles for the students to read and analyze, beyond the text, and then asks the students to work in groups to answer the question. The groups then present their results to the whole class and discuss their reasoning. The teacher uses specific CL techniques to help facilitate the group interactions. The students do the work necessary to consider the material being covered but the teacher maintains control of the process at each stage. What has to be, however, noted is that though cooperative and collaborative learning can be separately defined, they are in fact not mutually exclusive but co-exist in most group work learning environments.

1.5 COOPERATIVE LEARNING TECHNIQUES

They are very specific cooperative learning strategies teachers use to organize interactions between students. There are many such techniques that can be used in classrooms. Some of the commonly used cooperative learning techniques are:-

1. **Jigsaw**- Developed by Aronson (1978).Groups with five students are set up. Each group member is assigned some unique material to learn and then to teach to his group members. To help in the learning process, students across the class working on the same sub-section get together to decide what is important and how to teach it. After practice in these "expert" groups the original groups reform and students teach each other. Tests or assessment follows.

2. **Student Teams-Achievement Divisions (STAD)** – Developed by Slavin (1978a). In this students are assigned to four-member learning teams that are mixed in performance level, gender and ethnicity. The teacher presents a lesson, and then students work within their teams to make sure that all team members have mastered the lesson. Finally, all students take individual quizzes on the material, at which time they may not help one another. Students' quiz scores are compared to their own past averages, and points are awarded on the basis of the degree to which students meet or exceed their own earlier performance. These points are then summed to form team scores, and teams that meet certain criteria may earn certificates or other rewards.

3. **Group Investigation** – Developed by Sharan & Lazarowitz (1978). This is a general classroom organization plan in which students work in small groups using cooperative inquiry, group discussion, and cooperative planning and projects. In this method, students form their own two- to- six- member groups. After choosing subtopics from a unit that the entire class is studying, the groups break their subtopics into individual tasks and carry out the activities that are necessary to prepare group reports. Each group then makes a presentation or display to communicate its findings to the entire class.

4. **Teams- Games- Tournaments (TGT)** – Developed by De Vries and Slavin (1978). It is used at the conclusion of each chapter. The usual heterogeneous groups are split up temporarily. Students are put into homogeneous ability groups of three or four students for a competition, using the list of questions at the end of the chapter. Students randomly select a numbered card corresponding to the question they are to answer. Their answers can be challenged by the other students and winner keeps the card. Students earn points (one point for each card won) to bring back to their regular teams, a team average is taken, and the teams' averages are announced and all congratulated.

5. **Think- Pair- Share** – Developed by Lyman (1981). Involves a three step cooperative structure. During the first step individuals think silently about a question posed by the instructor. Individuals pair up during the second step and exchange thoughts. In the third step, the pairs share their responses with other pairs, other teams, or the entire group.

6. **Three- Step Interview** – Developed by Kagan (1989). Each member of a team chooses another member to be a partner. During the first step individuals interview their partners by asking clarifying questions. During the second step partners reverse the roles. For the final step, members share their partner's response with the team.

7. **Round Robin Brainstorming** – Developed by Kagan (1992). Class is divided into small groups (four to six) with one person appointed as the recorder. A question is posed with many answers and students are given time to think about answers. After the "think time", members of the team share responses with one another in round robin style. The recorder writes down the answers of the group members. The person next to the recorder starts and each person in the group in order gives an answer until time is called.

8. **Numbered Heads** – Developed by Kagan (1992). A team of four is established. Each member is given numbers of one, two, three, four. Questions are asked of the group. Groups work together to answer the question so that all can verbally answer the question. Teacher calls out a number (eg. two) and each two is asked to give the answer.

9. **Team Pair Solo** - Given by Kagan (1994). Students do problems first as a team, then with a partner, and finally on their own. It is designed to motivate students to tackle and succeed at problems which initially are beyond their ability. It is based on a simple notion of mediated learning. Students can do more things with help (mediation) than they can do alone. By allowing them to work on problems they could not do alone, first as a team and then with a partner, they progress to a point they can do alone that which at first they could do only with help.

1.6 GROUPING STUDENTS IN COOPERATIVE LEARNING

Groups should be made in such a way that all members are able to contribute. The teams should be made heterogeneous in ability level. The unfairness of forming a group with only weak students is obvious, but groups with only strong students are equally

undesirable. The members of such teams are likely to divide up the homework and communicate only briefly with one another, avoiding the interactions that lead to most of the proven benefits of cooperative learning. In heterogeneous groups, the weaker students gain from seeing how better students approach problems, and the stronger students gain a deeper understanding of the subject by teaching it to others. It is also better to assign different roles to team members (e.g. coordinator, recorder, checker, group process monitor), rotating the roles periodically or for each assignment. The coordinator reminds team members of when and where they should meet and keeps everyone on task during team meetings; the recorder prepares the final solution to be turned in; the checker double-checks the solution before it is handed in and makes sure the assignment is turned in on time and the monitor checks to be sure everyone understands the solutions and the strategies used to get them. Finally the activities and work to be allotted to students should also be clearly defined to them.

The following summarizes the research evidence on grouping students and also gives ideas for establishing mixed-ability groups (Gillies, 2007):

- ♠ Mixed-ability groups promote achievement gains for low and medium ability students.
- ♠ High–ability students are not disadvantaged by working with lower-ability peers.
- ♠ Second- language learners acquire language skills more readily when they work with peers in mixed-ability groups.
- ♠ Cross-ethnic relations and learning are promoted in mixed-ability groups.
- ♠ Students with learning disabilities are likely to be accepted by their peers.
- ♠ Status and learning for low-status children can be enhanced in mixed-ability groups.

1.6.1 Ideas for establishing Mixed-Ability Groups

- Teacher discusses the task with the students and informs them that they will be unable to complete it unless they include students who have different talents. For example, if the group is required to present a power point display to the class, students may need someone who is a technician (resolves difficulties with the computer, program materials), a researcher (conducts searches from different data

bases to locate information), manager (collects resources), and a presenter (responsible for organizing the group's presentation to the class). The recognition that different students have different talents provides status to those students and also makes others aware of the talents they can harness. It is recommended that the teacher, initially, constructs the groups to ensure that students with different talents are included. As the students become aware of the different attributes of others, they can begin to exercise more control over the selection of members.

- Students are given a line or lines of a limerick and are asked to find others with lines from the same limerick. This activity promotes a great deal of fun as they try to piece together the limerick and then present it to the larger class. This activity not only serves as an icebreaker, but it identifies the group's members. Students are often quite willing to accept this type of randomization in selecting members, whereas they may be reluctant to accept members the teacher identifies. The astute teacher, though, will see that each group consists of students with different talents or abilities by ensuring that lines from each limerick are given to students who reflect this diversity.
- Each student is given one task to work on from a complement of three tasks that are required to be completed by the group. Students have to find the remaining members of the group to ensure that they can identify a theme/focus for their combined tasks. This is a reverse-order approach: Rather than identifying the subtasks, students have the subtasks and are required to identify the group's task. For example, their group task may be to investigate the packaging of cookies currently used by a company and make recommendations on future packaging, although they are not explicitly told that this is the group's task. Students may be assigned one of the following subtasks and asked to find other members of their group and then identify the overall task of their group from the individual tasks that they have been given: (a) the needs of the consumer when packaging cookies; (b) the expectations of the community for environmentally friendly packaging of cookies; and (c) ways to minimize the costs to the company of packaging its cookies.

1.6.2 Team Building

Many teachers and proponents of CL advocate training students in how to work in groups, and there are many techniques for developing team spirit and cohesiveness. The team-building activities that follow are just a few of the many included in Kagan (1992).

1. Name Learning

   Each group is given a set amount of time to learn the names of their teammates. They then take a test and the average percentage of correct names per group is announced.

   Variations: include more information, such as favorite hobby or most unusual experience. Following hundred-percent mastery by all groups, have teams pair and repeat the exercise. This time, though, the goal is for each team to learn the names of all the members of the other team.

2. Interview

   Interview introduces teammates to each other in some depth and classmates to each other superficially. It gives students some basis for relating to others with common interests or experiences, it gives them the opportunity to feel welcome in the group, and it helps overcome initial resistances that some students have participating in groups. Interview consists of the following steps:

   i. The teacher has students gather in teams.
   ii. Teammates count off – one, two, three, four, or more, one number for each teammate.
   iii. The teacher informs the students that it is one's job to interview two, three's job to interview four, and so on, for five minutes. The aim of the interview is to gather information that will be used to introduce each person to his or her teammates. Interview topics may be suggested, such as hobbies, unusual experiences, favorite movies, and life goals. Interviewing tips may be provided, such as how to follow the lead of the other person rather than suggesting topics of interest yourself.
   iv. Introductions are carried out within groups. Each interviewer has one minute to present to the group the person he or she has interviewed.

v. Steps iii. and iv. Are repeated with students switching roles: interviews and presents one, four interviews and presents three, and so on.

vi. The team attempts to discover through discussion the "positive essence" of each teammate so that he or she can be described in an adjective or very brief phrase, such as "gutsy", "adventuresome", "caring" or "nature girl". Students are instructed to look for themes in the interview responses that will help them capture the positive essence of the person.

vii. Team members introduce their teammates to the class by taking turns stating the adjective or phrase that best captures the positive essence of the team member and providing a sentence or two of explanation.

3. Team Name, Banner, Logo, and/or Mural

When teams are first formed they are asked to name themselves. This process can be used as a teambuilding exercise. Three simple rules for the group process are stated: each team member must have a say; no decision can be reached unless everyone consents; no member consents to the group decision if he or she has a serious objection. These rules set the tone for future group processes, which must include participation, consensus, and respect for individual rights.

In addition to choosing a name, teams may create mural, banner or logo. If so, the same rules apply. Each member must contribute and the group cannot proceed without consensus. The teacher may facilitate the process by giving each member a different-colored marking pen and calling for an integrated product with all colors represented. The task can be structured so that other teams will judge how well all colors are integrated into a meaningful and artful whole.

4. Group Brainstorming

Any task that has many possible solutions may be setup for group brainstorming. The instructions are simply that the group members put their heads together and come up with as many correct or interesting solutions as they can. After groups have had time to brainstorm, they may get points for their number of correct solutions; they may rate the creativeness of each group's best solution or they may simply share their most creative products.

1.7 ENVIRONMENT FOR CL IN CLASSROOMS

In such small group techniques, students get a chance to share strengths and also develop their weaker skills. They develop their interpersonal skills and learn to deal with conflicts. When cooperative groups are guided by clear objectives, students engage in numerous activities and this helps them to improve their understanding of the specific subjects explored. In order to create an environment in which cooperative learning can take place it is important that students be made to understand the CL techniques and how they would be implemented and while implementing these techniques it has to be taken care that students feel at ease to express themselves along with the feeling of being challenged. For this, a positive learning environment is what is needed.

1.7.1 Ways of creating a cooperative learning environment (Gillies, 2007)

- Create an environment that enables students to move around different work stations so they can access information, seek help, and produce individual and group products with ease. For example, access to the internet may be critical for searching for information and downloading relevant materials. If students are working in groups, they need room to move freely around other groups as they seek help from others. They also need access to tables or floor space where they can lay out their work and prepare their group's report.
- Negotiate expectations for group and classroom behaviours before students begin working in their groups. If this is done in a consultative and friendly manner, students are more likely to respond positively to any negotiated rules or parameters for behaviour. Having students identify the types of behaviours they would expect from others is one way of helping students to generate their own list of behaviours they expect to see others demonstrate. Generating their own list of behaviours is more likely to promote ownership of them and a sense of responsibility to practice them.
- Taking a personal interest in students by asking about their weekend or their favorite game is one way of helping to build connections and letting students know that their teachers are interested in them as individuals. Language used during these exchanges is often very relaxed and friendly enables students to see another side of

their teacher. Teachers must be prepared to share some of their own thoughts with students so that students can understand their teacher's position or opinion on topics of mutual interest.

- ❖ Organize some icebreaking activities so students can get to know each other before they begin to work more formally together. This is particularly more important for adolescents, who are often very sensitive about how they are likely to be perceived by their peers. Such icebreaking activities may include: finding out three things about a person in the group and then introducing that person to the wider class; completing a limerick from the first stimulus line; and identifying and discussing one's funniest experience.
- ❖ Organize to hold debates between groups on topical and humorous subjects. Ensure that speakers understand that what is being discussed is to be presented in a lighthearted manner. Have the remaining groups identify the key aspects of the presentation that they liked and discuss these at the end of the debate. The teacher would need to help students highlight aspects of the debate that fulfilled the goal of the debate-to have fun. This type of exercise enables a teacher to demonstrate many of the mediated learning behaviours like acknowledging and validating students' efforts, challenging their perspectives, scaffolding their learning, and helping them to connect ideas and think meta cognitively.

1.7.2 FOSTERING THE FIVE ESSENTIAL ELEMENTS OF CL

Gillies (2007) has given different ways for promoting the five essential elements of cooperative learning in a cooperative classroom environment as follows:

1.7.2.1 Ways of structuring Positive Interdependence

- Allocate students to groups so that each brings different expert skills. For example, some students may have specific technological and media skills while others may have oracy and organizational skills that are needed if the task is to be completed successfully.
- Students are required to undertake different tasks and bring that information back to their groups to share with the members. This may involve students' leaving

their first group to acquire the specific information from a second group before bringing it back and sharing it with the first group.

- Members work in pairs to complete an aspect of the group's larger task. Each pair shares their completed task with the other pair, and the group members work together to ensure that the parts contribute to the larger task.

1.7.2.2 Ways of Promoting Interaction

- Assign students to two-person groups and have them interview each other about their favorite sport, hobby, or activity. Each two-person group then joins with another pair to make a group of four. Students, in turn, introduce each other to the group, informing the members of their partner's favorite sport, hobby, or activity.
- Give the students the first line of a limerick (make sure they understand it is a five-line rhyme) and have them work in their four-person groups to complete it. Groups then read their limericks to the class. This is an activity that can produce a lot of laughter as students often perform the limerick at the same time.
- Give students a "story topic" and have them contribute a sentence each until they have made up a story about it. Give the students about five to seven minutes to elaborate on their topic before discussing the outcome with the larger class. This activity can also be used as an icebreaker to help group members adjust to each other before settling down to work together.

1.7.2.3 Ways of Ensuring Individual Accountability

- Peer assessment. The teacher helps students understand how to develop criteria that can be used to assess the contribution of each member to the group. Assessments can range from "made a contribution" through to "contributed some worthwhile ideas".
- Teacher assessment. This involves the teacher's giving feedback to each group on her or his observations of members' contributions; feedback that is constructive and positive is always well received.
- Group assessment. Students agree to complete specific tasks or roles, with the group providing feedback to each member on how he or she performed the task or role. It may be necessary to provide students with some sentence stems to help

them reflect on how they might structure their feedback to members. Sentence stems that are designed to elicit positive feedback may start with, "I liked the way you…". However, students also need to be able to critique each other's work; the following sentence stem may help them to do this in a non confrontational way: "I can see that you are trying to do…but I wonder if you could also think about doing …?"

1.7.2.4 Ways of Ensuring That Children Learn These Interpersonal and Small-Group Skills

- Teacher leads a class discussion on the types of student behaviours that are important if students are to work successfully in groups. Adolescents prefer to negotiate rules or expectations for behavior rather than have them imposed. Guidelines for group behaviours could be developed and posted on the class website or notice board or pasted in each student's notebook. Examples of group behaviours may include: listens to others, no put downs, democratic decision making, discusses differences and tries to settle them, shares resources.
- Students may need to be taught how to manage conflict or express dissension. Giving "I-messages", that is, focusing on the issue and not the person is one way of helping students learn how to express concern/disagreement. This is particularly important with adolescents who can sometimes be hypersensitive to comments from their peers. An example of an I-message is: "I feel concerned when you make those comments".

1.7.2.5 Ideas for group processing

- Students spend five minutes in their groups reflecting on what they have accomplished and what they may still need to do. Simultaneously, members need to check each other's thoughts on how they managed their relationships in the group. Questions such as the following may stimulate discussion: how did we manage our relationships with each other? Was there anything in the way we worked together that you think needs to change? What would you like to happen differently next time?

1.8 MANGEMENT TECHNIQUES IN CL CLASSROOMS

1.8.1 The Zero-Noise Signal

In group work there is always the natural tendency for a class to become too noisy. If it is not taken care of it might disturb the other classes. This problem can be solved using the Zero-Noise Signal technique given by Slavin (1995). The zero-noise signal is a signal to students to stop talking, to give their full attention to the teacher, and to keep their hands and bodies still. Teachers choose different signals for students. Some may ask for attention while others may flip the lights on and off or ring a bell. One effective method is for the teacher to raise one hand. This is more convenient as the teacher needn't raise his/her voice over the group noise level nor walk over to the bell or light switch. For more effectiveness special recognition can be given to the first team or teams to have all their members quiet with full attention after teachers arm has been raised.

1.8.2 Group praise

It is not necessary that in spite of using the zero noise signal that the noise level be controlled in cooperative learning classrooms. There are chances of some students making noise when the teachers are not looking at their group. They might stop talking when zero noise signal is shown but might resume talking after that. In such situations group praise will help. Teachers should walk over to the best group in the class, give the zero noise signal and draw everyone's attention to the group, praising them for their good work and good behaviour. It is an effective means for dealing with such problems (Kagan, 1992). Group praise establishes the norms for the classroom; students learn which behaviours are valued and receive special recognition for exhibiting them. Holding up as a model the groups that are behaving best is the clearest way to give that message and to show students what is valued.

1.8.3 Special recognition bulletin

Special recognition becomes effective when charts or posters are used to record the special recognition points. A positive comment is of course valued but when it is recorded as a point in a chart it has additional power to motivate students towards desired behaviours. The team with highest points can be rewarded at the end of a month or week which is optional. In any case, teammates will work hard and encourage each

other toward desired behaviours if they know that their efforts will be recognized. When a desired behaviour is exhibited by a group a teacher can immediately walk over to the bulletin and mark the point and explain to the class the reason why that team received special recognition.

1.8.4 Special-Recognition ceremony

Slavin (1995) feels that teachers may hold a special recognition ceremony each week in which outstanding teams and individuals are recognized by the teacher and students. The ceremony can be quite brief but still very important. In the ceremony, students and teams who have earned the most recognition points write in or post their names on the weekly special- recognition chart, and receive applause from the rest of the class.

1.8.5 Class or Team Fun Time

Special-recognition points may be traded for class or team rewards. It is often helpful to have students choose fun-time activities. The teacher may announce that whenever any team or the class as a whole earns a certain number of points, they may cash them in for extra recess or fun activities.

1.9 SOLVING PROBLEMS WITH COOPERATIVE LEARNING

As one begins to use cooperative learning, few problems might be faced at the initial stages. Taking into consideration Slavin's (1986) view on this, some of these problems and the solutions that teachers have found effective for them are as follows:

1.9.1 Failure to get along

This problem comes up in the first week or two of cooperative learning. As students differ from one another in sex, ethnicity and academic performance they will be unhappy about their team assignments initially. The primary solution for this problem is time. When they get their first team scores and realize that they really are a team and need to cooperate to be successful, they will find a way to get along. However, some students will need reminding that their task is to cooperate with their teammates. The teacher must set a firm tone that cooperation with teammates is what appropriate behaviour is during team practice. It should be made clear that put-downs, making fun of teammates, or refusing to help teammates is not a very effective way for teams to succeed and is not acceptable. One effective way to get students to cooperate better is to

provide extra rewards to winning teams. Sometimes students will not care how the team or their teammates are doing until they know that the winning team will get refreshments, time off, release from a test, and so on. It is also a good idea to have students who work in pairs within their teams to switch partners every once in a while, to reemphasize that it is a team effort that is needed, not just individual preparation. If some teams just do not work out, teams maybe changed after three of four weeks.

1.9.2 Misbehaviour

One way to encourage students to behave appropriately is to give each team up to three additional points per day based on the team's behaviour, cooperativeness, and effort. While doing so the teacher has to move from team to team and tell the teams what they are doing right. The points team earn for their behaviour should definitely not be a surprise, but should reflect what the teacher was saying during the period.

1.9.3 Noise

Noise is more of a problem in some schools than in others, depending on acoustics, open versus traditional construction, and school attitudes toward noise. Cooperative learning does not mix well with a teacher who shushes students every five minutes, but if things are so noisy that students cannot hear each other, something should be done. For this the "Zero Noise signal" can be used. If it doesn't work then one should try to make noise level a criterion for earning extra team points and this would definitely help.

1.9.4 Absences

Student absenteeism can be a major problem in a cooperative learning class, because students depend on one another to study together and to contribute points to the team. The solution is simple in classrooms where absenteeism is not extremely high. When students miss a tournament or quiz, one may divide the team's score by the number of students present, to avoid penalizing the team for having an absent member. When Student Team Learning is to be used in a class with very poor attendance, poor attenders should be distributed evenly among teams as fifth or sixth members, so that at least three of four students will be likely to show up on each team each day.

1.9.5 Ineffective use of team practice time

If students do not use their time in team practice effectively, one may impose some structure on the team practice sessions to be sure that they do. One problem is that

students may be used to doing their worksheets alone and thinking that they are finished when they get to the end, regardless of whether they or their teammates understand the material. This problem is dealt with primarily by providing only two worksheets per team so that students have to work together.

1.9.6 Free Rider Effect

This is another important factor that has to be taken care of while implementing cooperative learning. If not properly taken care of there is a possibility of some group members to do all or most of the work while others sit back simply. This is called the free rider effect (Slavin, 1995) and is most likely to occur when the group has to perform a single task or when all group members have to submit a single report on a common task. Along with this there is also the possibility of the bright students ignoring the contributions of weak ones. These can be avoided by making each group member responsible for an unique part of the group's task as in Jigsaw and Group investigation explained above and by also making each one individually accountable for their learning as in Students Team Achievement Division. In the present study, hence, these three methods have been implemented in order to take care of the same.

1.10 TEACHER'S ROLE IN CL CLASSROOMS

Teachers play a critical role in establishing CL pedagogy in their classrooms. The role of a teacher here is that of a facilitator. The teacher should encourage students to interact together and create opportunities for students to collaborate around tasks. They should encourage students to take up responsibility for their own learning and make sure that learning is student – centered. They have to model the types of talks and behaviours expected to be done by their students and give feedback to students on their progress in class.

According to Jolliffe (2007) the teacher's role in a CL classroom is as follows:

(1) Plans lessons that decide on objectives, size of groups, how to group pupils, group roles, organization of the classroom and materials needed.
(2) Explains the task and the cooperative skill with criteria for the success of both.
(3) Monitors and intervenes with groups where necessary.

(4) Evaluates the quality and quantity of achievement and ensures that groups reflect on their achievement and effectiveness as a group and set goals for improvement.

(5) Celebrates achievement.

The research on teachers' responsibilities and teacher's discourse in establishing CL suggests the following (Gillies, 2007):

- Teachers need to create learning environments that are inclusive of all students
- Teachers need to establish student-centered learning environments that involve interactive, meaningful, constructive and reflective processes.
- Teachers actively need to teach students how to interact socially in groups.
- Teachers can facilitate students' dialoguing with others by helping them to use different scripts, adopt different group roles, or requiring them to complete tasks where they need to interact to solve the problem.
- Teachers need to be prepared to challenge students' thinking and scaffold their learning so they learn to think more cognitively and metacognitively about problem issues.
- Teachers can facilitate thinking in their students (e.g., Asking probing questions, confronting discrepancies in students' reasoning) when they use specific communication skills that challenge students' thinking and scaffold their learning.
- Teachers must actively monitor students' progress, provide feedback and redirections as appropriate, and be prepared to review students' achievements as a consequence of their small- group experience.

Teacher's discourse

- Teacher's discourse during cooperative learning is more personal and friendly and less authoritarian and impersonal than it is during whole-class instruction or unstructured small-group instruction.
- Teachers use more mediated learning behaviours during cooperative learning than during small –group instruction.
- Teachers' mediated learning behaviours are designed to challenge children's understanding and thinking and help them to connect ideas to previous learning.
- Mediated learning behaviours include: prompting, challenging, confronting, questioning and scaffolding children's thinking and learning.

- ♣ Children model the mediated learning behaviours they hear their teachers use in their interactions with each other during CL.
- ♣ Personal and social constructivism helps to explain children's learning during CL.
- ♣ Personal constructivism occurs when children encounter ideas that are different from their own, and they are forced to examine these alternative ideas in order to reduce the cognitive tension they experience and reconcile these ideas with their own.
- ♣ Social constructivism occurs when children interact with others and are introduced to new ideas and new patterns of thought until eventually, after repeated exchanges, these ideas and patterns of thought are internalized.

Learner-centered teachers view each student as unique and capable of learning, have a perspective that focuses on the learner, understand how students learn, and respect and accept the students' point of view. Young children are motivated to learn and achieve when teachers establish a positive classroom environment, adapt instruction according to individual differences and facilitate students' learning and thinking skills. Adolescents are motivated to learn and achieve when teachers honor their voices and provide opportunities for individual choice and challenge. This is because at this stage they like the feeling that what they are doing is meaningful and that they have control over how and what they learn. Students are motivated when they are given opportunities to be actively involved in their own learning. Effective teachers, according to Gillies (2007), ensure that they create learning environments that provide opportunities for students to work in situations that are positive and supportive of their personal, social and academic needs. He feels that with adolescents it is important to negotiate appropriate codes of behaviour to help create a safe working environment so that students understand the following:

- ❖ All actions must be safe and aboveboard. This includes ensuring that no weapons or drugs or other harmful substances are brought into schools. When this does happen, students need to understand that they have an obligation to ensure the safety of themselves and their peers by reporting such information.

- Bullying is not tolerated. Provide students with strategies for dealing with bullies, including the use of self-affirming statements to promote personal resilience, peer support networks and avenues to report the abuse to school personal.
- Provide opportunities for students to have their voices or choices heard. This may include establishing a classroom council where all students have the right to raise issues with the class group. It may include opportunities for students to drop in to see teachers during break time to discuss personal issues or negotiate alternative submission dates for assignments. In short, teachers need to be creative about providing opportunities that let students make their wishes known or express their opinions.
- Provide opportunities for students to work on intellectually challenging tasks where they can test their ideas and receive feedback from their peers. Adapting the working environment so students have opportunities to move around to different work stations that have different tasks and different technologies is one way to challenge students and motive their interests. Establishing expectations that they have to report back to the class group is another way to ensure that students complete requires tasks.

1.11 ASSESSING COOPERATIVE LEARNING

Implementing cooperative learning successfully does not ensure its success. For tha,t it is very essential to know whether students have benefited from the technique and if yes to what extent and how. All these questions come under the important and difficult task of assessment. Assessment plays a key role in educational accountability. Being able to assess the outcomes of students' learning is very important, and probably more so for such pedagogical practices as CL where responsibility for learning is devolved to the group and where teachers act as facilitators of learning rather than instructors of knowledge. Instructors new to cooperative learning often find it very difficult to assess students in CL situations because here it is not mere the achievement that has to be assessed which could be easily done by a paper-pencil test. Assessing students in CL means assessing them on the five essential elements of CL, namely, positive interdependence, individual accountability, face-to-face promotive interaction,

appropriate use of collaborative skills and group processing. The five essential elements of cooperative learning are not those that can be measured by the academic achievement of students. Also it is not necessary that students who score high in paper-pencil test will always develop cooperative learning skills. Even if their academic scores are not much high they might have progressed a lot in the five essential elements of cooperative learning. So there needs to be a different kind of assessment for the same. Some approaches that can be used for assessing students in cooperative learning activities include checklist, rating scale, rubric, field diary, activity sheets, portfolios, group work questionnaire, group assignments and group presentation.

Checklists usually offer a yes/no format in relation to student demonstration of specific criteria. Rating Scales allow teachers to indicate the degree or frequency of the behaviours, skills and strategies displayed by the learner. Rating scales state the criteria and provide three or four response selections to describe the quality or frequency of student work. Teachers can use rating scales to record observations and students can use them as self-assessment tools. Teaching students to use descriptive words, such as always**,** usually**,** sometimes and never helps them pinpoint specific strengths and needs. Rating scales also give students information for setting goals and improving performance. In a rating scale, the descriptive word is more important than the related number. The more precise and descriptive the words for each scale point, the more reliable the tool. Rubrics use a set of criteria to evaluate a student's performance. They consist of a fixed measurement scale and detailed description of the characteristics for each level of performance. These descriptions focus on the quality of the product or performance and not the quantity**;** e.g., examples to support an idea, spelling errors. Rubrics are commonly used to evaluate student performance with the intention of including the result in a grade for reporting purposes. Rubrics can increase the consistency and reliability of scoring. A portfolio is a purposeful collection of student work samples, student self-assessments and goal statements that reflect student progress. Students generally choose the work samples to place in the portfolio, but the teacher may also recommend that specific work samples be included. Portfolios are powerful tools that allow students to see their academic progress from grade to grade. An essential requirement of portfolios is that students include written reflections that explain why each sample was selected. The power of the

portfolio is derived from the descriptions, reactions and metacognitive reflections that help students achieve their goals (Alberta Education, 2008). Field diary is used for noting down all that happens in the class during the entire teaching learning process. Every minute detail of the entire process is written down.

1.12 SCIENCE TEACHING AND COOPERATIVE LEARNING

According to Wikipedia (2011), science is a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the universe. An older and closely related meaning still in use today is that of Aristotle, for whom scientific knowledge was a body of reliable knowledge that can be logically and rationally explained. Scientific fields are commonly divided into two major groups: natural sciences, which study natural phenomena (including biological life), and social sciences, which study human behavior and societies. These groupings are empirical sciences, which means the knowledge must be based on observable phenomena and capable of being tested for its validity by other researchers working under the same conditions. There are also related disciplines that are grouped into interdisciplinary and applied sciences, such as engineering and medicine. Mathematics, which is classified as a formal science, has both similarities and differences with the empirical sciences (the natural and social sciences). It is similar to empirical sciences in that it involves an objective, careful and systematic study of an area of knowledge; it is different because of its method of verifying its knowledge, using *a priori* rather than empirical methods. The formal sciences, which also include statistics and logic, are vital to the empirical sciences. Major advances in formal science have often led to major advances in the empirical sciences. The formal sciences are essential in the formation of hypotheses, theories, and laws, both in discovering and describing how things work (natural sciences) and how people think and act (social sciences).

Science is both a body of knowledge and a process. In school, science may sometimes seem like a collection of isolated and static facts listed in a textbook, but that's only a small part of the story. Just as importantly, science is also a process of discovery that allows us to link isolated facts into coherent and comprehensive understandings of the natural world. Science is a way of discovering what's in the universe and how those

things work today, how they worked in the past, and how they are likely to work in the future. Scientists are motivated by the thrill of seeing or figuring out something that no one has before. The knowledge generated by science is powerful and reliable. It can be used to develop new technologies, treat diseases, and deal with many other sorts of problems. Science is continually refining and expanding our knowledge of the universe, and as it does, it leads to new questions for future investigation. Science will never be "finished." Science is a global human endeavor**.** People all over the world participate in the process of science (Understanding Science, 2012).

Science occupies a very important place not only with life of an individual but in the existence of the society as well. This important place of science in the human society has affected different aspects of man's life. The modern developments in the society are the contributions of science and technology. The world is increasingly becoming small today with the scientific and technological advancements. Actions in one part of the world exert powerful influences on other parts of the world. There is more engagement of communities and individuals from different parts of the world. This growth in science and technology is providing challenges and opportunities for people in science education. Science Education today must enable students to meet the challenges ahead and demands of the work environment and of daily living. It should prepare them for advanced studies and for their occupations and careers, and also help students recognize the importance, usefulness, and value of science in their personal lives.

The general aims of science education follow directly from the six criteria of validity: cognitive, content, process, historical, environmental and ethical. To summarize, science education should enable the learner to (NCF, 2005):

- know the facts and principles of science and its applications, consistent with the stage of cognitive development,
- acquire the skills and understand the methods and processes that lead to generation and validation of scientific knowledge,
- develop a historical and developmental perspective of science and to enable her to view science as a social enterprise,

- relate to the environment (natural environment, artifacts and people), local as well as global, and appreciate the issues at the interface of science, technology and society,
- acquire the requisite theoretical knowledge and practical technological skills to enter the world of work,
- nurture the natural curiosity, aesthetic sense and creativity in science and technology,
- imbibe the values of honesty, integrity, cooperation, concern for life and preservation of environment, and
- cultivate 'scientific temper'- objectivity, critical thinking and freedom from fear and prejudice.

What is needed today is a new wave of educated students ready for modern scientific research, teaching and technological development. With students of diverse abilities and differing rates of learning in our classrooms, therefore, it is essential for the teacher to have the knowledge of how students learn science and how best to teach. The kind of activities provided in the classroom by the teacher should enable the students to understand the nature of science and scientific enterprise. Teachers must embrace the view that effective teaching means constantly being aware of and attending to students' struggles to learn science and continually adjusting their teaching strategies and techniques to help students work through difficulties. The students must be well equipped with all the knowledge about new scientific research and technological development and for all this a deep scientific understanding is needed. Deep understanding in science goes well beyond memorization of isolated facts and concepts. Effective science teachers use these techniques to promote deep scientific understanding (Staver, 2007):

- To determine if tasks are problems or exercises for students, ask all students if they have a good-to-excellent idea or little-to-no idea on how to do specific tasks.
- Organize cooperative student groups that reflect intellectual, gender, and cultural diversity; have members of the group share and discuss their representations of the gap and proposed solution strategies.
- Use guided-inquiry teaching strategies that lead learners to continue developing and modifying their knowledge.

- ★ Aim problem-solving instruction slightly beyond what students can do alone but within the boundaries of what they can do with assistance from others.
- ★ Use science concepts and processes as contexts for students to write persuasive essays, engage in oral discussions, connect data with scientific theories, and solve problems requiring mathematical reasoning.
- ★ Design discussions and negotiations among students as on-going learning experiences.
- ★ Provide opportunities for students to claim ownership of their learning.

Lemke (1990) found that the traditional classroom teaching pattern tends to engage only a few students, and he asserted that the one change in science teaching that should do more than any other to improve students' ability to use the language of science is to give them more practice actually using it. This view has been reinforced by the social constructivist perspective that we construct meanings within specific verbal interactions within groups of people; and as we participate in such environments we become full members of such groups. According to Sherman (1994), the investigative nature of science provides a unique setting for group work particularly cooperative learning to build its framework. Wong (2001) reports, that cooperative classrooms can effectively foster discussion, which is so essential for understanding in science as well as other subjects. The combining of cooperative learning with science is seen as a natural union for many experienced science teachers who have worked extensively with small groups. When cooperative learning is properly implemented, it provides a vehicle for student teams to share materials and equipment as well as ideas. Shukla (India Science Report, 2005) indicates that, in India, science education needs to be strengthened in terms of methods of teaching, teacher quality and infrastructure. This observation has been found valid for all regions of the country. The National Curriculum Framework (2005) also emphasizes that rote learning be discouraged in science and group work be promoted. It says that at upper primary level, apart from simple experiments and hands on experiences, an important pedagogic practice at this stage is to engage the students (in groups) in meaningful investigations- particularly of the problems they perceive to be significant and important. This maybe done through discussions in the class with the

teacher, peer interactions, gathering information from newspapers, talking to knowledgeable persons in the neighbourhood, collecting data from easily available sources and carrying out simple investigations in the design of which the students have a major role to play. Thus science teachers should give more emphasis on students' understandings of a particular concept, guiding students in active learning, providing opportunities for discussion and elaboration and encouraging them to work with peers and teachers and this is what cooperative learning does. An often-heard query about cooperative learning is the following: "But, if I succeeded in a predominantly competitive or individualistic learning environment, why should I change my instructional practice to include cooperative learning strategies?" However, the National Science Education Standards (1996) emphasize that access to a rigorous science education must be available for all students, not just those who gravitate to the field or consider themselves "science types." And for this cooperative learning is apt.

It can be therefore seen from the above discussions that CL is an effective teaching strategy which helps in both academic and social gains and that the nature of science is such that it provides ample scope for implementing CL. Along with enhancing academic achievement, CL helps in all round development of the child which is the need of the hour. The present study was taken up in this context to find out the effectiveness of CL in teaching science and to find out how CL helps in developing the five essential elements like positive interdependence, face to face interaction, individual accountability, appropriate use of collaborative skills and group processing.

1.13 RATIONALE OF THE STUDY

The past twenty years have seen a tremendous increase in the use of peer directed small group work to give students opportunity to learn from each other. Among the various group strategies, cooperative learning has been cited as an effective one. According to Uscher (1986), cooperative learning breaks down stereotypes and leads to an increase in self-esteem. Sharan & Sharan (1987) report that it builds cooperative skills, such as, communication, interaction, cooperative planning, sharing of ideas, decision making, listening, taking turns and exchanging and synthesizing ideas. Lyeman & Foyle (1988) call it a method of promoting academic achievement that is not expensive to implement.

Mergendollar & Packer (1989) say that cooperative learning promotes active learning- students learn more when they talk and work together than when they listen passively. It motivates, leads to academic gains, fosters respect for diversity and advances language skills. Cooperative learning has been proved to be effective in all subject areas and science is no exception. Science enables pupils to be involved in group work where they have the opportunity to share ideas and cooperate with each other in collaborative practical activity. According to Rutherford & Ahlgren (1990), "The collaborative nature of scientific and technological work should be strongly reinforced by frequent group activity in the classroom. Scientists and engineers work mostly in groups and less often as isolated investigators. Similarly, students should gain experience sharing responsibility for learning with each other. In the process of coming to common understandings, students in a group must frequently inform each other about procedures and meanings, argue over findings and assess how the task is progressing. In the context of team responsibility, feedback and communication become more realistic and of a character very different from the usual individualistic textbook- homework- recitation approach." Dickens (2005) says that to model real science in the making, instructional activities and situations should engage students in more student-to-student discussion of scientific ideas and more cooperative group work. There have been many studies conducted abroad on the effect of cooperative learning in science and almost all have found cooperative learning to have a positive impact on science learning. But in spite of this, not many studies have been conducted on cooperative learning in India. Even if National Curriculum Framework (2005) has stressed on group activities and discussion with peers and teachers to be made important components in science pedagogy, cooperative learning has still not become a common instructional technique in science in our country. This might be because teachers don't have proper awareness regarding cooperative learning and its implementation in classroom. According to Umasree (1999), students are rarely given opportunities to do things or take the initiative in classes. The student participation is limited only to seeking clarification on their teaching points. Lecture method is used in seventy percent of the cases observed. Similar findings were also reported by Ramkumar (2003). So this calls for research to be done on these aspects. The findings of such studies

can help teachers to make a move from the traditional methods of teaching and use cooperative learning more frequently and easily.

According to the National Curriculum Framework (2005) " the period of elementary school is now recognized as the period of compulsory schooling vide the constitutional amendment making education a fundamental right. The beginning of this period marks the formal introduction of the child to reading, writing and arithmetic, culminating in the introduction of the formal disciplines such as the sciences and the social sciences towards the end of elementary school. This period of eight years is one of tremendous cognitive development, shaping reason, intellect and social skills, as well as the skills and attitudes necessary for entering the work place. As the effort to achieve Universalisation of Elementary Education (UEE) is stepped up, the elementary school classes now cater to many children of school-going age coming from diverse backgrounds. Plurality and flexibility without compromising standards need to become the hallmark of education for the period". For some children primary education will be the only education they receive. So it becomes essential that students are taught effectively and efficiently in order to help them face the challenges and demands of work environment and daily living ahead. Even for students pursuing higher education the quality of primary education plays a very major role. So teachers need to change their way of teaching from traditional methods to a more student centered approach. This will help both the bright as well as weak students equally. Here cooperative learning will be of great help. According to Noddings (1985), peer maybe more effective explainers than adults because peers share a similar language, and they can translate difficult vocabulary into language that fellow students can understand. Using cooperative learning will help all students learn the concepts of science easily. The present study was conducted on seventh standard students, Kerala. It is in seventh that most of the important concepts of science get introduced. If only they develop a strong knowledge base of the subjects in the early stage can they build on it at higher level. Also in Kerala, the seventh standard books were revised in 2001 as a part of the ongoing curriculum and textbook revision. The child centered, activity based and enjoyable learning methods that characterize the new curriculum provides the basis for these textbooks. Thus the content of these textbooks provide ample scope for group work. But, in spite of all the efforts in terms of curriculum and textbook revision, science

education in Kerala still has a far way to go. George & Kumar (1999) states, that the pedagogic practices followed by the State's educational system are equally outmoded. They do not take into account either the social or physical realities of Kerala. They are entirely teacher oriented and non participatory. They encourage only rote learning. According to the Kerala Curriculum Framework (2007), science teaching in Kerala is examination oriented and not learner centered. Encouragement is given to rote learning and not to learners' curiosity and interest in investigations. Scientific attitude is also not being developed. In today's science classes, individual and competitive learning is given more importance. Thus the curriculum framework stresses for a change in this present system and emphasizes the importance of cooperative learning in science teaching. It states that cooperative learning is an effective strategy for science teaching and should be used in classes by teachers. It further goes on to point out the advantages of using cooperative learning viz.

(1) it makes teaching-learning process learner centered,
(2) each child gets individual attention,
(3) it enhances creative thinking, problem solving abilities, reasoning power and communication skills,
(4) it helps the weak as well as bright students equally and
(5) finally, it helps them to respect and accept other people and their views too.

So, as an education community committed to the success of our students, it is our duty to work out on these areas and come up with possible solutions to help them.

Also, in the present study only six cooperative learning techniques were used out of the many mentioned. They are Jigsaw, STAD, Group Investigation, TGT, Round Robin brainstorming and Think-Pair-Share. From review of literature it can be seen that STAD, TGT, Jigsaw and Group Investigation have been very successfully used in teaching science. According to Jolliffee (2007), round robin brainstorming and think-pair-share are two simple and easy techniques which are widely recommended for implementing in the introduction and conclusion part. Also the investigator found these techniques more simple and easy. An important point is that, implementing cooperative learning successfully does not require adopting every technique. In fact, trying to do so all at once might be a serious mistake: the instructor would have to juggle many unfamiliar

techniques and end by doing none of them well, and the students would be deluged by an array of unfamiliar demands and many might rise up in rebellion. According to Felder & Brent (2007), instructors new to cooperative learning should take a more gradual approach, choosing mainly the methods with which they feel most comfortable and adopting additional methods only when they have had time to get used to the current ones. If they do that, they will never stray too far from their comfort zones and will become increasingly adept at defusing student resistance long enough for the students to see the benefits of this new form of instruction for themselves. Thus, the present study was taken up keeping in mind all the above things.

1.14 STATEMENT OF THE PROBLEM

The study is titled as "A Study on the Effectiveness of a Strategy based on Cooperative Learning for Science Teaching in Class VII".

1.15 OBJECTIVES OF THE STUDY

1) To develop a strategy based on cooperative learning for teaching of science in class VII.
2) To study the effectiveness of the strategy based on cooperative learning in science for class VII students in terms of:-
   (a) their academic achievement
   (b) gender
   (c) units of science
   (d) the five essential elements of cooperative learning, that is, Positive Interdependence, Face-to-face promotive interaction, Individual Accountability, Collaborative skills which is further subdivided into leadership skills, communication skills, trust building skills, decision making skills and skills of resolving conflicts, and group processing.
3) To study the reaction of students to the strategy based on cooperative learning in science.

1.16 HYPOTHESIS OF THE STUDY

1) There will be no significant difference between mean scores of achievement of the students who studied through cooperative learning strategy and that with conventional method.
2) There will be no significant difference between mean scores of achievement of experimental group students with respect to
   (a) Gender
   (b) Units of science
3) There will be no significant difference in positive interdependence of students before and after implementation of cooperative learning.
4) There will be no significant difference in face to face promotive interaction of students before and after implementation of cooperative learning.
5) There will be no significant difference in individual accountability of students before and after implementation of cooperative learning.
6) There will be no significant difference in the collaborative skill of leadership of students before and after implementation of cooperative learning.
7) There will be no significant difference in the collaborative skill of communication of students before and after implementation of cooperative learning.
8) There will be no significant difference in the collaborative skill of trust building of students before and after implementation of cooperative learning.
9) There will be no significant difference in the collaborative skill of decision making of students before and after implementation of cooperative learning.
10) There will be no significant difference in the collaborative skill of resolving conflicts of students before and after implementation of cooperative learning.
11) There will be no significant difference in group processing of students before and after implementation of cooperative learning.

1.17 EXPLANATION OF THE TERMS

1.17.1 STRATEGY BASED ON COOPERATIVE LEARNING

Strategy is a means or the tool by which objectives are consciously and systematically pursued and obtained over time. In teaching it describes the process designed explicitly and systematically to ensure that the learners acquire the terminal behaviors and achieve the instructional objectives. The present study used a strategy based on cooperative learning in which small teams, each with students of different levels of ability, use a variety of learning activities to improve their understanding of a subject. The strategy took care of the five essential elements of cooperative learning like positive interdependence, individual accountability, face-to-face promotive interaction, appropriate use of collaborative skills and group processing and the techniques of cooperative learning like Jigsaw, STAD, TGT, Group Investigation, Round Robin Brainstorming and Think-Pair-Share. And the same was linked with identified content areas of class VII science and accordingly lesson plans designed.

1.17.2 UNITS OF SCIENCE

Units of science refer to the five chapters of science included in the study. They are Green cover, Water to be conserved, When Heat acts, The World of Sound and Let us grow together.

1.18 OPERATIONALISATION OF THE TERMS

1.18.1 ACHIEVEMENT

Achievement in the present study was measured by administering a test constructed by the investigator on selected units of class VII science.

1.18.2 EFFECTIVENESS

Effectiveness in the present study was measured on performance of tests and assessment of the five essential elements of cooperative learning.

1.19 DELIMITATIONS OF THE STUDY

The study wass delimited to:

1) English medium Upper Primary Schools

2) Five Units of Class VII Science

The concept of Cooperative learning and how it can be used in science teaching, statement of the problem, need and significance of the study, objectives and hypotheses, operational definitions of the terms and delimitations of the study are described in the present chapter. The succeeding chapter gives a detailed review of literature related to the present study.

Chapter 2
Review of Related Literature

CHAPTER 2

REVIEW OF RELATED LITERATURE

2.0 INTRODUCTION

Research takes the advantage of the knowledge which has accumulated in the past as a result of constant human endeavor. It can never be undertaken in isolation of the work that has already been done on problems which are directly or indirectly related to a study proposed by a researcher. A careful review of the research journals, books, dissertations, theses and other sources of information on the problem to be investigated is one of the important steps in the planning of any research study.

The review of related literature helps the researcher to delimit and define his problem. It brings the researcher up-to-date on the work which others have done and thus to state objectives clearly and concisely. It helps the researcher avoid unintentional duplication of well established findings. It gives an understanding of the research methodology which refers to the way the study is to be conducted. It helps to know about the tools and instruments to be used and also provides insight into statistical methods through which validity of results is to be established. The final and important specific reason for reviewing related literature is to know about the recommendations of previous researchers for further research which they have listed in their studies.

A perusal of related literature reveals that from a long time researchers have been trying to work on effective teaching strategies in classrooms. Programmed learning material (PLM) was the first of its kind to be tried on. Studies in PLM started in 1960's. Studies were done abroad as well as in India and it was found that PLM improved pupil performance. Studies by Alter (1962), Doty & Doty (1964), Sansanwal (1976) & Parlikar (1978) are a few among them. Then gradually there was a shift from PLM to audio visual aids and multimedia strategies. Machula (1976) carried out an experiment to determine effects of audio tape, video tape and print on learning. Sadam (1983) studied effects of modern education technology on mathematics performance of elementary students in Saudi Arabia. Walker (1977) and Johnson et al., (1982) conducted studies on influence of ETV on classroom learning. It was found in all these studies that audio visual aids had a

positive effect on classroom learning. Similar results were obtained in India also in studies conducted by Vibha (1987), Joshi (1991) and Karandikar (1996). Some studies were taken up to develop multimedia instructional strategies by Ravindranath (1982), Vardhini (1983) and Menon (1984). It was seen that these strategies had a positive impact on learning. With the advent of 90's computer based instruction (CAI/CAL) gained popularity. Many studies have been conducted in this area abroad as well as in India. It was found that computer based instructions help improve performance at all stages in various subjects. Studies by Koltz (1980), Bobbert (1983), Raghavan & Dharmaraja (1991) and Khirwadkar (1998) are a few among them.

2.1 CL AND ACADEMIC ACHIEVEMENT

On one side as studies were being conducted on how to make teaching- learning process effective by using multiple media and computers, it was being realized by some other researchers abroad that for making teaching- learning process effective student centered group activities are also needed. They felt that peer directed small group work give students an opportunity to learn from each other. Thus cooperative learning came into focus. Johnson et al. (1987) conducted a Meta analysis of 122 studies of cooperative learning done between 1924 and 1981. It was found that cooperative learning tends to promote higher achievement than does competition or individual work, with this finding holding for all age levels, all subject areas, and a variety of tasks. Slavin (1991) identified seventy studies that evaluated various cooperative learning methods for periods of four week or longer. Here also it was reported that cooperative learning was found to be effective at all grade levels in the same degree, in all major subjects and in urban, rural and suburban schools. Effects were equally positive for high, average and low achievers.

2.1.1 CL IN MATHEMATICS

Sherman & Thomas (1986) reported CL to have significant effects favoring experimental group after conducting a study on grade ten students in Ohio for five weeks using the STAD method. Dees (1991) found CL to be helpful in a college remedial mathematics course in Chicago. It was seen that CL helped increase students' problem solving abilities in mathematics. A study by Whicker, Bol & Nunnery (1997) indicated favorable

responses towards the CL procedure in a secondary mathematics classroom. Most students expressed that they liked working in groups and appreciated getting help from other students, especially for learning difficult concepts. The quasi experimental design was used for the study and data was analyzed using Multivariate analysis of variance (MANOVA). Eam (1999) conducted a study using TGT and STAD as a model. It was found that students who were taught with a cooperative structure outperformed the students in individualistic goal structure in mathematics problem solving. This finding goes along with that of Brecht (2000) who studied the effects of CL on mathematics achievement and problem solving. Zainun (2001), Mazlan (2002), Vaughan (2002) and Mehra & Thakur (2008) examined the effect of CL using STAD as a model. Results indicated a positive attitude towards mathematics. Most students also had positive perception towards STAD. The findings of Vaughan (2002) also revealed positive gains in mathematics for fifth grade students in Bermuda. The single group pretest-posttest design was used and data was analyzed using ANOVA. The study by Mehra & Thakur (2008) on attitude of seventh graders towards cooperative learning in mathematics revealed that students showed favorable responses towards CL. Students indicated that they were highly benefited from CL, appreciated getting help from each other, discussing and sharing ideas, stressed for learning all kinds of topics by this method and favored alternate group membership. This study was done in India. Likhia (2008-‘09) also conducted a study in India using STAD on ninth grade students. Results showed significant improvement in learning awareness and achievement in the experimental group. Cline (2007) studied the impact of Kagan CL structures on fifth graders mathematical achievement. The pretest- posttest quasi experimental design was used and data analysis was done using t- test for two independent samples. A significant difference in the mathematical achievement of students who participated in Kagan CL structures was found when compared to mathematical achievement of students who did not participate in Kagan structures. The findings of Tarim & Akdeniz (2008), Conrig (2009) and Pandya (2010) also add weight to literature on effectiveness of CL on mathematics achievement. Tarim & Akdeniz (2008) conducted experimental study on fourth grade students’ academic achievement in and attitudes towards mathematics in Turkey. STAD and Team Assisted Individualization (TAI) methods were used and 3X 1 Covariance

Analysis was used for data analysis. Though positive effects were found on students' achievement no significant difference was observed in students' attitudes towards mathematics. Conrig (2009) examined the effects of STAD method on second grade students using the quasi experimental pretest-posttest control group design. Data analysis was done using t – test for two independent samples. The study by Pandya (2010) was conducted on eighth standard students in India. The CL model was found to be more effective for students with moderate and low IQ as well as students with an extrovert personality. Also it was found to be equally effective for boys as well as girls. The study used the quasi experimental design and data was analyzed using t-test and two way ANOVA. Studies by Edward & DeVries (1972), Moskowitz et al., (1985) and Gilbert (2008), however, contradict the above findings. Edward & Devries (1972) carried out a study on grade seven students in Baltimore using TGT for four weeks and no significant difference was found. Moskowitz et al., (1985) found significant effect favoring control group while teaching mathematics to grade five students in California using Jigsaw for a duration of thirty weeks. Similarly Gilbert (2008) examined the effects of CL to that of non CL in elementary mathematics for six weeks. The repeated measures comparison between control and experimental group study design was used and data was analysed using ANOVA with repeated measures. It was found that CL does not have a significant impact on academic success.

2.1.2 CL IN LANGUAGE ARTS AND ENGLISH

In 1975, DeVries & Mescon found CL (TGT model) to be effective for grade three students in New York while teaching language arts for a period of six weeks. This was supported by the findings of Hawkins et al., (1988) and Renegar & Haertling (1993). Hawkins et al. (1988) found CL to be effective for grade seven students in Seattle who were taught for one year using TGT and STAD in language arts, mathematics and social science. Renegar & Haertling (1993) implemented CL in seventh grade literature groups in Missouri and found it to be an appropriate tool that can be used in literature projects. Bibi (2002) studied the comparative effectiveness of teaching English grammar with the help of textbook and by using group work activities. The study also attempted to see which of these two methods had a positive effect on the academic achievement of the

elementary and secondary school students in Pakistan. It was found that the teaching of English grammar through group work activities (inductive approach) played a positive role in improving the academic achievement of the students studying English at the elementary as well as the secondary stage. The students of the experimental groups at both the given stages had positive attitude towards the group work activities. Similar findings were reported by Liao (2005) and Wang (2006). According to Liao (2005), CL was found to have large positive effects on motivation and strategy use and medium-to-large positive effects on grammar achievement and it also positively affected learning at higher cognitive levels. The quasi experimental pretest- posttest comparison group research study was used. MANCOVA, one way and two way ANCOVA and Pearson Correlation was used for data analysis. Findings of Wang (2006) indicated that students learning cooperatively had higher final course grades and had more positive attitudes about the English learning mechanism they experienced through Jigsaw than those who learned through traditional Chinese methods. The quasi experimental and descriptive methods were used. In spite of all the positive findings there are also studies that contradict these findings. Slavin (1979) found no significant difference in achievement of students taught using STAD and regular classroom instruction for grades seven and eight in language arts in spite for teaching for twelve weeks. Yang (2007) also reported that CL was not more effective in improving Taiwanese college students' oral performance and increasing their motivation towards learning oral English as compared to traditional teaching methods. The quasi experimental design was used and data analyzed using one way ANCOVA.

2.1.3 CL IN SOCIAL SCIENCE

Allen & Van Sickle (1984) conducted a study on grade nine students in Geography for six weeks using STAD. CL was found to have a significant effect on the achievement of students compared to individualistic classroom learning. The result was supported by the findings of Sharan & Shachar (1988) and Mattingly & Van Sickle (1991). In the former study it was reported that CL was found to be effective in Geography and History achievement of grade eight students in Israel. Group Investigation technique was used for eighteen weeks. In the latter study students of grade nine were taught Geography using

Jigsaw for nine weeks and it was found to be effective. Layne et al., (2008) worked on Academic Achievement, Pupil Participation and Integration of Group Work Skills in Secondary School Classrooms in Trinidad and Barbados. Over the period studied, virtually all pupils improved their social studies attainment; especially the lowest achieving pupils. These findings were however contradicted by the findings of some other studies. Rich, Amir & Slavin (1986) conducted a study on grade seven students in Israel. Students were taught History and literature using Jigsaw for twelve weeks. Results showed significant effect favoring control group. Similar results were also reported by Phelps (1990) and Abu & Flowers (1997). Phelps (1990) used Jigsaw II for teaching grade eight students US History for a period of nine weeks. Abu & Flowers (1997) determined the effects of the CL approach of STAD on the achievement of content knowledge, retention and attitudes, of home economics students in North Carolina, towards the teaching method. CL was not found to be more effective than non cooperative learning.

2.1.4 CL AND SOME OTHER SUBJECT AREAS

Finally studies were also spotted on the effects of CL on some other academic areas. Singhanayok & Hooper (1998) investigated the effects of studying alone or in CL groups on the performance of high and low achievers of sixth grade students in Ecology, using either learner or programme controlled computer based instruction. Both high and low achievers in the cooperative treatment performed better and had more positive attitudes toward grouping than did students working individually, on both programme controlled and learner controlled computer lessons. MANOVA was used for data analysis. Veenman et al., (2002) studied the implementation effects of a course on CL for student teachers in Netherlands. The majority of the student teachers subscribed to CL to achieve both academic and social goals and also showed a readiness to use CL methods in their future lessons. The pupils taught by the treatment student teachers also showed positive attitudes towards working in groups and rated the benefits of working in groups relative to working alone quite positively. Hancock (2004) investigated the effects of graduate students' peer orientation on achievement and motivation to learn with CL strategies while enrolled in a first semester educational research methods course. Differences in the

achievement of students with high and low peer orientation were not statistically significant. However students with high peer orientation were significantly more motivated to learn than were students with low peer orientation. A study by Smith (2005) revealed that using CL coupled with Accelerated Reader Program did in fact increase level one high school students reading achievement on the Florida Comprehensive Assessment Test. Similarly CL was found to have a positive impact on vocabulary and fluency achievement scores of male fourth and fifth grade students in a study by Alhaidari (2006) in a Saudi Arabian School. Law (2008) conducted two studies to investigate the effects of CL on second graders' motivation and learning from text in Hong Kong. The pretest- posttest control group design (quasi experimental design) was used. Results showed that students' positive cooperative behaviour and attitudes were related to their motivation and reading comprehension and they tended to be more motivated and performed better in reading comprehension. Rai & Rout (2008) have reported the results of a two year study of the cooperative elementary school model using cooperation as an over aching philosophy to change school and classroom organization and instructional processes in Delhi. It was seen that after two years academically disabled students in cooperative elementary schools had significantly higher achievement in reading vocabulary, reading comprehension, language expression, math computation and math application in comparison with similar students in comparison schools. There also were better social relations in cooperative elementary schools and disabled students were more accepted socially by their non disabled peers than similar students in traditional schools. Findings by Lybeck & Jean (2001) however contradict the above findings of CL being effective. This multi institutional study of medical technology students indicated that CL and individual learning produce similar achievement and attitudinal results.

2.1.5 CL IN SCIENCE

With the effectiveness of CL being proved in various disciplines researchers started studying on CL in science. Humphreys, Johnson & Johnson (1982) conducted a study on grade nine students using the Learning Together model with individual accountability. Students were taught physical science for six weeks. CL was found to have a significant

effect on physical science achievement of students. Similar results were obtained by Okebukola (1985) and Okebukola (1986a) using the STAD, TGT, Jigsaw and Learning Together models of CL in teaching science for grade eight and grade seven students. Okebukola (1986b) investigated effect of cooperative work on students' attitudes towards science laboratory in ninth grade. Results indicated that students in experimental treatment held significantly more favorable attitudes towards laboratory work than did students in the control group. Newmann & Thompson (1987) reviewed twenty seven reports of high quality research on cooperative learning at secondary level. These studies involved cooperative learning techniques like Jigsaw, STAD, TGT, Learning together and group Investigation. Science was the subject in most of the studies. Cooperative learning was favored by majority of them. Conwell et al., (1988) interviewed twenty eight students who worked in cooperative learning groups in intermediate science classrooms in an urban system. The researchers reported that students perceived science achievement positively. Nearly two third rated their level of self- esteem as high. Kinney (1989) studied the effects of cooperative learning on achievement of ninth grade students in a multicultural general biology class. All students in experimental group had a significant increase on chapter test scores. There were however few other studies which indicated results contradicting those above. Johnson et al., (1985) found no significant difference in science achievement of fifth and sixth grade students taught using CL and using individualistic learning. Similarly Lazarowitz et al., (1985) also reported the same for tenth and twelfth grade students taught Biology using Jigsaw. Significant effects favoring control group were revealed in studies by Okebukola (1984), Sherman & Zimmerman (1986) and Sherman (1988). Okebukola (1984) studied the effect of Learning Together model of CL lacking individual accountability on grade nine students. Students were taught Biology for eleven weeks and results favored the control group. Similar results were also found by Sherman & Zimmerman (1986) and by Sherman (1988) while teaching Biology using Group Investigation method. The former study was on grade ten students and the latter on high school students and both were held for a period of seven weeks.

Jones (1990) worked on teachers and students in grades three, four and five in two rural elementary schools to compare the effectiveness of cooperative learning (versus

traditional work of pairs of pupils) in moving students through misconceptions about temperature. It was seen that cooperative learning did result in changes in students' misconcepts of temperature. Similar results were also obtained by Basili & Sanford (1991) in community college chemistry classes. Lazarowitz (1991) reported a study using Jigsaw method and group investigation to teach ninth grade general biology students. On the post test the experimental group scored significantly higher on all comparisons. Scott & Heller (1991) advocate the use of group work in science to encourage female and minority students. They advocate the use of Jigsaw method for reinforcing different reading material and preparing research projects and demonstrations. Rahaya (1998) conducted a study using STAD/Jigsaw as a model which involved 1180 students from eighteen schools. It was also found that cooperative learning can enhance scientific skills, promote enquiry learning and increase science achievement. Fortner (1999) also has suggested the Jigsaw method to have been successfully used to introduce students to the research literature of biology and provide peer support in understanding the complexities of language in written scientific communications. After teaching organic chemistry for ten years using non interactive lectures, Paulson (1999) switched to active learning and cooperative learning techniques. He found that the average number of students passing the three-quarter organic chemistry sequence doubled.

Agashe (2000) studied the effect of group investigation technique in cooperative learning to teach two topics in science to students of grade VIII in India. It was found that this technique of learning was effective, enjoyable and interesting for students. It had a positive impact on their achievement. Similarly Kalaiyarasan & Krishnaraj (2002) studied the effectiveness of CL approaches in learning science at secondary level in India. STAD and Group Investigation approaches were used and it was found that CL enhanced academic achievement of learners than traditional approach. A review of eight studies that investigated children's academic achievement and social behaviour in CL from grades five to eleven across seven subject areas was done by Shachar (2003). It was seen that students in CL derived maximum benefits which include academic and social gains. The academic gains were found across the curriculum in English, Science, Mathematical reasoning and information processing, Chemistry and Social Studies in elementary and high school students. In another study by Gupta (2004) in Australia, students of physical

science course were introduced to CL. Results suggested that CL was very well received by students and they expressed willingness to join CL groups in other courses. In addition, CL offered many benefits to students in terms of graduate attributes such as team work, communication, lifelong learning and problem solving. Bilgin & Geban (2006) investigated the effects of CL approach based on conceptual change conditions over traditional instruction on tenth grade students' conceptual understanding and achievement of computational problems related to chemical equilibrium concepts. Data was analyzed using MANCOVA. Results showed that students in the experimental group had better conceptual understanding and achievement of computational problems related to the chemical equilibrium concepts. Similarly Baines et al., (2006) investigated the impact of collaborative group work on pupils' science learning. The researchers found that the teachers' involvement in the group work programme had a positive effect in terms of pupils' measured progress in science. They also found that group work could be used by teachers in other disciplines to develop reasoning and problem solving skills and enhance learning and achievement. In India, Pandey & Joshi (2009) conducted a comparative study of effectiveness of CL, programmed instruction and traditional method on science achievement of eighth standard students. The non randomized control group pretest-posttest design was used and data was analyzed using ANCOVA. Results revealed that CL group is not significantly different from programmed instruction but CL and programmed instruction groups are significantly more effective than the groups taught by the traditional method as much as achievement in science is concerned. To add strong support to the above findings Romero (2009) conducted a systematic review of two thousand five hundred and six published and unpublished citations identified in a literature search on science outcomes associated with CL in secondary and early post secondary science classrooms between 1995 and 2007. Results of review indicated that CL improves student achievement in science. Results of a study by Wachanga, Kokero & Mbugua (2010) also showed that there was a statistically significant difference between achievement means of secondary school students in Kenya who were taught using cooperative project based model and those taught through regular teaching methods. It indicated that cooperative method facilitates the students' achievement in Chemistry than regular teaching methods. The quasi experimental design was used for the study and data

was analyzed using ANOVA, ANCOVA and t-test at $\alpha = 0.05$. When all the above studies indicated effectiveness of CL in science one study was such that it reported the follow up of effectiveness of CL in science from primary to high school. Thurston et al., (2010) conducted this two year longitudinal study of the effects of CL on science attainment, attitudes towards science and social connectedness during transition from primary to high school. A previous project on CL in primary schools observed gains in science understanding and in social aspects of school life. This project followed two hundred and four children involved in the previous project and four hundred and forty comparison children who were not as they undertook transition from twenty four primary schools to sixteen high schools. Cognitive, affective and social gains observed in the original project survived transition. Data presented in this research indicate that using CL strategies in science may allow transfer of knowledge and skills acquired to new contexts. Prior learning undertaken during the previous project in the science topic of forces was still evident and appeared stable after transition to high schools. Follow up pupils were advantaged in respect of their knowledge in this topic and also reported more positive attitudes towards science than comparator pupils. According to a study by Kishore (2012), in India, STAD and Learning Together techniques were found to be equally effective in terms of science achievement at secondary level. The quasi experimental design was used and data was analysed using ANCOVA.

In spite of all these research findings we can see that in our country there is a dearth of such studies related to cooperative learning and science. Going through the educational surveys will make this clearer and give the present scenario of research in science education. According to the fourth educational survey, in studies on science teaching, Sharma (1978) found guided activity, Sivadasan (1981) found science kits and the tutorial system, Hopper (1982) found modular approach, Adinarayan (1984) found instructional packages, Desai (1986) and Kalacherry (1987) found programmed learning, Sushma (1987) found concept attainment model in biology and Pillai (1987) found Gagner's conditions of learning more effective than the traditional methods of teaching science. Dighal (1985) discovered that two or three methods when combined gave better results than anyone in isolation. Basu (1981), Ravindranath (1982), Vardhini (1983), Desai (1985), Joshi (1987) and Lambhate (1987) developed instructional strategies for

science teaching and found them effective. So here there were no studies on group strategies.

In the fifth survey we can see that only very few studies were done on science learning and science teaching. Aziz (1990) examined the effectiveness of information processing models in acquiring chemical concepts. Raghavan (1991) stressed the importance of concept mapping in learning physical science. Goel & Agbebi (1990) reported that the acquisition of psychomotor skills favored the group which followed individual laboratory method rather than the lecture demonstration method. Shishta (1990) found that the treatment/ intervention compressing the blended strategies of different modes of teaching given to the experimental group brought about significant differences in achievement in biology in comparison to the control group.

Coming to the sixth educational survey only eighteen percent of the research in science education is on science teaching. The use of various strategies in teaching science to benefit learning was the subjects of only some studies. Banerjee (1997) compared the effect of lecture and cooperative learning strategies on achievement in chemistry in undergraduate students. Peer tutoring was a strategy reported on, by Gyanani & Pahiya (1996). It proved to be effective. Reddy & Ramar (1997) focused on slow learners and use of multimedia instructional strategy in teaching science to slow learners. Here we can see that only very few studies have been done in the field of science education particularly in science teaching. More research is needed on varied teaching strategies that can be used in effective science teaching. This call for more serious research in science teaching has led to the present study.

2.2 CL AND OUTCOMES OTHER THAN ACADEMIC ACHIEVEMENT

CL is not only an instructional technique for increasing student achievement; it is also a way of creating a happy pro-social environment in the classroom, one that has important benefits for a wide array of affective and interpersonal outcomes. CL as we know increases contact between students as they are engaged in activities together. This helps in building positive effects on relationships between students. Slavin (1978b) found positive effects of STAD on the number of friends named on a 'liking of others' questionnaire scale. In a combined study of STAD, TGT and Jigsaw II, Slavin & Karweit

(1981) found that the CL students named more friends than did control students, and they named fewer classmates as individuals with whom they would not like to work. A study of Jigsaw II by Phelps (1990) found significantly more positive friendship choices and fewer negative choices than in a control group. The evidence linking CL (STAD) to gains in cross-racial friendships is also strong. In two studies Slavin (1977, 1979) found that students who had experienced STAD for ten to twelve weeks gained more in cross-racial friendships than did control students. Cooper et al., (1980) found greater friendship across racial lines in a cooperative treatment than in an individualized method in which students were not permitted to interact.

Usually students who are of normal intelligence but not performing upto grade-level expectations are seen to be less well accepted by others in class. Same is the case in mainstreamed educable mentally retarded students (Bruininks, Rynders & Gross, 1974). If mainstreaming thus has to fulfill its potential to socially integrate handicapped children something more than the usual instructional methods is needed and according to Slavin & Stevens (1991), CL is an obvious solution for the same. Cooper et al., (1980) found significantly more friendship choices of academically or emotionally handicapped students in a cooperative condition than in an individualistic one. Ballard et al., (1977) studied the effects of cooperation in heterogeneous groups on acceptance of academically handicapped students of grades three to five. The results indicated that educable mentally retarded in experimental groups were better accepted by their classmates than were in control groups. Apart from effects on social acceptance according to Stevens & Durkin (1992) mainstreamed academically handicapped children achieve better in CL than in traditionally organized classes. Stevens & Slavin (1995) conducted a two year study to determine the long term effects of a comprehensive CL approach to elementary reading and language arts instruction on students' achievement, attitudes and Meta cognitive awareness. Academically non handicapped students showed significantly higher achievement in vocabulary, comprehension and language expression and exhibited greater Meta cognitive awareness than did their peers. Academically handicapped students who were mainstreamed had significantly higher achievement in reading vocabulary, reading comprehension and language expression than did comparable special education students taught in traditional settings. Shachar (2003) reviewed eight studies

that investigated children's academic achievement and social behaviour from grades five to eleven across seven subject areas- English, science, mathematical reasoning and information processing, chemistry and social studies- in elementary and high school students. It was found that although children from all three ability levels (high, medium, low) benefitted from CL, low ability children consistently emerged as those who derived maximum benefit from their CL experiences and these benefits included academic and social gains. Ryan, Reid & Epstein (2004) also found that CL experiences enhanced the development of positive social attitudes toward other group members in students with emotional and behavioral disorders.

An important factor that plays a crucial role in the success of an individual is self esteem. According to Slavin (1995), two of the most important components of students' self esteem are the feeling that they are well liked by their peers and the feeling that they are doing well academically. CL methods affect both of these components and thus CL could in fact increase students' self esteem. Students' beliefs that they are valuable and important individuals are of critical importance for their ability to withstand the disappointments of life, to be confident decision-makers, and ultimately to be happy and productive individuals. Blaney et al., (1977) found positive effects of CL on student self esteem. Jigsaw was used in the study. Madden & Slavin (1983) found significantly greater general self esteem in STAD than in control groups. Johnson & Johnson (1983) reported that cooperation increased students' general and school self esteem more than competition or individualization did, but they found no differences on peer self esteem. According to Uscher (1986), CL breaks down stereotypes and leads to an increase in self esteem. These results are supported by the findings of Kalaiyarasan & Krishnaraj (2004) and Tripathi (2004). It was seen that STAD and Group Investigation methods showed greater effectiveness than traditional method in enhancing self esteem of learners. Johnson et al., (1985) however found no differences in self esteem between cooperative and individual methods. It can be thus seen that though evidence concerning CL and self esteem is not completely consistent, CL can definitely influence self esteem and according to Slavin (1995) if CL methods are used over longer periods as a principal instructional methodology, genuine, lasting changes in students' self esteem might result.

In CL it can be seen that the cooperative incentives motivate students to try to get each other to do academic work making students feel that their classmates want them to do their best. Cooperative goals thus create peer norms that support high achievement. Deutsch (1949) found that college students who discussed human relations problems under cooperative conditions felt more pressure to achieve from their group mates, felt more of an obligation to their group mates, and had a stronger desire to win their group mates' respect than did students who worked under competitive instructions. These results indicate that in the cooperative groups, students wanted to achieve because their group mates wanted them to do so. Thomas (1957) found that individuals in cooperative groups exerted social pressures on one another to achieve. These interpersonal sanctions maintained behavior that helped the group to succeed.

Another widely assumed outcome of CL is that students will become more cooperative or altruistic. A study by Hertz-lazarowitz, Sharan & Steinberg (1980) showed that students who had experienced Group Investigation made more altruistic choices than did control students. It was seen that when students who had worked in cooperative groups were reassigned to new groups for an experimental task, they cooperated better and their groups had higher productivity than groups made from the control classes. Ryan & Wheeler (1977) found that students who had studied cooperatively made more cooperative and helpful decisions in a simulation game than did students who had studied competitively.

Finally another important outcome of CL to be seen is the ability to understand someone else's perspective. Bridgeman (1977) reported that students who had worked cooperatively using Jigsaw were better able to take the perspective of another person than were control students. A study by Battistich & Watson (2003) revealed CL experiences to enhance the development of positive social attitudes towards other group members. Kishore (2012) also found that social acceptability of students increased after undergoing CL. Apart from all the above mentioned outcomes, CL contributes to an enhanced sense of psychological health and well being as per the findings of Johnson & Johnson (2000). This is supported by the results revealed by Johnson, Johnson & Stanne's (2000) study that CL experiences are crucial to preventing and alleviating many of the social problems related to children, adolescents and young adults. Study by Ballantine & Larres (2009)

reported that the CL cohort perceived their learning experience to be significantly more effective at enhancing interpersonal and communication skills than that of the simple group learning cohort. This study provides evidence that CL is a more effective model for delivering interpersonal and communication skills than simple group learning, thereby creating a more successful interface between academic accounting and professional accountancy training.

From the above findings thus we can conclude that CL may enhance the kinds of pro-social behaviors that are needed in the present globalised society where the ability to get along with others is becoming more and more crucial thereby strengthening the need to promote CL as an instructional strategy in our educational institutions.

2.3 IMPLICATIONS FROM REVIEW

From review it can be seen that a total of ninety nine studies have been reviewed on CL. Of these two were meta analyses of studies and both reported CL to be effective for all age levels and for all subjects equally. Sixty nine studies were reviewed on CL and its effect on the academic achievement of students.

2.3.1 IMPLICATIONS FROM STUDIES ON CL AND ACADEMIC ACHIEVEMENT

- Seventeen studies were on CL and mathematics achievement. Few focused on attitude of students towards learning mathematics through CL. Of these fourteen studies supported the effectiveness of CL on mathematics achievement. Two studies reported no significant difference between CL and regular classroom teaching. One study however found significant effect favoring control group. Six studies reported that students had favorable responses and positive attitudes towards CL. It can be seen that studies were done at different age levels. Eight were done at elementary level, four at secondary level and one at college level. TGT, STAD and Jigsaw were the CL methods used in above studies except for one study which used Kagan CL structures. The quasi experimental design was used in four studies. One study used the single group pretest-posttest design. Data analysis techniques used were t- test for two independent samples in two studies, MANOVA in one study, 3X1 Covariance

analysis with two way ANOVA in one study and ANOVA in two studies. Thus we can see that studies have been done mostly at elementary level. Quasi experimental design was used more and for data analysis t-test and ANOVA were mostly used. TGT, STAD and Jigsaw were the methods used in the above studies. It can be also seen that of the total studies only three were from India.

- In language arts and English eight studies were seen. Six were in favor of CL while the findings of two studies showed no significant effect of CL on students' achievement. Here four studies were at secondary level, two at elementary and one at college level indicating that all levels have been researched on, though only one study was spotted at college level. The CL methods used in the above studies were TGT, Jigsaw and STAD. Three studies mentioned above used the quasi experimental design. Data analysis was done using MANCOVA, one way and two way ANCOVA in one study and one way ANCOVA in another one.
- Seven studies were reviewed in Social science out of which four were in favor of CL while two reported findings in favor of control group and in one CL was not found to be more effective than non CL. Most of the studies here were at secondary level, that is, five out of the seven were done at secondary level and only one study each has been spotted in elementary and college level. The methods of CL used in above studies were Jigsaw, STAD and Group Investigation.
- Apart from above studies, eight single studies were also seen. Out of the eight, seven showed CL to have significant effect on students' academic achievement and social aspects. Students also showed positive attitude towards CL. One study, however, reported CL and individual learning to produce similar achievement and attitudinal results. Coming to age levels it can be seen that four were done at elementary level, one at high school, two at college level and one in teacher education.
- In science, twenty nine studies were reviewed. It can be seen that twenty four studies indicated results in favor of CL in science. Two studies reported that CL had no significant effect when compared to traditional classroom teaching while in three studies significant effect favoring control group was seen. Coming to the age levels it can be seen that most of the studies were done at secondary level. Fifteen studies were spotted at secondary level, four at elementary level, three at high school level,

one at intermediate level and three at college level. There was also one study at early post secondary level and another one was a follow up study from primary level to high school. Jigsaw, TGT, STAD, Group Investigation and Learning Together methods of CL were used in the above studies. It could also be seen that out of the total studies reviewed only four were from India. Design of the study could be spotted only in three studies. One study in India used non randomized control group pretest- posttest design and the other one used quasi experimental design. In both studies data was analyzed using ANCOVA. The other study which was conducted in Kenya used the quasi experimental design and for data analysis ANOVA, ANCOVA and t-test at α=0.05 was used.

Thus, from review it can be seen that CL has been used in many other subjects apart from science. The findings also go in favor of CL in most of the studies. CL has been found to have a positive impact on achievement of students and also on their non cognitive outcomes. Students have shown favorable responses and positive attitudes towards CL. In spite of that there were also studies which reported no significant effects of CL and also which showed significant effects favoring control group. In science out of the total twenty nine studies, five were not in favor of CL. More studies thus can be conducted to check the effects of CL in science. Studies were distributed at all age levels but maximum number of studies reviewed above were at secondary level and then at elementary level. In science, fifteen studies were at secondary level among the twenty nine studies and only four were at elementary level. This indicates a need for more studies to be conducted at elementary level. It can be seen that the CL methods used in almost all the studies reviewed include TGT, STAD, Jigsaw, Group Investigation and Learning Together thereby supporting the feasibility and effectiveness of these methods. The design of the study could be dotted only in some studies of which nine studies have used quasi experimental design, one has used single group pretest-posttest design and another one has used non randomized pretest-posttest design. For data analysis ANOVA, ANCOVA, MANCOVA, MANOVA and t-test were found to be used by some studies mentioned above. In science, if taken specifically, ANCOVA, ANOVA and t-test were found to be used. Apart from all this, it can be seen that out of the total studies reviewed only eight studies were done

in India. In science only four studies were done in India and all four were done at secondary level. There is therefore a dearth of studies on CL in science at elementary level especially in India and hence more studies need to be conducted on CL in science in India in order to find out its effectiveness.

2.3.2 IMPLICATIONS FROM STUDIES ON CL AND OUTCOMES OTHER THAN ACADEMIC ACHIEVEMENT

In this review three studies were related to positive effects of CL on relationships between students and at enhancing interpersonal and communication skills. Three studies linked CL to gains in cross racial friendship. There were seven studies relating CL and academically handicapped students. Results showed effects on not only their achievement but also showed gains in their social acceptance. Another major outcome of CL as seen from review is self esteem. Six studies supported the significant effect of CL on self esteem. Two studies relating to CL and group peer norms were also reviewed and findings were in support of CL. Two studies that showed CL to make students more cooperative or altruistic were also reviewed. Similarly there were two studies that reported CL to increase students' ability to understand and accept someone else's perspective. Finally there were single reviews on some other non cognitive outcomes of CL too. There was a study supporting CL's contribution to an enhanced sense of psychological health and well being. Apart from this, there was also one more study that reported that CL experiences are crucial to preventing and alleviating many of the social problems related to children, adolescents and young adults. Another study provided evidence that CL is a more effective model for delivering interpersonal and communication skills than simple group learning.

The findings above, thus, reveal that CL can enhance pro social behaviors of students. The effects of CL on non cognitive outcomes reviewed above appear to be strong but there is much yet to be done in this area. For this there is a need for careful analysis of what goes on in a cooperative classroom and also for more attention to just how the various outcomes come about. It is, however, the development of the five essential elements of CL- positive interdependence , individual accountability, face-to-face promotive interaction, appropriate use of collaborative skills and group processing- that

ultimately lead to all these and so it is essential to study the five elements and how they develop in cooperative classrooms.

This chapter provides a detailed account of the contributions made by earlier investigators in the field of CL. The method used for the study is described in the subsequent chapter.

Chapter 3
Methodology

CHAPTER 3
METHODOLOGY

3.0 INTRODUCTION

This chapter deals with methodology employed in order to achieve different objectives and to verify hypotheses of the study. It deals with sampling procedures, design, the tools used, details on collection of data and statistical techniques employed for analysis and interpretation of the data.

3.1 POPULATION

The study was carried out in Ernakulam district, Kochi in the state of Kerala. There are 105 English medium schools with upper primary classes in Ernakulam following Kerala State Board Syllabus. All class VII students (approximately 8400 students) of Ernakulam district formed the population of the study.

3.2 SAMPLE

First, the English medium schools with upper primary classes and following Kerala State Board Syllabus that are ready to provide facilities for implementing the developed strategy were listed. The list is given in Appendix J. From this, two schools were randomly selected and from these two schools, students of class seven from one school were randomly selected as experimental group and the other as control group. All students in the class were included. There were thirty six students in experimental group and thirty nine in control group. Thus in a way this becomes cluster sampling. Cluster sample is a variation of the simple random sample that is particularly appropriate when the population of interest is infinite, when a list of the members of the individuals is widely scattered.

3.3 TOOLS

The tools used for the study were science achievement test, rating scale for assessing the five essential elements of CL and rating scale for knowing students reaction towards CL.

The tools were sent to experts for validation and based on their suggestions it was finalized. There were nine experts. The list of experts is attached in Appendix I.

3.3.1 ACHIEVEMENT TEST

Achievement test was designed based on the selected five chapters of science. The same test was used in parallel form for the pre-test and post-test. First, the instructional objectives were prepared for each chapter. This would describe the type of performance pupils are expected to demonstrate. Then the course content was outlined which indicates the areas in which each type of performance is to be shown. Objective and short answer type questions were used. Based on these, the blue print was prepared for each chapter and then test items were designed. Answer keys were also prepared to maintain objectivity of scoring. The developed test was then given to experts for validation in terms of content, instruction, objectives etc. and based on the suggestions, same was modified. A pilot study was also conducted on ten students in schools other than the sampled schools. The following were the suggestions given by experts.

Chapter 1

i. Expert one commented that question number four has to be split under two objectives- application and skill.

Chapter 2

i. Experts two, three, four and six said that question number three come under the understanding level and so this question was modified accordingly to suit the objective skill.
ii. As per the suggestions of experts one, two, three and eight the objective of question number four was changed from skill to understanding
iii. In question number eleven the objective was changed to knowledge on the recommendation of experts two ,seven and nine.

Chapter 3

i. Experts one and eight gave suggestions to modify question number two to suit the objective skill.
ii. For question number three experts two, three, four and seven commented that it came under application level.

iii. The objective of question number five was changed from application to understanding as per the suggestions of experts one, two, three, four, five and eight.

iv. Question number fourteen was modified as per suggestions given by experts two, three, six and nine.

v. Question number fifteen was modified taking into view the suggestions given by experts six, seven and eight.

Chapter 4

i. Expert five suggested a modified question for question number four.

ii. Experts one, two and three classified question number eight as application level.

iii. Question number twelve was reported as knowledge level question by experts two, three and five.

iv. Experts two, three, six, seven and eight commented that question number sixteen comes under application level.

Chapter 5

i. It was indicated by experts two, three, four and seven that question number two was at application level and question number three at understanding level.

ii. In question number seven the objective was changed to understanding as per commented by experts two, three and eight.

iii. Experts one, three, five, six and nine commented that question number three and question number fifteen had no difference and similarly question number four and question number sixteen were also similar. Taking this into consideration questions fifteen and sixteen were modified accordingly.

The suggestions were incorporated and appropriate modifications were made and finalized. All the experts recommended that there were no changes to be made in the language used and instructions given in the test. The initial and final version of achievement test is attached in Appendices B and C. The final blue print of each chapter is as given below.

BLUE PRINT

Table 3.1

CHAPTER 1: CULTIVATION OF CROPS

OBJECTIVES / CONTENT	K	U	A	S	TOTAL MARKS
Methods of cultivation	(11) 1	(9)1 (15)1	(1)2 (3)2		7
Methods to produce improved varieties of seeds	(5)1 (8)1	(6) 1 (10)1 (13)1	*(4) 1	*(4) 1	7
Hybrid Variety Plants	(14) 1	(12) 1		(2)2	4
Research Institutions	(7)1 (16) 1				2
Total marks	6	6	5	3	20

K- knowledge, U- understanding, A- application, S- skill

The number inside the bracket indicates the question number and the number outside the bracket indicates mark.

The '*' sign indicates that the question is split under different objectives.

BLUE PRINT

Table 3.2

CHAPTER 2: WATER TO BE CONSERVED

OBJECTIVES / CONTENT	K	U	A	S	TOTAL MARKS
Rainwater into earth		(14) 1	(1) 2		3
Powerful water	(11) 1	(8) 1			2
Hydroelectric power	(16) 1	(4) 2 (12) 1			4
Sources of water	(5) 1 (7) 1				2
Distillation		(9) 1		(3) 2	3
Quality of water	(15) 1	(10) 1			2
Water purification		(6) 1	(2) 2		3
Water pollution	(13) 1				1
Total marks	6	8	4	2	20

K- knowledge, U- understanding, A- application, S- skill

The number inside the bracket indicates the question number and the number outside the bracket indicates mark.

BLUE PRINT

Table 3.3
CHAPTER 3: WHEN HEAT ACTS

OBJECTIVES / CONTENT	K	U	A	S	TOTAL MARKS
Drying of clothes	(16) 1	(1) 2 (11) 1 (12)1			5
Thermal expansion		(15) 1	(6) 1	(2) 2	4
Density	(13) 1	(5) 1 (9) 1	(3) 2		5
Convectional current	(8) 1 (14) 1	(10) 1			3
Air and fluid pressure		(7) 1	(4) 2		3
Total marks	4	9	5	2	20

K- knowledge, U- understanding, A- application, S- skill

The number inside the bracket indicates the question number and the number outside the bracket indicates mark.

BLUE PRINT

Table 3.4

CHAPTER 4: SOUND

OBJECTIVES / CONTENT	K	U	A	S	TOTAL MARKS
How is sound produced	(12) 1		(8) 1	(3) 2	4
Human voice	(15) 1		(4) 2		3
Control of voice	(13) 1	(10) 1			2
Sound for what	(6) 1 (14) 1				2
When sound strikes		(1) 2	(2) 2		4
How do I hear	(7) 1				1
Propagation of sound		(5) 1 (9) 1	(16) 1		3
Noise pollution	(11) 1				1
Total marks	7	5	6	2	20

K- knowledge, U- understanding, A- application, S- skill

The number inside the bracket indicates the question number and the number outside the bracket indicates mark.

BLUE PRINT

Table 3.5
CHAPTER 5: LET US GROW TOGETHER

OBJECTIVES / CONTENT	K	U	A	S	TOTAL MARKS
Dependency of organisms			(2) 2		2
Preys	(9) 1 (13) 1	(15) 1		(1)2	5
Decomposers		(5) 1			1
Ecosystem	(14) 1	(3) 2 (6) 1			4
Things we throw away	(10) 1	(7) 1			2
Bio waste	(16) 1	(8) 1 (12) 1	(4) 2		5
Plastics		(11) 1			1
Total marks	5	9	4	2	20

K- knowledge, U- understanding, A- application, S- skill

The number inside the bracket indicates the question number and the number outside the bracket indicates mark.

3.3.2 RATING SCALE FOR ASSESSING THE FIVE ESSENTIAL ELEMENTS OF CL

A five-point rating scale was developed for assessing students in cooperative learning. The scale checked categories for positive interdependence, individual accountability, face-to-face promotive interaction, use of collaborative skills and group processing.

(1) To check positive interdependence it was seen whether students were building on each other's ideas, listening to all before reaching conclusions, sharing responsibility for tasks evenly, had positive attitude about task and work of others and encouraged and supported the efforts of others.

(2) Individual accountability was assessed on the following**:** accepting assigned roles responsibly, completion of assigned work; producing quality/relevant work, participating on clean up willingly and punctuality/regular attendance.

(3) For checking face to face promotive interaction the following were looked for**:** criticizing ideas without criticizing people, listening to others, seeking elaboration, asking in-depth questions and providing constructive praise and criticism.

(4) Collaborative skills were assessed on the following**:** leadership skills, communication skills, trust building skills, decision making skills and resolving conflicts.

(5) Finally to assess group processing it was seen how groups set goals, seek and promote consensus on teams goals and work plans to reach these goals, assess their team and think of changes to be made in future.

A field diary was used along with rating scale. Participant observation was also done. The tool was given to experts and based on their suggestions it was finalized. The initial and final tool copies are attached in Appendices D & E. All experts commented that rating scale was lengthy and few items could be done away with as they were more or less similar in meaning to some other items. There were no corrections on language and instructions of the test. As per their suggestions the following changes were made:

(a) Positive interdependence

i. Item two was deleted.

(b) Face to face promotive interaction

i. Items five, six and seven were deleted.

ii. Item four was modified.

(c) Individual accountability

i. Item seven was deleted.

(d) Appropriate use of collaborative skills

Leadership

i. Item two was modified

ii. Items four and five were deleted

Communication

i. Items four and six were deleted

Trust Building

i. Item three was deleted

Decision making

i. Item one was deleted

Resolving conflicts

i. Item four was deleted

(e) Group processing

i. Items four and five were deleted.

3.3.3 RATING SCALE FOR KNOWING STUDENTS' REACTION TOWARDS CL

For knowing students' reaction towards cooperative learning a rating scale was developed. There were twenty eight items and three options- sometimes, always and never. Students ticked the option that they felt indicated their experience in CL. This rating scale was also send to experts for their suggestions and then finalized. All items were retained except for some modifications in the structure as per suggestions of experts. The options given as Yes/No were changed to Sometimes, Always and Never as per suggestions. There were no changes to be made in the instructions given in the test. The copies of initial and final tool have been given in Appendices F & G.

3.4 DESIGN OF THE STUDY

Study is quasi experimental in nature. The Pretest-Posttest Non Equivalent-Groups Design was used. Random selection of students is not possible because of practical limitations. That is why this design is chosen. This design is often used in classroom experiments when experimental and control groups are such naturally assembled groups as intact classes, which may be similar. Here the Dependent variable is science achievement and the five essential elements of cooperative learning. The independent variable is the strategy based on cooperative learning.

O_1 X O2	O_1O_3= Pretests	X= Experimental group
O_3 C O4	O_2O_4= Posttests	C= Control group

First pretest was given to both experimental and control group. Then experimental group was given intervention. Finally posttest was administered to both the groups. Any experimental design will have threats to its experimental validity i.e. to internal validity and external validity. The presence of control group will take care of the threats to internal validity like maturation, history and testing. To make up for experimenter bias a teacher from that school was asked to assess the students for the five essential elements of cooperative learning using rating scale along with the investigator. In threats to external validity, interference of prior treatment is not applicable here. For dealing with potential threat investigator directly observed classes to make sure process was carried out as intended by investigator. Thus every effort was made to minimize threats wherever possible and accordingly interpret results.

3.5 STRATEGY BASED ON COOPERATIVE LEARNING

It broadly constitutes the methods, procedures and techniques that the teacher uses to confront students with the subject and to bring about an effective outcome, with each method, procedure and technique having its components and procedures. Steps involved are- selection of content, analysis of content, preparing list of instructional objectives and designing activities based on specific learning outcomes and students' needs. Each

member of a team is responsible not only for learning what is taught but also for helping teammates learn, thus creating an atmosphere of achievement.

The main steps involved in designing this strategy were-

(1) The relevant content to be taught was selected. There are five chapters in this study: Green cover, Water to be conserved, When Heat acts, The World of Sound and Let us grow together.

(2) Content of each chapter was analyzed.

(3) Instructional objectives of each chapter were noted down.

(4) Then the six cooperative learning techniques were analyzed to see which technique is most suited to teach the selected content taking into account instructional objectives also.

(5) During implementation of strategy care was taken to see that there is positive interdependence, individual accountability, face-to-face promotive interaction, use of collaborative skills and group processing among students.

An example from the chapter "Green Cover" is as given in Table 3.6. The strategy used is given in Appendix A.

Table 3.6 Example of strategy based on CL

CONTENT	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
1) Methods of cultivation	Students (i) Compares advantages and disadvantages of methods (ii) Differentiates between them (iii) Infers which method is better and why (iv) Summarizes all points (v) Concludes which method is better	Teacher narrated the example of two farmers using different methods of cultivation. Asked students to discuss on how these methods differ, which method is better and why. Gave hints on crop rotation and intercropping.	Technique of Round Robin Brainstorming was used. Students were made to sit in groups of five. One student was made recorder. Each student expressed his ideas and views on the example of the two farmers. All the points of each student	After the allotted time teacher asked questions to each group and based on that evaluated them on content. Field diary was used to note down activities and progress of every group. Rating scale was used for assessing students in five essential

CONTENT	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
			regarding methods of cultivation, which method is better and why were noted down by a recorder in the group. Group discussion followed. Students reached final answer that crop rotation and intercropping are better methods of cultivation.	elements of CL during the group work.

3.6 DATA COLLECTION

Data was collected for one term of the year i.e. six months from June 2010 to November 2010. The number of working days was 110 in that term. The working days were from Monday to Friday and each day had a period for Science. The duration of each period was forty five minutes. In one term there are five chapters to be taught in science- Green cover, Water to be conserved, When Heat acts, The World of Sound and Let us grow together. The tools prepared for the study were validated by experts and based on their suggestions changes were incorporated. The tools used were achievement test(the same test was used as pre-test and post-test), rating scale to assess students on the five essential elements of CL, which are positive interdependence, face to face promotive interaction, individual accountability, appropriate use of collaborative skills and group processing, and rating scale to know students reaction towards CL. First the pre-test was administered to both the groups. Then the respective five chapters in science were taught to the experimental group using the strategy based on cooperative learning techniques. For this, first the content to be taught was analyzed thoroughly and then appropriate techniques

chosen accordingly. The CL techniques used were Round Robin Brainstorming, Think Pair Share, Group Investigation, STAD and TGT. The control group was taught by their class teacher using regular classroom teaching. After that, post-test was administered to all students of both control and experimental group. The field diary and rating scale were used in between for assessing students on the five essential elements of cooperative learning while learning. Students were rated on the five essential elements of CL six times i.e. first before implementing CL and then after each chapter. The class teacher of the experimental group also rated students on the five essential elements of CL along with the investigator. After the intervention the rating scale for knowing students reaction towards CL was administered to the experimental group.

3.7 DATA ANALYSIS

In the present study, existing or intact groups were involved but treatments were assigned to them randomly and to take care of that, Analysis of Covariance (ANCOVA) was used for analysis. For a study based on a pretest- posttest control group design, covariance is a superior method for controlling for pretest differences. Difference in achievement of boys and girls and chapter wise analysis of data were also done using ANCOVA. Rating scale was used to assess students on the five essential elements of Cooperative Learning- Positive Interdependence, Face to face promotive interaction, Individual accountability, Appropriate use of collaborative skills and Group processing. Scoring was done accordingly and the corresponding average means of all the elements during each rating was found. A graph was plotted for each of the elements using the mean values of the nine elements corresponding to each rating. The development of the essential elements was thus seen, but in order to see if the increase is significant or not the Wilcoxon Signed Rank Test was used. The Wilcoxon Signed-Rank Test is the nonparametric test equivalent to the dependent t-test. It is used when we wish to compare two sets of scores that come from the same participants. This can occur when we wish to investigate any change in scores from one time point to another. The data on students' reaction to CL was analyzed using percentage.

In this chapter the sample, tools used and method of administration of tools are explained followed by the different methods applied for the analysis of data. The ensuing chapter discusses the data analysis and the interpretation of data.

Chapter 4
Data Analysis and Interpretation

CHAPTER 4

DATA ANALYSIS AND INTERPRETATION

This chapter deals with analysis and interpretation of the data collected. The collected data was subjected to appropriate statistical procedures. Based on these results the hypotheses is accepted or rejected. What is thus done in this chapter is analyzing the data, testing the hypotheses and then interpreting the results, that is taking decisions regarding the rejection or acceptance of the hypotheses.

4.0 Comparison of achievement through CL and Conventional method.

The null hypothesis formulated was "There will be no significant difference between mean scores of achievement of the students who studied through cooperative learning strategy and that with conventional method".

To test this ANCOVA was used. The ANCOVA is a statistical method for equating randomly formed groups on one or more variables and is most appropriate when a study deals with intact groups. ANCOVA adjusts scores on a dependent variable for initial differences on some other variable, such as pretest scores, IQ, readiness or aptitude. It is used in two major ways, as a technique for controlling extraneous variables and as a means of increasing the power of a statistical test.

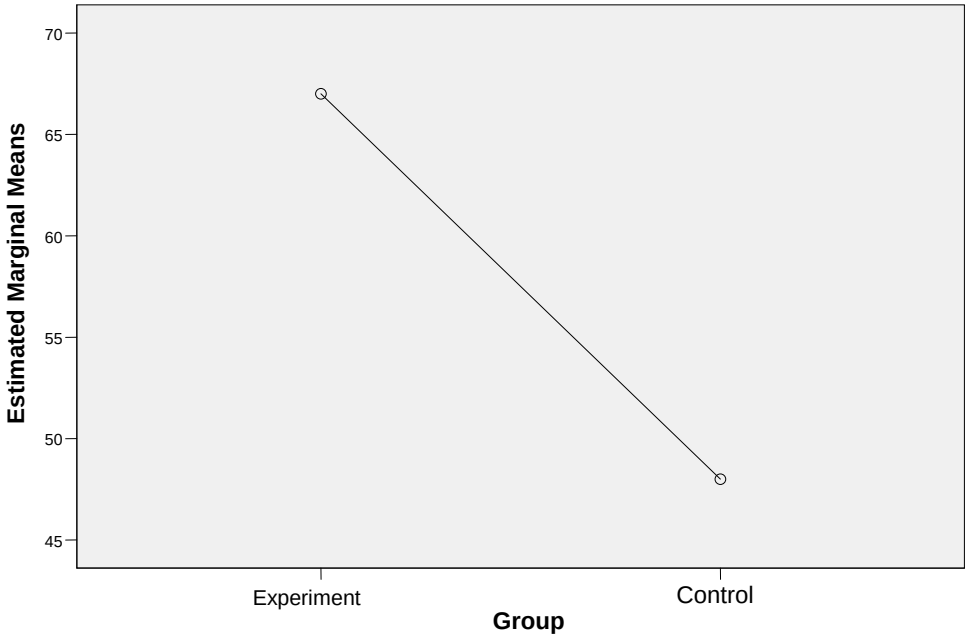
First, a profile plot was plotted using the estimated marginal means of post test of experimental and control group and it is as given in Figure 1. The Profile Plot is a plot that gives a visual picture of what is going on with the study. In the present study a profile plot using values found in Table 4.1 will give a visual picture of the results obtained in the study.

Table 4.1

Estimated Marginal Means of Posttest of experimental and control group

Group	Mean	Std. Error	95% Confidence Interval	
			LB	UP
Experiment	67.002	2.176	62.664	71.340
Control	47.998	2.087	43.838	52.159

Figure 1. Profile Plot of Estimated Marginal Means of Posttest of experimental &control group



The line shows the estimated marginal means of posttest scores obtained by experimental and control group. It can be seen that the experimental group has a higher value than control group.

Before conducting an ANCOVA, however, the assumptions underlying ANCOVA were tested. The assumptions to be met in ANCOVA are (i) various treatment groups are selected at random from the population (ii) regression is linear and same from group to group and (iii) the groups are homogeneous in variability. First the homogeneity of regression assumption was tested and then Levene's test was applied to check the assumption of constant variance. Results obtained are given as follows.

Table 4.2

Mean and Standard Deviation of pretest and posttest of experimental and control group

Group	Pretest		Posttest	
	Mean	**SD**	**Mean**	**SD**
Experiment	29.14	6.067	68.08	11.537
Control	25.54	5.982	47.00	14.457
Total	27.27	6.250	57.12	16.815

Table 4.3

Test of Between Subject Effects

Source of Variation	Sum of Squares	df	Mean Square	F - value	p - value
Group	14.553	1	14.553	0.090	0.765
Pretest	905.369	1	905.369	5.579	0.021
Group * Pretest	194.186	1	194.186	1.196	0.278
Error	11523.019	71	162.296		
Total	12637.127	74			

The test of homogeneity of regression assumption evaluates the interaction between covariate and the factor. Since the p-value for the interaction between pretest (covariate) and group (factor) in above table is greater than the significance level (0.05), the interaction is not significant and ANCOVA can be applied.

Table 4.4

Mean and Standard Deviation of post test of experimental and control group

Group	Mean	SD	N
Experiment	68.08	11.537	36
Control	47.00	14.457	39
Total	57.12	16.815	75

Table 4.5

Levene's Test of Equality of Error Variances

F	df1	df2	p - value
3.775	1	73	0.056

Levene's test is performed to check the assumption of constant variance. From the above output – we see that the underlying assumption of homogeneity of variance for the ANCOVA has been met as p>0.05. Details of ANCOVA are given below.

Table 4.6

ANCOVA output

Source of Variation	Sum of Squares	df	Mean Square	F - value	p - value
Pretest	883.545	1	883.545	5.429	0.023
Group	6192.939	1	6192.939	38.054	<0.001
Error	11717.205	72	162.739		
Total	18793.689	74			

at 0.05 level of significance

From above table it can be seen that p value is less than 0.05 and so null hypothesis is rejected. This means that there is a significant difference between mean scores of achievement of the students who studied through cooperative learning strategy and that with conventional method.

4.1 Comparison of achievement of experimental group with respect to gender

The null hypothesis formulated was "There is no significant difference between mean scores of achievement of experimental group students with respect to gender".

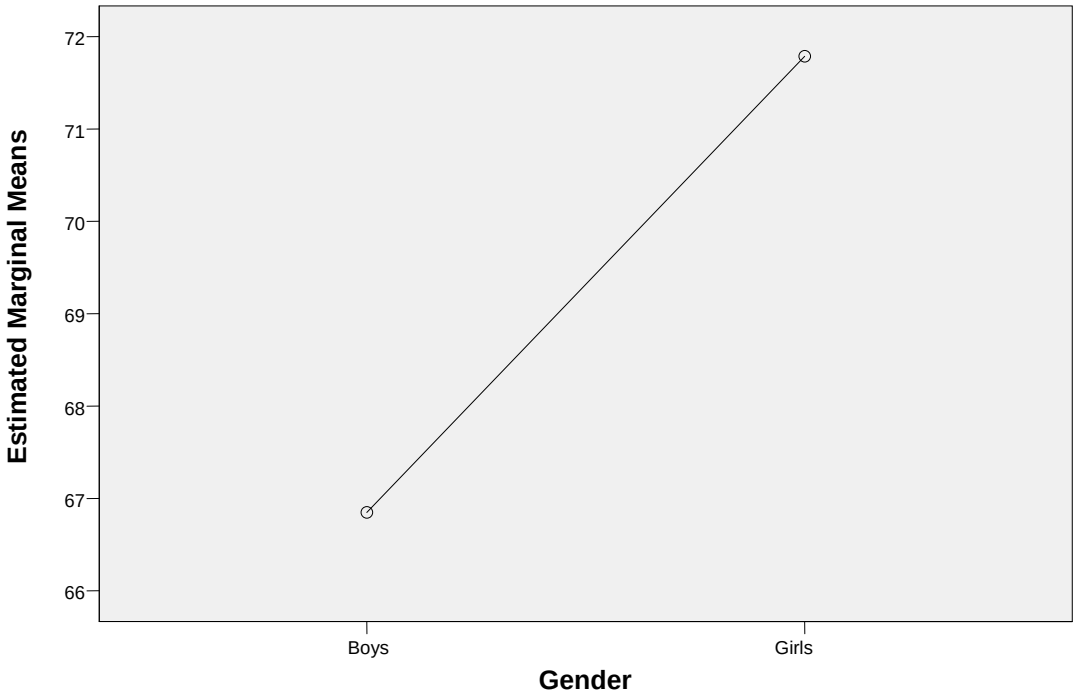
Profile plot was plotted first before ANCOVA, as in Figure 2, using the estimated marginal means of post test of boys and girls in the experimental group given in Table 4.7.

Table 4.7

Estimated Marginal Means of post test of boys and girls

Gender	Mean	Std. Error	95% Confidence Interval	
			LB	UP
Boys	66.849	2.037	62.705	70.993
Girls	71.787	3.646	64.370	79.204

Figure 2. Profile Plot of Estimated Marginal Means of Post test of boys and girls



From the profile plot it can be seen that the scores for girls are greater than boys in posttest but the difference is present in the pre test scores also. Scores of girls are greater than that of boys in the pre test itself and the same difference is maintained after the test too and so there is no additional difference.

The assumptions of ANCOVA were satisfied and hence ANCOVA was conducted and the summary is given below.

Table 4.8
Mean and Standard Deviation of pretest and posttest of boys and girls

Gender	Pretest		Posttest	
	Mean	SD	Mean	SD
Boys	27.93	5.737	65.96	10.843
Girls	32.78	5.848	74.44	11.812
Total	29.14	6.067	68.08	11.537

Table 4.9

Test of Between Subject Effects

Source of Variation	Sum of Squares	df	Mean Square	F - value	p - value
Pretest	343.247	1	343.247	3.096	0.088
Gender	48.757	1	48.757	.440	0.512
Gender * Pretest	23.564	1	23.564	.213	**0.648**
Error	3547.253	32	110.852		
Total	3962.821	35			

It can be seen that p value is greater than 0.05. This indicates that the interaction between covariate (pretest) and factor (gender) is not significant and thus ANCOVA can be used.

Table 4.10

Mean and Standard Deviation of post test of boys and girls

Gender	Mean	SD	N
Boys	65.96	10.843	27
Girls	74.44	11.812	9
Total	68.08	11.537	36

Table 4.11

Levene's Test of Equality of Error Variances

F	df1	df2	p - value
0.263	1	34	**0.611**

Assumption of equality of variance is accepted as p value in table is greater than 0.05.

Table 4.12

ANCOVA output

Source of Variation	Sum of Squares	df	Mean Square	F - value	p - value
Pretest	602.369	1	602.369	5.567	0.024
Gender	144.299	1	144.299	1.334	0.256
Error	3570.817	33	108.207		
Total	4317.485	35			

0.05 level of significance

The table shows that p value is greater than 0.05 and so null hypothesis is not rejected. This implies that there is no significant difference between mean scores of achievement of experimental group students with respect to gender.

4.2 Achievement of experimental group with respect to chapters

The null hypothesis formulated was "There is no significant difference between mean scores of achievement of experimental group students with respect to chapters".

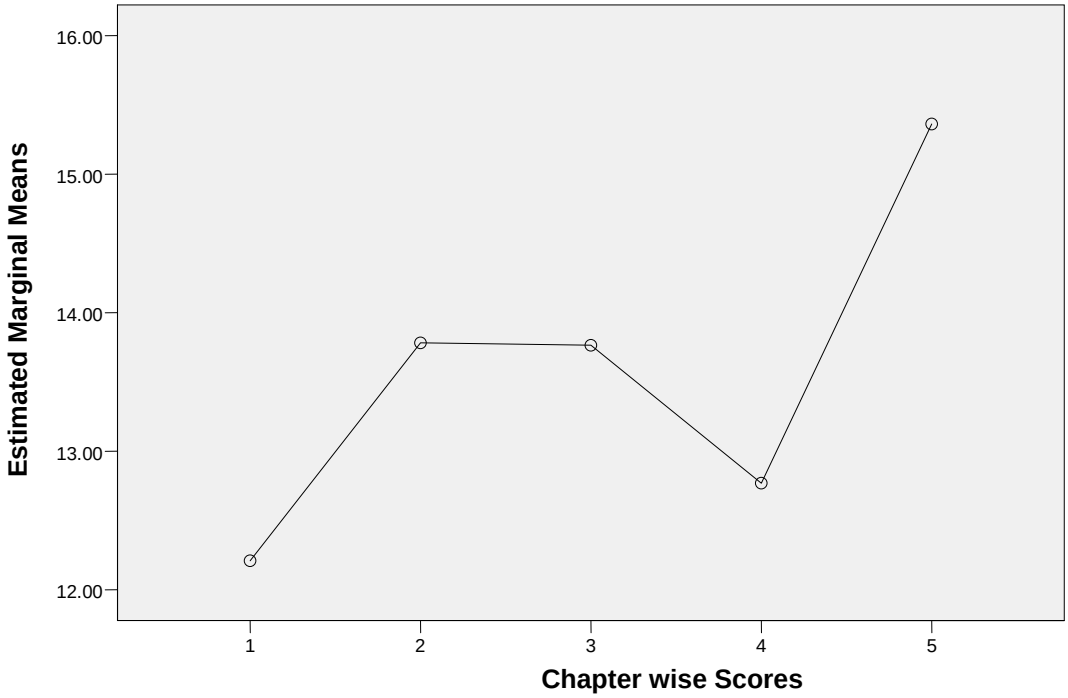
First the estimated marginal means of post test of the five chapters were found as given in Table 4.13. The profile plot was plotted for the same using these values and is given in Figure 3.

TABLE 4.13

Estimated Marginal Means of post test of five chapters

Chapter	Mean	Std. Error	95% Confidence Interval	
			LB	UP
Chapter1	12.209	.610	11.006	13.413
Chapter2	13.782	.490	12.816	14.749
Chapter3	13.765	.523	12.733	14.798
Chapter4	12.769	.498	11.786	13.752
Chapter5	15.362	.516	14.344	16.380

Figure 3. Profile plot of Estimated Marginal Means of Posttest of five chapters



It can be seen that in the fifth chapter students have achieved more when compared to other chapters.

To test the difference with respect to chapters further, ANCOVA was used and its summary is provided in the following section.

Table 4.14
Test of Between Subject Effects

Source of Variation	Sum of Squares	df	Mean Square	F - value	p - value
Chapter	68.116	4	17.029	2.313	0.060
Pretest	49.553	1	49.553	6.731	0.010
Chapter * Pretest	33.102	4	8.275	1.124	0.347
Error	1251.526	170	7.362		
Total	1402.297	179			

The p value here is greater than 0.05 and so assumption of homogeneity of regression is met and therefore ANCOVA can be conducted.

Table 4.15

Mean and Standard deviation of five chapters

Chapter	Mean	SD	N
Chapter1	13.42	2.795	36
Chapter2	13.23	2.624	36
Chapter3	12.99	2.817	36
Chapter4	12.15	2.959	36
Chapter5	16.10	2.680	36
Total	13.58	3.054	180

Table 4.16

Levene's Test of Equality of Error Variances

F	df1	df2	p - value
0.456	4	175	0.768

Assumption of equality of variance is met as p value is greater than 0.05. ANCOVA output is given in Table 4.17.

TABLE4. 17

ANCOVA OUTPUT

Source of Variation	Sum of Squares	df	Mean Square	F - value	p - value
Pretest	65.334	1	65.334	8.849	0.003
Chapter	208.253	4	52.063	7.052	<0.001
Error	1284.628	174	7.383		
Total	1773.541	179			

0.05 level of significance

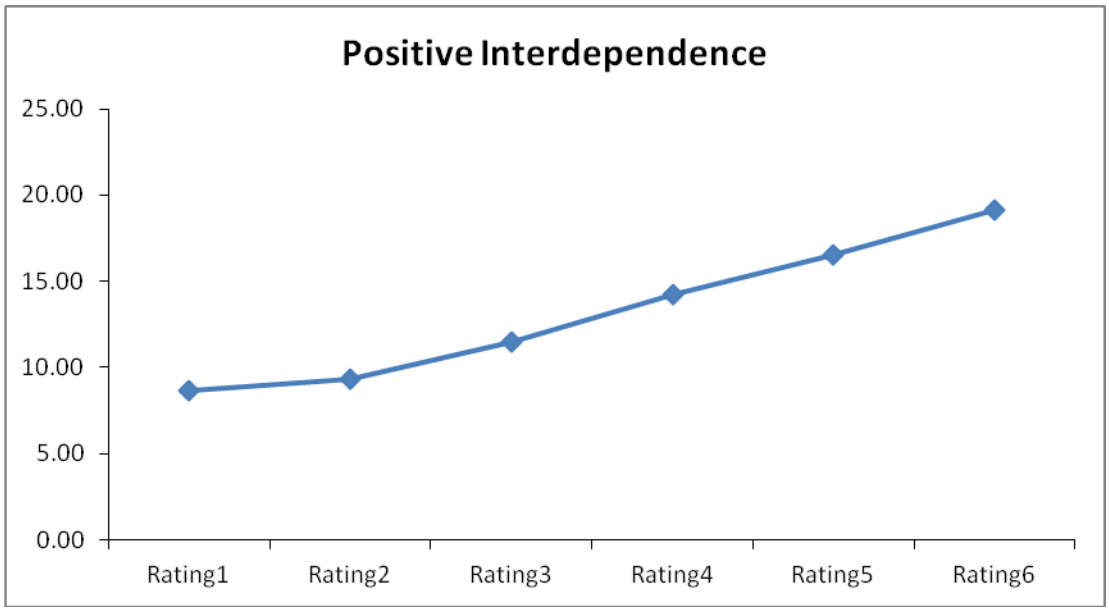
From the output it can be seen that p value is less than 0.05 and so null hypothesis is rejected. This means that there is a significant difference between mean scores of achievement of experimental group students with respect to chapters. Students have scored more marks in the fifth chapter.

4.3 ANALYSIS OF THE RATING SCALE TO ASSESS THE FIVE ESSENTIAL ELEMENTS OF CL

Rating scale was used to assess students on the five essential elements of Cooperative Learning- Positive Interdependence, Face to face promotive interaction, Individual accountability, Appropriate use of collaborative skills and Group processing. Appropriate use of collaborative skills is further subdivided into the following elements-leadership, communication, trust building, decision making and resolving conflicts. The rating scale was a five point rating scale- Never (1), Rarely (2), Sometimes (3), Always (4) and Frequently (5). Students were rated on the essential elements six times, that is, before implementation of CL and then after each chapter. Scoring was done accordingly and the corresponding average means of all the elements during each rating was found. It is given in Appendix H. A graph was plotted for each of the elements using the mean values of the nine elements corresponding to each rating. It is as given.

Fig. 4

Positive Interdependence

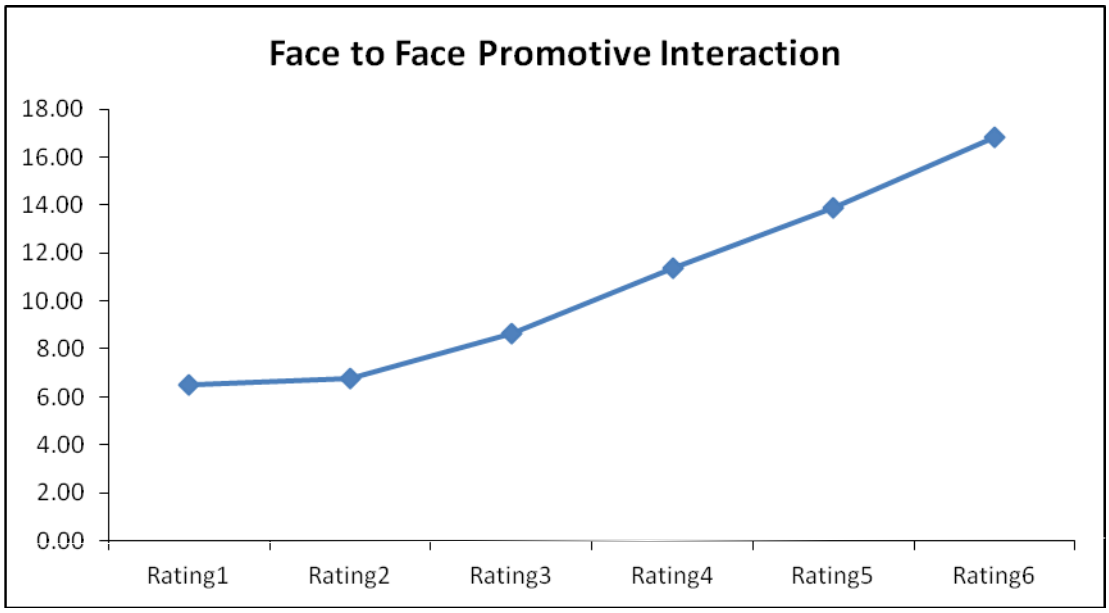


It can be seen from the graph that positive interdependence gradually increased in students during the period of intervention of cooperative learning strategy. Initially the

mean value of this element was 8.67. It gradually increased to 9.31 in the second rating, 11.47 in third rating, 14.19 in fourth rating, 16.56 in fifth rating and finally it reached 19.17. It can be therefore said that positive interdependence was developed in students in an effective way, as initially its value was only 8.67 and at the end it became 19.17. The difference between initial and final values is 10.5.

Figure 5

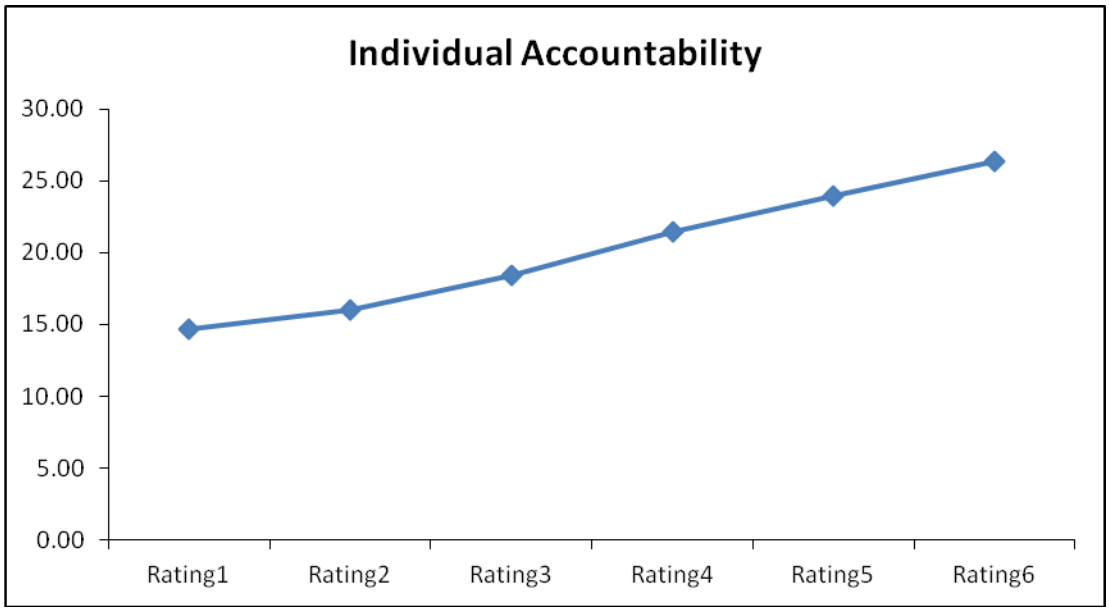
Face to Face Promotive Interaction



The graph clearly shows that there was an increase in face to face promotive interaction of students. During the first rating mean value was 6.53. This did not change much during the second rating also. It was 6.75. After that it increased to 8.64, 11.36, 13.89 and finally reached 16.83. If we thus see the initial value of 6.53 and final value of 16.83 there is a difference of 10.3. It can be thus clearly stated that students did develop face to face promotive interaction while undergoing cooperative learning.

Figure 6

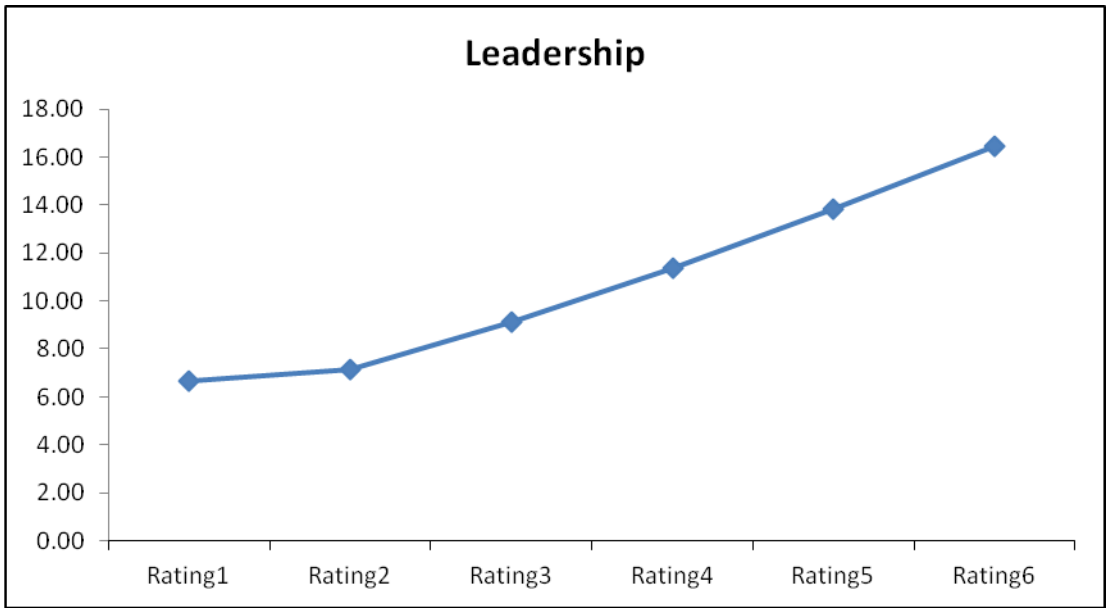
Individual Accountability



Individual accountability was displayed by students at a good level initially itself. The initial value was 14.67 and is a good one at the beginning stage. It however improved further as can be seen from the graph. In the second rating, value was sixteen and in third rating it was 18.44. It further increased to 21.42 in fourth rating, 23.92 in fifth rating and finally reached 26.39. The difference between initial and final values is 11.72. It can therefore be said that students developed the sense of individual accountability after completion of cooperative learning strategy.

Figure 7.1

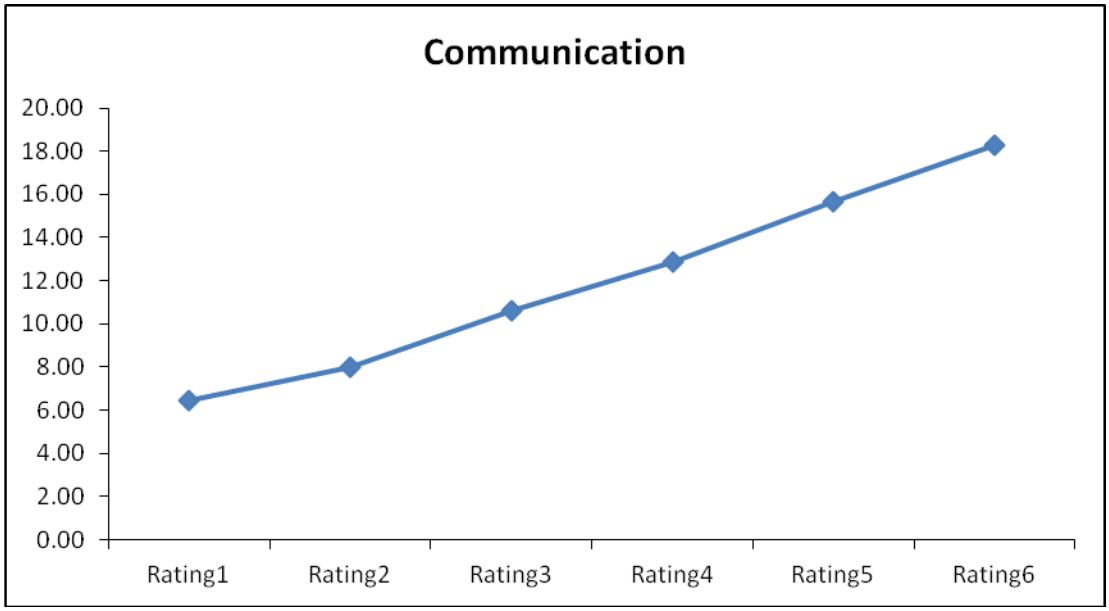
Appropriate use of collaborative skills- Leadership



The graph clearly shows that cooperative learning helped in developing leadership skills of students. The mean value of leadership which was 6.7 before implementation of CL techniques reached 16.47 at the completion of strategy based on CL, thereby indicating development of leadership skills in students. The other values are indicated in graph. During the second rating mean value was 7.17 and gradually increased to 9.14, 11.39 and 13.83 in the following ratings. The difference in initial and final values is 9.8.

Figure 7.2

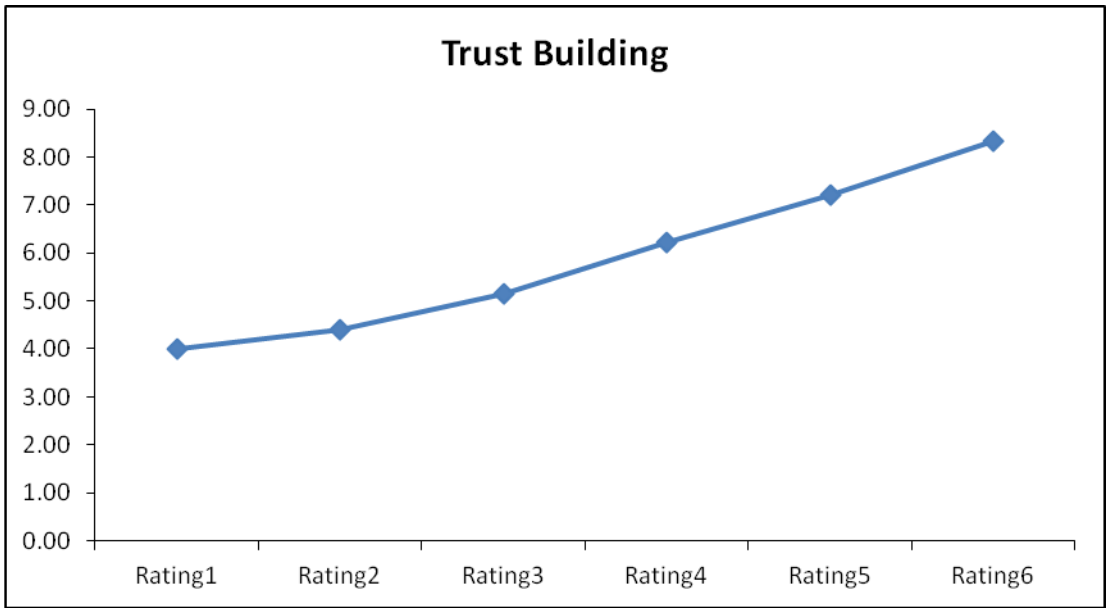
Appropriate use of collaborative skills – Communication



Communication skills are one of the most important skills to be possessed by students for their success as it helps them effectively express what they have in their minds. CL techniques helped students develop communication skills and this can be seen from the graph. Initially mean value of this element was 6.44. After that it became eight in the second rating. It then increased to 10.61 during third rating, 12.86 during fourth rating, 15.67 during fifth rating and finally it reached 18.31. It can be seen that there is a difference of 11.87 between the initial and final values.

Figure 7.3

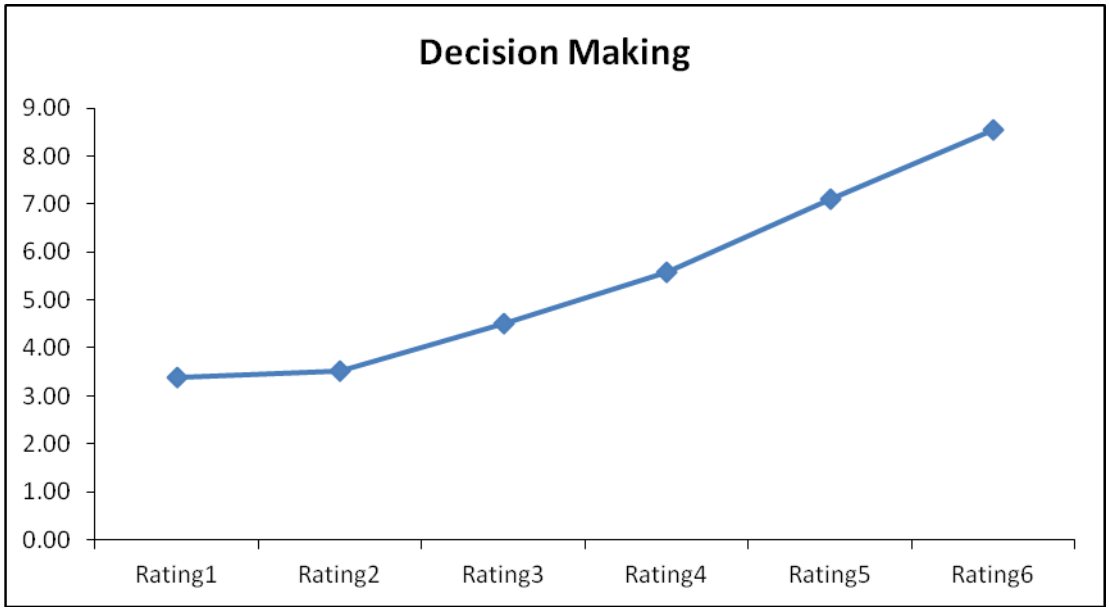
Appropriate use of collaborative skills- Trust Building



Trust building among students is not an easy task. It is a process which requires a lot of time. CL did help in building skills of trust building in students but not as much as when compared with the other elements. The initial mean value of the element was four. In the second rating it was 4.39 which is not much different from the first. In the third rating it increased to 5.14, then to 6.22 in fourth rating and 7.22 in fifth rating. During the last rating mean value of the element of trust building was 8.33 and the difference between initial and final value is 4.33.

Figure 7.4

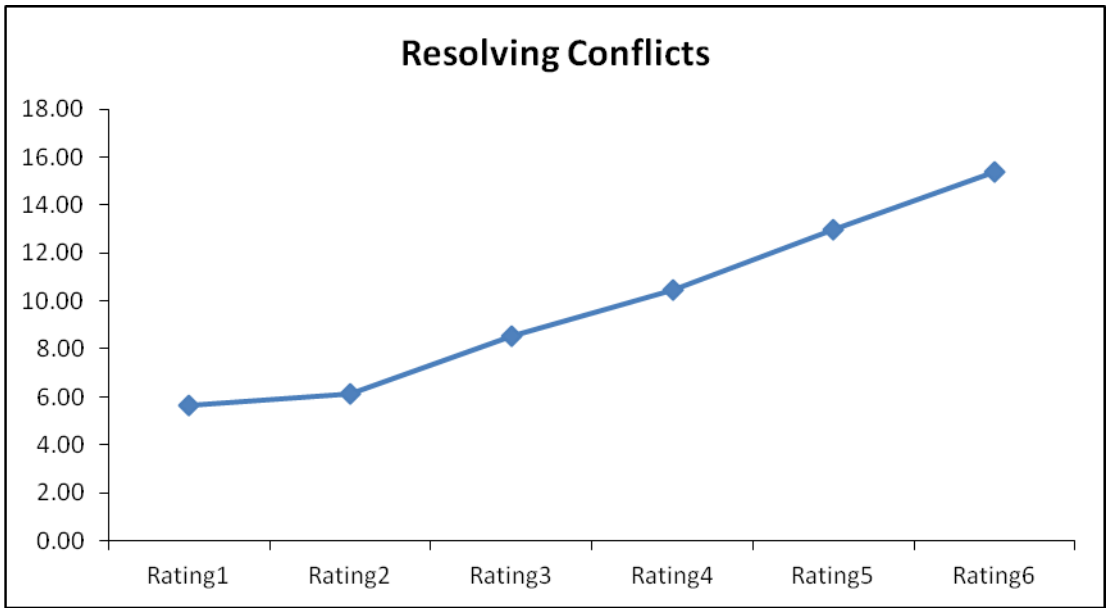
Appropriate use of collaborative skills- Decision Making



Decision making is another important skill that has to be developed in students in order to succeed in life. CL techniques pave way for this though it takes time. The graph indicates the same. Before implementing CL techniques, students had a mean value of 3.39 on decision making. In the next rating there was no significant change and value was 3.53. The value slightly increased to 4.50 in third rating and then to 5.58 in fourth rating. There was an increase to 7.11 in fifth rating and at the end of the term, mean value was 8.56. The difference between initial and final value here is 5.17.

Figure 7.5

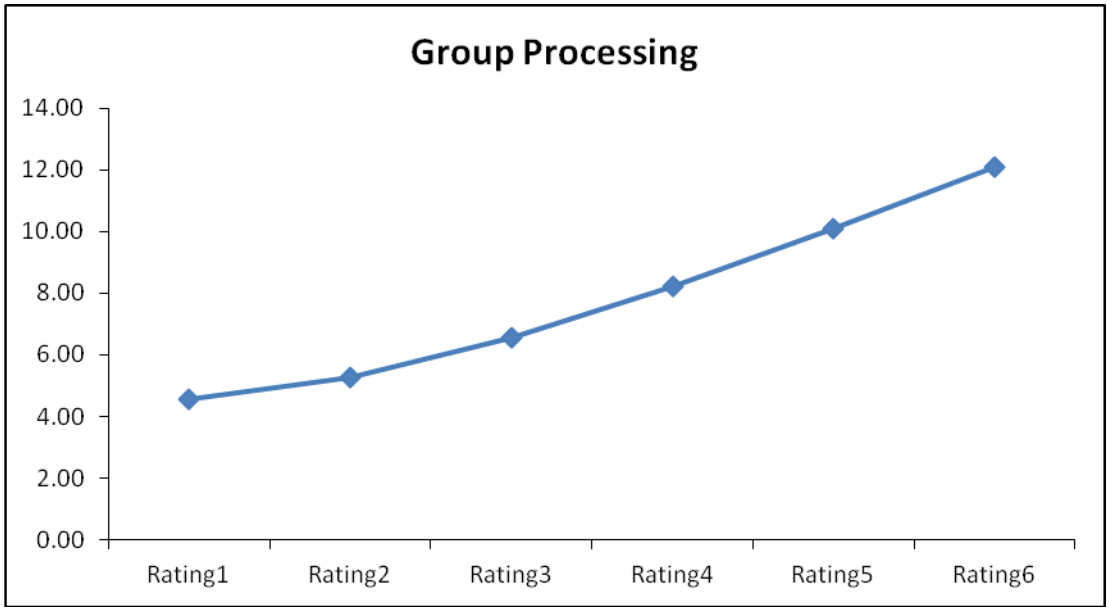
Appropriate use of collaborative skills- Resolving Conflicts



Resolving conflicts with one another is one of the most difficult as well as important task for students. In order to do well in team work in future, it is very essential that students learn to resolve conflicts by themselves. This was successfully built in students while learning through CL. From graph it can be seen that there was an increase in mean values of the element of resolving conflict during the period of CL. Initially the value was 5.64. It then increased to 6.14 in second rating, 8.56 in third rating, 10.47 in fourth rating, 12.97 in fifth rating and in the final month it was 15.36. This gives a difference of 9.72 between the initial and final values.

Figure 8

Group processing



CL techniques helped develop group processing element of CL in students. The graph clearly indicates the gradual development of the same in students. The mean value of the element of group processing when students were rated initially was 4.56. In the next rating the value was 5.25. During the third rating it increased to 6.56 and then to 8.22. In the fifth rating the mean value increased to 10.11 and finally it reached 12.08 thereby making a difference of 7.52 between the initial and final values.

It can be seen from the above results that CL helped develop the essential elements of CL namely Positive interdependence, Face to face promotive interaction, Individual accountability, Appropriate use of collaborative which was further subdivided into leadership, communication, trust building, decision making and resolving conflicts, and Group Processing. The maximum change was seen in communication skills of students and minimum in the skill of trust building. The development of the essential elements

was thus seen but in order to see if the increase is significant or not the Wilcoxon Signed Rank Test was used.

4.4 Testing significance in increase of five essential elements of CL

For testing the significance in increase of the five essential elements of CL the Wilcoxon Signed Rank Test was used. The Wilcoxon Signed rank Test is the non parametric test used to compare two sets of scores that come from same participants. It is used in studies that gather before and after measurements where interest focuses on the difference between the observations for each individual.From the six ratings the initial and final rating was used. The results are given below.

Table 4.18

Positive Interdependence

	Z - value	**p - value**
Building on each other's ideas	-5.436	<0.001
Listening to all before reaching conclusion	-5.439	<0.001
Sharing responsibility for tasks evenly	-5.459	<0.001
Positive attitude about task and work of others	-5.377	<0.001
Encourages and supports the efforts of others	-5.304	<0.001
Positive Interdependence	-5.248	<0.001

The null hypothesis formulated was "There is no significant difference in positive interdependence of experimental group students before and after cooperative learning". It can be seen from the above table that the p value is less than 0.05 and so the null hypothesis is rejected. This means that there is a significant improvement in positive interdependence of students after the period of cooperative learning.

Table 4.19
Face to face Promotive Interaction

	Z - value	p - value
Listening to others without interrupting them	-5.356	<0.001
Stating differences when there is disagreement	-5.461	<0.001
Asking people to explain their reasoning	-5.429	<0.001
Asking in-depth questions & discussing	-5.311	<0.001
Providing constructive praise and criticism	-5.308	<0.001
Face to Face Promotive Interaction	-5.249	<0.001

The null hypothesis formulated for this was "There is no significant difference in face to face promotive interaction of experimental group students before and after cooperative learning". P value is less than 0.05 as can be seen from the table. The null hypothesis is therefore rejected and so it can be concluded that there is a significant improvement in face to face promotive interaction of students while undergoing cooperative learning.

Table 4.20
Individual Accountability

	Z - value	p - value
Accepts assigned role responsibly	-5.436	<0.001
Participates on clean up willingly	-5.410	<0.001
Contributes ideas and suggestions to group	-5.387	<0.001
Produces quality/relevant work	-5.491	<0.001
Completion of assigned work on time	-5.387	<0.001
Punctuality/regular attendance	-5.556	<0.001
Individual Accountability	-5.246	<0.001

For testing this, the null hypothesis formulated was “There is no significant difference in individual accountability of experimental group students before and after cooperative learning”. The null hypothesis is rejected as the p value was found to be less than 0.05. This reveals that there is a significant improvement in individual accountability of students after learning through cooperative learning techniques.

Table 4.21.1
Appropriate use of Collaborative Skills - Leadership

	Z - value	**p - value**
Performing assigned role and helping others to do so	-5.352	<0.001
Involving, valuing and recognizing contributions	-5.345	<0.001
Effectively managing time	-5.489	<0.001
Summarizing results and next steps before finishing	-5.436	<0.001
Maintaining focus and keeping to the point	-5.558	<0.001
Leadership	-5.252	<0.001

From the above table it can be seen that the p value is less than 0.05. This implies that the null hypothesis “There is no significant difference in leadership skills of experimental group students before and after cooperative learning” is rejected. It can be thus concluded that there is a significant improvement in leadership skills of experimental group students after undergoing cooperative learning.

Table 4.21.2
Appropriate use of Collaborative Skills - Communication

	Z - value	p - value
Addressing others by name	-5.346	<0.001
Looking at the person speaking	-5.360	<0.001
Actively listening to others	-5.318	<0.001
Interacts and discusses with all members	-5.348	<0.001
Communication	-5.248	<0.001

The null hypothesis formulated for testing the above was "There is no significant difference in communication skills of experimental group students before and after cooperative learning". The p value here is less than 0.05 and so the null hypothesis is rejected. This implies that cooperative learning brought a significant improvement in communication skills of the experimental group students.

Table 4.21.3
Appropriate use of Collaborative Skills – Trust Building

	Z - value	p - value
Depending and adding on each other's ideas	-5.460	<0.001
Accepting others suggestions/answers	-5.347	<0.001
Trust Building	-5.298	<0.001

The p value as can be seen from the above table is less than 0.05 and therefore the null hypothesis "There is no significant difference in trust building skills of experimental group students before and after cooperative learning" is rejected. This indicates that trust building skills improved significantly in experimental group students after undergoing cooperative learning.

Table 4.21.4

Appropriate use of Collaborative Skills – Decision Making

	Z - value	p - value
Pulls together all ideas into a single position	-5.466	<0.001
Directing the group in reaching consensus	-5.242	<0.001
Defends/ rethinks ideas relating to the group's goals	-4.975	<0.001
Decision Making	-5.248	<0.001

The null hypothesis formulated here was "There is no significant difference in decision making skills of experimental group students before and after cooperative learning". The p value obtained is less than 0.05 and thus the null hypothesis is rejected. There was thus a significant improvement in decision making skills of experimental group students after learning through cooperative learning techniques.

Table 4.21.5

Appropriate use of Collaborative Skills – Resolving Conflicts

	Z - value	p - value
Controlling emotional reactions	-5.385	<0.001
Disagreeing in an agreeable way	-5.374	<0.001
Makes necessary compromises	-5.370	<0.001
Suggesting solutions to conflicts	-5.386	<0.001
Resolving Conflicts	-5.257	<0.001

From above table p value obtained is less than 0.05. The null hypothesis "There is no significant difference in the resolving conflicts skill of experimental group students before and after cooperative learning" is rejected. It can be thus concluded that there was a significant improvement in experimental group students in the skill of resolving conflicts after undergoing cooperative learning.

Table 4.22

Group Processing

	Z - value	p - value
Setting group goals and work plans that everyone understands	-5.292	<0.001
Seeking and promoting consensus on teams goals and work plans to reach these goals	-5.353	<0.001
Assessing their team	-5.004	<0.001
Reflecting on what changes need to be done	-5.237	<0.001
Group Processing	-5.241	<0.001

For testing the above the null hypothesis formulated was "There is no significant difference in group processing of experimental group students before and after cooperative learning". It can be seen from the above table that p value is less than 0.05 and thus we can reject the null hypothesis. This implies that cooperative learning helped in the significant improvement of group processing element in experimental group students.

4.5 ANALYSIS OF STUDENTS' REACTION TOWARDS COOPERATIVE LEARNING

A rating scale was used to know the reaction of students towards cooperative learning. It was analyzed using percentage as shown in Table.4.23.

Table 4.23 Percentage Analysis of Student's Reaction towards Cooperative Learning

Sl. No.	Statements	S	A	N	S %	A %	N %
1	Peer interaction helped me to obtain a deeper understanding of the material	6	24	6	17	66	17
2	Group efforts in learning helped me to foster positive attitude towards learning	9	21	6	25	58	17
3	I discovered that CL enhanced my social skills	8	21	7	22	58	20
4	Cooperative efforts helps me to take on more responsibility for learning	10	18	8	28	50	22
5	CL paves easier way for me to learn difficult concepts.	7	23	6	19	64	17
6	I feel that CL helps us learn from each other what we don't know	10	19	7	28	53	19
7	Team efforts arouses my interest in studying the subject	8	21	7	22	58	20
8	Group efforts enhanced my communication skills	10	20	6	28	55	17
9	Working in teams promotes me to interact with all other members of class	6	23	7	17	64	19
10	Group work helps me learn new skills by viewing other students work	8	22	6	22	61	17
11	CL enhanced my learning skills	6	22	8	17	61	22
12	CL helped me get better grades	7	21	8	20	58	22
13	I am of the view that CL creates many disciplinary problems	14	6	16	39	17	44
14	I find that CL promotes friendship among students	10	20	6	28	55	17

Sl. No.	Statements	S	A	N	S %	A %	N %
15	I am against CL that makes the class too noisy	10	5	21	28	14	58
16	CL helped me know every member of the class closely	6	22	8	17	61	22
17	CL developed in me trust towards others	8	21	7	22	58	20
18	CL wastes much precious and valuable time for my studies	8	6	22	22	17	61
19	I found that some members never do works assigned to them but put it on others	10	8	18	28	22	50
20	CL helped to raise self-esteem and self-confidence in me	6	23	7	17	64	19
21	CL makes me feel more independent	8	20	8	22	56	22
22	CL helped me develop and gain leadership qualities	7	20	9	19	56	25
23	CL promotes and develops in me respect for others	11	19	6	30	53	17
24	I find that CL helps me make good and effective decisions	9	19	8	25	53	22
25	CL helps me to easily resolve conflicts that arise during the learning process	12	18	6	33	50	17
26	I understand that CL has the power to develop spirit of team work	7	22	7	19	62	19
27	I enjoyed cooperating with team members	10	20	6	28	55	17
28	I would like to study other subjects also using cooperative learning	6	22	8	17	61	22

S- Sometimes, A-Always, N-Never

Statement 1

"Peer interaction helped me to obtain a deeper understanding of the material".

Sixty six percent of the students revealed that peer interaction always helped them obtain a deeper understanding of the science content that they had to learn. Seventeen percent felt that sometimes only peer interaction helped them get a deeper understanding of their learning materials while the other seventeen percent said that it never helped them get a deeper understanding of the content. It can however be seen that majority of the students support the same and thus it can be concluded that peer interaction does help students obtain a deeper understanding of the materials.

Statement 2

"Group efforts in learning helped me to foster positive attitude towards learning".

Fifty eight percent students support the statement that group efforts always help foster positive attitude towards learning while twenty five percent felt that it happens only sometime. Seventeen percent of students have revealed that group efforts in learning never helped them to foster positive attitude towards learning. Since majority of students have reported positively it can be concluded that group efforts help to foster positive attitude towards learning.

Statement 3

"I discovered that CL enhanced my social skills".

Majority of the students (fifty eight percent) have supported the statement. They felt that CL always helped in enhancing their social skills. Twenty two percent felt that sometimes CL helped in enhancing their social skills while only twenty percent reported that CL never helped them enhance their social skills. It can be thus said that CL helps in enhancing the social skills of students.

Statement 4

"Cooperative efforts help me to take on more responsibility for learning".

Fifty percent of students have indicated that cooperative efforts always helped them to take on more responsibility for learning while twenty eight percent indicated that only sometimes it helped them take on more responsibility for learning. Only twenty two percent felt that it never helped take on more responsibility for learning thereby leading to the conclusion that cooperative efforts do help to take on more responsibility for learning.

Statement 5

"CL paves easier way for me to learn difficult concepts".

According to sixty four percent of students CL always paved easier way for them to learn difficult concepts in science and nineteen percent felt the same but only sometimes. Seventeen percent however revealed that CL never helped them learn difficult concepts in an easier way but as majority go in favour of the statement it can be concluded that CL paved easier way to learn difficult concepts.

Statement 6

"I feel that CL helps us learn from each other what we didn't know".

Fifty three percent of students reported that CL always helped them learn from each other what they didn't know and twenty eight percent felt that sometimes CL helps for the same. Nineteen percent have said that they never found CL help them learn from each other what they didn't know. It therefore can be seen that a significant proportion of students favored the statement and thus CL helped to learn from each other what they didn't know.

Statement 7

"Team efforts arouse my interest in studying the subject".

It was revealed by fifty eight percent of students that team efforts always aroused their interest in studying science and that by twenty two percent that only sometimes it aroused interest in studying. Twenty percent students said that team efforts never aroused their

interest in studying science. The findings thus indicate that a significant proportion of students agreed on it and so team efforts helped aroused interest in studying the subject.

Statement 8

"Group efforts enhanced my communication skills".

According to fifty five percent students group efforts always enhanced their communication skills and according to twenty eight percent it sometimes enhanced their communications skills. Only seventeen percent felt that group efforts never enhanced their communication skills. This therefore reveals that a significant proportion of the students agreed on it and thus group efforts enhanced communication skills.

Statement 9

"Working in teams promotes me to interact with all other members of class".

Sixty four percent students reported that working in teams always promoted them to interact with all other member of class, seventeen percent felt that it sometimes promoted interaction with all class members and only nineteen percent felt that it never promoted them to interact with all other members of class. It can be therefore concluded that working in teams promoted interaction with all members of class.

Statement 10

"Group work helps me learn new skills by viewing other students' work".

Findings indicate that sixty one percent of students felt that group work always helped them learn new skills by viewing other students' work, twenty two percent felt that only sometimes group work helped for the same while seventeen percent felt that group never helped them learn new skills by viewing other students' work. A significant proportion of students therefore agreed that group work helped learn new skills by viewing other students' work.

Statement 11

"CL enhanced my learning skills".

According to sixty one percent of students CL always helped them enhance their learning skills while as per seventeen percent CL sometimes helped in the same. Twenty two percent said that CL never helped them enhance their learning skills but as can be seen from above majority of the students supports the statement. It can be thus concluded as per students report that CL enhanced learning skills.

Statement 12

"CL helped me get better grades".

Majority of the students (fifty eight) agreed that CL always helped students get better grades. Twenty percent felt that sometimes CL helped them get better grades while twenty two percent said that CL never helped them to get better grades.

Statement 13

"I am of the view that CL creates many disciplinary problems".

It could be seen that majority of the students were in favour of CL and believed that CL doesn't create much disciplinary problems in class. Forty four percent reported that they never felt that CL creates disciplinary problems in class and thirty nine percent felt that only sometimes CL creates disciplinary problems. Only seventeen percent felt that CL always creates many disciplinary problems.

Statement 14

"I find that CL promotes friendship among students".

Fifty five percent found CL to always promote friendship among them and twenty eight percent felt the same sometimes. Seventeen percent however disagreed and felt that CL never helped promote friendship. It can be however seen that majority goes along with the statement and thus it can be concluded that CL promotes friendship among students.

Statement 15

"I am against CL that makes the class too noisy".

Fifty eight percent of the students never felt that CL makes the class too noisy and twenty eight percent felt that only sometimes it makes the class noisy. Only fourteen percent have said that CL always makes the class noisy. This implies that majority of students was not against CL and agreed that CL does not make the class too noisy.

Statement 16

"CL helped me know every member of the class closely".

Sixty one percent students agreed that CL always helped them to know every member of the class closely and seventeen percent felt that sometimes CL did help in the same. Twenty two percent students however said that CL never helped them know every member of the class closely. Since majority of the students were in support of the statement it can be said that CL does help students to know every member of the class closely.

Statement 17

"CL developed in me trust towards others".

It was revealed that CL developed in students trust towards others. Fifty eight percent of students indicated that CL always developed in them trust towards others and twenty two percent felt that sometimes CL did help build trust in them towards their classmates. Only twenty percent felt that CL never helped to build trust towards others.

Statement 18

"CL wastes much precious and valuable time for my studies".

Majority of the students were in favour of CL and revealed that CL does not waste much precious and valuable time for studies. Sixty one percent supported CL that it never wastes time for their studies and twenty two percent said that sometimes CL wastes time

for their studies. Only seventeen percent supported the statement that CL always waste their precious and valuable time for their studies.

Statement 19

"I found that some members never do works assigned to them but put it on others".

According to fifty percent students they never felt that members put their work on others and not do works assigned to them. Twenty eight percent felt it happened sometimes only while twenty two percent felt that it happened always. Since majority of the students were against the statement it can be said that in CL members do their assigned works and don't put it on others.

Statement 20

"CL helped to raise self-esteem and self-confidence in me".

Sixty four percent of students supported CL and said that it always helped them to raise their self-esteem and self-confidence. Seventeen percent felt the same sometimes and only nineteen percent were against the statement. Majority of the students supported CL and thus it can be said that CL does help to raise self-esteem and self-confidence.

Statement 21

"CL makes me feel more independent".

Majority of the students agreed that CL made them feel more independent thereby supporting CL. Fifty six percent have supported this. Twenty two percent have said that sometimes CL did make them feel more independent and twenty two percent never felt so.

Statement 22

"CL helped me develop and gain leadership qualities".

Fifty six percent of the students reported that CL always helped them develop and gain leadership qualities and nineteen percent felt that though not always, sometimes CL did

help in the same. Only twenty five percent felt that CL never helped them in developing and gaining leadership qualities. It can be seen that majority goes along with the statement and thus can be said that CL does help develop and gain leadership qualities.

Statement 23

"CL promotes and develops in me respect for others".

It was revealed by majority of the students (fifty three percent) that CL always promoted and developed in them respect for others. Thirty percent said that sometimes CL helped promote and develop in them respect for others and only seventeen percent never felt so.

Statement 24

"I find that CL helps me make good and effective decisions".

This statement has been supported by fifty three percent of students and also twenty five percent revealed that sometimes CL did help them make good and effective decisions. Twenty two percent however were against this but since majority of the students were in favour of the statement it can be concluded that CL does help make good and effective decisions.

Statement 25

"CL helps me to easily resolve conflicts that arise during the learning process".

According to majority of the students (fifty percent) CL always helped them easily resolve conflicts that came up during their learning process and as per thirty three percent sometime it did help them in the same. Seventeen percent however reported that CL never helped them in resolving conflicts but as majority of the students supported the statement it can be said CL does help in easily resolving conflicts that arise during their learning process.

Statement 26

"I understand that CL has the power to develop spirit of team work".

It was found that majority of the students agreed that CL had the power to develop spirit of team work. Sixty two percent supported CL and said that CL always has the power to develop spirit of team work and nineteen percent said that CL sometimes helped develop spirit of team work. Only nineteen percent students said that they never felt that CL has the power to develop spirit of team work.

Statement 27

"I enjoyed cooperating with team members".

Fifty five percent students indicated that they always enjoyed cooperating with team members. While majority of students felt that they always enjoyed cooperating with group members twenty eight percent revealed that though not always but sometimes they enjoyed cooperating with team members. Seventeen percent however said that they never felt so but as majority was in favour of the statement it can be concluded that in CL students enjoy cooperating with team members.

Statement 28

"I would like to study other subjects also using cooperative learning".

Majority of the students (sixty one percent) reported that they always would want to study other subjects also using cooperative learning, seventeen percent revealed that they would like to study other subjects using CL sometimes and only twenty two percent expressed their dislike to study other subjects using cooperative learning. This implies that students favour CL and would like to study other subjects also using cooperative learning.

Analysis of data obtained from present study and interpretation of results are considered in this chapter. It reveals that CL did make a significant difference in science achievement of students. There was a significant improvement in the five essential elements of CL in students and they showed a positive reaction towards CL. The chapter to follow delves deeper into these findings in the light of prior reviews done so as to draw valid inferences and meaningful implications.

Chapter 5
Discussion and Implications

CHAPTER 5
DISCUSSION AND IMPLICATIONS

In this chapter findings of the present study are discussed in relation to theory and prior research. The findings of the present study indicate that CL helped students to increase their achievement in science and also helped them develop the five essential elements of CL. This chapter tries to explain the findings in connection to theories and previous researches on CL and also gives implications of the study.

5.0 CL AND SCIENCE ACHIEVEMENT

A lot of studies are being carried out on teaching learning process and on how to make it effective. One such area is CL. A Meta analysis of 122 studies of CL done between 1924 & 1987 conducted by Johnson & Johnson (1987) revealed that CL tends to promote higher achievement than does competition or individual work with this finding holding for all age levels, all subject areas and a variety of tasks. Slavin (1991) also identified seventy studies that evaluated various CL methods for periods of four weeks or longer and reported that CL was found to be effective at all grade levels in the same degree, in all major subjects and in urban, rural and suburban schools. Effects were equally positive for high, average and low achievers. There were however some studies that contradicted the above findings also. Johnson et al., (1985) and Lazarowitz et al., (1985) found no significant difference in achievement of control and experimental group students. Apart from that, studies by Okebukola (1984), Sherman & Zimmerman (1986) and Sherman (1988) found results which were even favoring control group students.

The present study focused on the effectiveness of CL in science at elementary level. It was found that CL produced significant effects on achievement of experimental group students in science when compared to control group students who were taught using conventional method. This finding is in line with the findings of previous researches conducted by Humphreys et al., (1982), Okebukola (1985), Okebukola (1986), Kinney (1989), Lazarowitz (1991), Rahaya (1998), Paulson (1999), Agashe (2000), Kalaiyarasan & Krishnaraj (2002), Shachar (2003), Pandey & Joshi (2009), Wachanga, Kokero &

Mbugua (2010) and Kishore (2012) that CL helped improve science achievement of students effectively. The present finding supports the importance of group activities and discussions in science pedagogy as suggested by NCF (2005) and KCF (2007). It proves that the investigative nature of science does provide a unique setting for group work, particularly CL to build its framework as stated by Sherman (1994). The significant improvement in science achievement of experimental group students when compared to control group students rightly indicate that how effective cooperative learning is when compared to the traditional teacher centred method of teaching. It shows that working and learning in groups are much beneficial to students than individualistic learning. This can be explained in the words of Noddings (1985) that peer maybe more effective explainers than adults because peer share a similar language and they can translate difficult vocabulary into language that fellow students can understand. Apart from that, students feel free to ask questions and doubts while learning from their peers. The outcome of the present study that CL improved science achievement of students when compared to the traditional method of teaching science, corroborates the statement of KCF (2007) that CL is an effective strategy for science teaching and that it should be used in classes by teachers. Rutherford & Ahlgren (1990) have stated that the collaborative nature of scientific and technological work should be strongly reinforced by frequent group activity in the classroom. Apart from this the present finding also leads to the point that CL produces positive results for all types of students in a class. Every student in the class benefits through CL, irrespective of being high, average and low achievers. This supports the report of Slavin (1991) which identified seventy studies that evaluated various CL methods for periods of four week or longer and concluded that effects of CL were equally positive for high, average and low achievers. The significant improvement of science achievement of all students in the experimental group is an indicator of the same. Similar results were also obtained by Singhanayok & Hooper (1998). Their study investigated the effects of studying alone or in CL groups on the performance of high and low achievers of sixth grade students in Ecology and it was revealed that both high and low achievers in cooperative treatment performed better. CL gives low achievers a platform to mingle with the high achievers. It gives them an opportunity to share and discuss ideas and doubts with the high achievers, thereby leading to a better understanding and learning of

concepts. A study by Omrod (2004) also revealed that students of all ability levels show higher academic achievement. The findings of Wong (2001) and Mergendollar & Packer (1989) support the above statements. Wong (2001) reported that cooperative classrooms can effectively foster discussion which is so essential for understanding in science as well as other subjects. Mergendollar & Packer (1989) say that CL promotes active learning and students learn more when they talk and work together than when they listen passively. It motivates students and leads to academic gains. This can be explained from Vygotsky's (1978) concept of zone of proximal development. It is the distance between actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers. In CL, students operate in one another's close proximity. According to Kishore (2012), students learn according to their pace in CL, while in traditional teaching method all students have to follow a common pace, most of the time, set by the teacher. Students as a result enjoy and take interest in CL because role of teacher is not fixed to one or two students in the group. But it is interchanged among all of them according to the expertise on a particular topic. Group work gives students chances for interaction with others which is not available in the traditional teaching methods. In traditional classrooms, teachers do the talking and students remain passive listeners. Kishore (2012) explains that in CL when a child hears contradictory or challenging statements in the group, his/her equilibrium is upset and then their efforts to search answers enable to achieve a new and higher equilibrium. Working in groups also helps students develop positive attitude towards one another. The feeling of competing and outdoing one another as in individualistic learning is replaced with the feeling of oneness and concern for one another. They identify themselves with the group and start encouraging and motivating each other to learn and achieve.

The different techniques of CL used in the present study were Think-Pair-Share, Round robin Brainstorming, Group Investigation, Jigsaw, STAD and TGT. The positive finding of the study is a clear indicator of the effectiveness of these techniques in teaching science. It proves that these techniques are effective in teaching science and can foster science achievement of students. This is in congruence with the findings of previous researches conducted by Okebukola (1985), Okebukola (1986), Newmann & Thompson

(1987), Lazarowitz (1991), Scott & Heller (1991), Rahaya (1998), Fortner (1999), Agashe (2000), Kalaiyarasan & Krishnaraj (2002) and Kishore (2012). In these studies, some have used Jigsaw, STAD, TGT and Group Investigation specifically and some have used a combination of these techniques. Results indicated that these techniques were very effective in science teaching. Kishore (2012) revealed that STAD and Learning Together techniques of CL were equally effective in terms of achievement in science.

It can be therefore concluded that CL enhances achievement in science more than the traditional method of teaching and that CL techniques like Jigsaw, STAD, TGT, Group Investigation, Think-Pair-Share and Round robin Brainstorming are effective in science teaching.

5.1 CL AND GENDER

The present study revealed that CL does not influence gender. No significant difference was found between mean scores of achievement of experimental group students with respect to gender. The researcher did not also come across any study that reported CL to influence gender. This implies that CL techniques are equally effective for boys and girls. It helps all students irrespective of gender to make academic gains. Both boys and girls can reap maximum benefits by learning through CL techniques. In these techniques it is the group work, group discussions and sharing of ideas that matter and not the gender difference. The findings of the study lead to the fact that gender is not a barrier for effective learning to take place in science and what really matters is the methods of teaching. This has also been emphasized by Kalra (2007), that encouragement for participatory teaching learning process in such a way that every child gets opportunity to actively interact with the teacher and classmates is what is needed in science teaching. Teaching students using CL techniques would provide effective science education experiences to the students which will help them understand and learn concepts easily thereby leading to academic gains. The findings of the study support the same. According to Dickens (2005), to model real science in the making, instructional activities and situations should engage students in more student-to-student discussion of scientific ideas and more cooperative group work. The above views have also been reinforced by the social constructivist perspective that learners construct meanings when they interact with

each other. Collaborative activity among children promotes growth because children of similar ages are likely to be operating within one another's proximal zones of development, modeling in the collaborating group, behaviours more advanced than those they could perform as individuals.

5.2 CL AND CHAPTERWISE

It was seen that there is a significant difference between mean scores of achievement of experimental group students with respect to chapters. Students achieved more in fifth chapter when compared to the other four chapters. It cannot be however concluded that CL was more effective in fifth chapter and so students achieved more as there is no supportive evidence for the same. The findings of the study just indicate that there has been a difference in chapter wise achievement scores of students and that it was evident in fifth chapter. Usually it is seen that students score high marks in easy topics and comparatively less marks in difficult ones. In the present study however they scored almost equal scores for the first four chapters in spite of these four chapters having both easy and difficult concepts. One argument which may be considered is that while reaching the fifth chapter students were already well adapted to CL and had reached the comfort zone. They had developed the liking towards CL and knew how exactly to go ahead with it, as a result of which they performed well in the fifth chapter which is the last one. While reviewing studies on CL the investigator did not come across any study on effectiveness of CL with respect to different topics of a subject.

5.3 COOPERATIVE LEARNING AND THE FIVE ESSENTIAL ELEMENTS

The five essential elements of CL – Positive Interdependence, face-to-face interaction, individual accountability, appropriate use of collaborative skills and group processing were assessed using rating scale and accordingly graphs plotted as given in Chapter four. The Wilcoxon Signed Rank Test was also used to see if the increase in the essential elements of CL during the period of intervention was significant or not. The interpretations of the results for the five essential elements are as given below.

5.3.1 Positive interdependence

The graph plotted shows the initial value of positive interdependence to be 8.67 and at the end it becomes 19.17 (Figure 4). It gradually increased thereby showing the steady rise in Positive Interdependence of students while undergoing CL. The results of Wilcoxon Signed Rank Test show that the increase in Positive Interdependence of students was significant. They started building on each other's ideas and also listened patiently to each other before reaching conclusions in group activities. They started sharing responsibilities for the given tasks evenly. CL also helped them to develop positive attitude about the task and work of others which cannot be seen in the traditional methods of teaching. Group work enabled students to encourage and support the effort of others. This goes along with the findings of Bridgeman (1977) that students who had worked cooperatively using Jigsaw were better able to take the perspective of another person than were control students. A study by Battistich & Watson (2003) also revealed CL experiences to enhance the development of positive social attitudes towards other group members. Ryan, Reid & Epstein (2004) also reported that CL experiences enhanced the development of positive social attitudes toward other group members in students with emotional and behavioral disorders. In the global era it is very essential that students learn to work in groups effectively. The importance of Positive Interdependence is also rightly stressed by UNESCO (1996) that one of the tasks of education is to teach pupils and students about human diversity and to instill in them an awareness of the similarities and interdependence of all people. As per the social interdependence theory, Positive Interdependence tends to result in promotive interaction which in turn tends to result in a wide variety of outcomes that maybe subsumed into the categories of high effort to achieve, positive relationships and mental health. Johnson, Johnson & Holubec (1994) says that one of the important cooperative elements that have to be structured in the classroom is positive interdependence or cooperation and when it happens, group members encourage and ease each other's efforts to learn. Initially, students did not consider each other's ideas and were not ready to accept ideas from others. They jumped to conclusions before listening to other's ideas in the group but as CL progressed this changed. Students started to realize that they have to rely on one another to achieve the goal and that if any team member fails to do their part everyone suffers consequences.

The findings of the present study clearly indicate that CL helped develop Positive Interdependence in students in an effective way and CL therefore should be promoted more as an instructional strategy in schools.

5.3.2 Face to Face Promotive Interaction

The graph plotted using the values of face to face promotive interaction during each rating clearly indicate that there was an increase in face to face promotive interaction of students (Figure 5). Initially the value of face to face promotive interaction of students was 6.75 and after completion of CL strategy it became 16.83. The Wilcoxon Signed Rank test showed that the increase was significant. While implementing CL it was seen that in the beginning students interrupted each other while discussing. They never asked their group members to explain their reasoning and statements. Very rarely they asked questions to others and involved in discussions. When there were disagreements on statements they were reluctant to state their viewpoints and also they never got involved in providing constructive praise and criticism. It was however seen that as CL progressed, students started listening to others without interrupting them and even voiced differences when there were disagreements. They started questioning and asking group members to explain their reasoning and also got involved in discussions. They even developed the habit of providing constructive praise and criticism towards the end of CL though it was difficult for them and took a little more time in development when compared to other sub elements of face to face promotive interaction. Johnson & Johnson (1989) report that face to face promotive interaction powerfully influences efforts to achieve caring and committed relationships and psychological adjustment and social competence. Face to face promotive interaction is very important because without proper interaction students cannot share and learn new concepts. According to Damon (1984) and Murray (1982), the fundamental assumption of the developmental theories is that interaction among children around appropriate tasks increases their mastery of critical concepts. This supports Vygotsky's (1978) view that collaborative activity among children promotes growth because children of similar ages are likely to be operating within one another's proximal zones of development, modeling in the collaborating group, behaviours more advanced than those they could perform as individuals. Wittrock (1978) says that

research in cognitive psychology has found that if information is to be retained in memory, the learner must engage in some sort of cognitive restructuring, or elaboration of the material and one of the most effective means of elaboration is explaining the material to someone else which is developed through face to face promotive interaction. According to NCF (2005), interaction with teachers, with other peers of the same age group, as well as those who are older and younger can open up many more rich learning possibilities and CL helps for the same. A study by Jordan & Metais (1997) showed that social interactions became noticeably more varied and interpersonal relationships improved as a result of CL. The findings of the present study also support the same.

5.3.3 Individual Accountability

The graph plotted for individual accountability during the period of study clearly indicates that individual accountability of students increased with course of time (Figure 6). The mean initial value of individual accountability displayed by students before implementing CL was 14.67 and the final value after implementing CL was 26.39 which clearly shows an improvement for the same. The results of Wilcoxon Signed Rank test revealed that the difference in initial and final mean value of individual accountability of students was significant, that is, there was a significant increase in individual accountability of students after undergoing CL. Initially they had to be persuaded to accept their roles in groups and participate in clean up. It was also seen that if some members of the group gave ideas and suggestions others would accept it and further not give any of their own suggestions. The enthusiasm and responsibility to produce quality/ relevant work was lacking. This however was changed by the completion of CL. Students started accepting their assigned roles responsibly and willingly participating on clean up. Each member of the group started contributing ideas and suggestions to group and showed responsibility in producing quality/relevant work. Assigned works were completed on time and punctuality and regular attendance was maintained. CL helped students develop in them the sense of self accountability. They realized their duties and started performing them on their own. Working in groups developed in them the feeling that for their group to succeed each member should actively contribute and sincerely perform assigned duties. As a result students started being punctual and regular. Johnson

&Johnson (1998) report that generally the more positive the relationships among group members, the lower the absenteeism, the more students commit effort to achieve educational goals, take on difficult tasks, be motivated to learn, commit to each other's learning and success and achieve and produce. In a review of literature that documented the positive social benefits of CL by Onwuegbuzie (2001), it was seen that students developed good attitudes towards school, self-esteem, self efficacy, motivation, good relationships and regular attendance as a result of cooperative learning. It can be therefore seen that how CL helps develop individual accountability in students. It makes them responsible and they start understanding and performing their duties on their own. This is one essential element that has to be developed in students of present era where team works and team skills are gaining importance. The success of a person depends on how well he is able to work in group and also on how efficiently and responsibly he carries out his assigned role in the group. And for this CL is one of the best options. Teaching students though CL will help them develop individual accountability in their school days and thus have a better future.

5.3.4 Appropriate use of Collaborative Skills

Collaborative skills were divided into five sub skills like leadership, communication, trust building, decision making and resolving conflicts. Students were assessed on these sub skills while undergoing CL.

5.3.4.1 Leadership Skills

The graph plotted shows that CL helped in developing leadership skills of students. Before implementing CL the mean value of leadership skills of students was 6.67 and after implementation it became 16.47 (Figure 7.1). This clearly indicates that CL was effective in building leadership skills. The Wilcoxon Signed Rank test clearly indicates that there was a significant increase in leadership skills of students after undergoing CL. Initially students performed their assigned roles but didn't give attention to how and what their group members performed. They did not consider it important to involve, value and recognize the contribution of their group members. Many a times they couldn't maintain focus and keep to the point of discussion. They would deviate into other topics. As a

result time management was not possible and they could not summarize their results before finishing. It was however seen that while learning through CL techniques these aspects of students started undergoing change and by the end of the term they portrayed leadership skills as was desired. Along with performing their assigned roles they also helped their group members to do so and even started involving, valuing and recognizing the contributions of their group members. During group activities they started managing time effectively by maintaining focus on the topics of discussion. It also helped them in summarizing results and steps before finishing their group work.

5.3.4.2 Communication Skills

Results of Wilcoxon Signed Rank test clearly reveal that CL brought a significant improvement in communication skills of students. It can be seen from the graph that initially the mean value of communication skills of students was 6.44 and finally it reached 18.31thereby indicating a substantial improvement of the same (Figure 7.2). During the initial classes it was seen that they hardly addressed their group members by names and rarely looked at the person speaking. They were not interested in listening to their groupmates' views and also did not interact or discuss with all members. They would interact with only those whom they liked or knew well. CL helped change these characteristics and students started developing appropriate communication skills. They started addressing others by name and looking at them while they spoke. They even started actively listening to all members and interacting and discussing with all group members without any bias. This was very appreciable and positive as in the global era, team work skills and social interaction are what are most in demand and for this good communication skills are very crucial.

5.4.3.3 Trust Building

CL also helped develop in students trust building skills. They started depending and adding on each other's ideas which were initially not done. CL helped them build trust on group members. They developed mutual trust and started accepting each other's suggestions/ answers. The graph plotted shows how trust building skills developed in students (Figure 7.3). The mean value of this skill which was four before implementation

of CL reached 8.33 after implementation of the same. The results of Wilcoxon Signed Rank test implies that trust building skills improved significantly in students after learning through CL techniques.

5.3.4.4 Decision Making

The mean value of skill of decision making of students was 3.39 as can be seen from the graph (Figure 7.4). After implementing CL, however, the mean value became 8.56 which supports CL as a method for improving decision making skills of students. There was a significant increase in decision making skills of students after undergoing CL and this was supported by the results of Wilcoxon Signed Rank test. At the beginning, students were hardly able to relate and direct all ideas into a single position. They never defended or thought again on ideas relating to their group's goal. As CL progressed, this situation started changing and it could be seen that students started directing their group in reaching consensus. They started defending and rethinking ideas relating to their group's goals and started directing all ideas into a single position thereby showing improved signs of decision making.

5.3.4.5 Resolving Conflicts

The graph plotted using mean values of students' skills of resolving conflicts reveal that it was successfully built in students while learning through CL (Figure 7.5). The mean value of skills of resolving conflicts which was 5.64 before implementation of CL reached 15.36 after implementation of CL. It can be therefore seen that CL helped to effectively develop the skills of resolving conflicts in students and also the improvement was significant. This is supported by the results of Wilcoxon Signed Rank test. While undergoing CL it was seen that students started controlling their emotional reactions which was not to be seen before implementation of CL. Initially they used to rudely disagree with other members when their views didn't match and never made compromises. But after undergoing CL it was seen that students started making necessary compromises and even if there were disagreements in views they expressed it in an agreeable way in order to avoid conflicts. As a step further they even started suggesting solutions to conflicts which came up between their group members.

It can be therefore seen how CL helped develop in students the appropriate use of collaborative skills. These findings go in line with the findings of Ryan & Wheeler (1977) that students who had studied cooperatively made more cooperative and helpful decisions in a simulation game than did students who had studied competitively. A study by Towns & Grant (1997) on graduate students revealed that the sharing of insights and ideas between students leads to the development of interpersonal skills and communication skills which the students perceive as an important component. Findings of Ballantine & Larres (2009) also support the present findings. They reported that the CL cohort perceived their learning experience to be significantly more effective at enhancing interpersonal and communication skills than that of the simple group learning cohort. This study provides evidence that CL is a more effective model for delivering interpersonal and communication skills than simple group learning. In the present era, it is very essential that learners be well equipped with collaborative skills along with good academic skills records. With globalization on its merge, a skilled workforce is the need of the hour. It demands learners with good interpersonal and team building skills and those who can work, adjust and perform well in teams. The above findings clearly indicate that CL is one of the best methods for the same and thus highlights its importance.

5.3.5 Group Processing

It can be seen from the graph that CL techniques helped develop group processing element of CL in students (Figure 8). Initially mean value of group processing element was 4.56 and after implementation of CL it reached 12.08. The Wilcoxon Signed Rank test also reveals that CL helped in the significant improvement of group processing element of students. Before implementation of CL it was seen that students set group goals and work plans as per group leader decided. The consent of all group members was also not taken care of while setting teams goals and work plans to reach these goals. Hardly students assessed their teams and reflected on what changes need to be done. It could however be seen that with the progress of CL, the group processing element of CL started developing and being displayed by students. The members started making sure

that all group members understood the group goals and work plans and also sort consent of all members of group for the same. CL developed in them the spirit of performing better than other groups and as a result they started assessing their groups and reflecting on what changes need to be done so that their group would excel in the tasks given. The above findings can be explained with the views of Johnson et al., (1981) and Slavin (1983) that cooperative goal structures create a situation in which the only way group members can attain their own personal goals is if the group is successful. Therefore to meet their personal goals, group members must help their group mates to do whatever helps the group to succeed. For this, students have to make sure that all have understood the team goals and work plans and also assess their group and find out where changes need to be done. This element is very essential because it gives students chance to find out how their group performed and what necessary modifications need to be taken to improve the effectiveness of group performance. It can be seen from above discussion that how effective CL is in developing Group Processing element in students and thus this supports the need for promoting CL in our classrooms.

5.4 STUDENTS REACTION TOWARDS CL

For any new teaching method to be successful it is very essential that students develop an interest and liking towards the method. The findings of the present study indicate that students benefitted from CL both academically and socially and they also developed a positive outlook towards CL. They developed a genuine liking and interest towards CL after experiencing the benefits of CL by themselves. Majority of the students said that peer interaction always helped them to obtain a deeper understanding of the material and it paved an easier way for them to learn difficult concepts. It helped them to take on more responsibility for learning. They revealed that CL helped them learn new skills by viewing other students work and learn from each other what they don't know. It enhanced their learning skills thereby helping them get better grades. They felt that CL fostered positive attitude towards learning and aroused interest in studying the subject. These findings are corroborated by the findings of Okebukola (1986c), Whicker, Bol & Nunnery (1997), Zainun (2001), Mazlan (2002), Vaughan (2002), Mehra & Thakur (2008) and Thurston et al., (2010). Singhanayak & Hooper (1998) and Bibi (2002) found

that students had positive attitudes towards group work activities. A study by Wang (2006) indicated that students learning cooperatively had higher final course grades and had more positive attitudes about the English learning mechanism they experienced through Jigsaw than those who learned through traditional Chinese methods. Students also expressed that they would like to study other subjects using CL. Similar results were also obtained by Veenman et al., (2002), Gupta (2004) and Mehra & Thakur (2008).

Findings of the present study revealed that students felt that working in teams helped them to interact with all members of class and thus know every member of class closely. It promoted and developed in them trust and respect for others. This helped promote friendship among students. Students stated that group efforts enhanced their communication skills and also enhanced their social skills. They also revealed that they enjoyed cooperating with team members. Similar findings were also reported by Cooper et al., (1980), Phelps (1990), Battistich & Watson (2003), Schachar (2003), Ryan, Reid & Epstein (2004), Rai & Rout (2008) and Ballantine & Larres (2009). Majority of the students have stated that CL helped to raise their self- esteem and self confidence. This goes in line with the findings of Blaney et al., (1977), Madden & Slavin (1983), Johnson & Johnson (1983), Uscher (1986) and Kalaiyarasan & Krishnaraj (2004). It was also revealed by students that CL made them feel more independent. It helped them develop and gain leadership qualities and make good and effective decisions. They felt that CL also helped them to easily resolve conflicts that came up during the learning process and CL has the power to develop the spirit of teamwork. The findings of Deutsch (1949), Ryan & Wheeler (1977), Gupta (2004) and Liao (2005) corroborate the same.

Finally majority of the students have supported CL and mentioned that CL doesn't make the class too noisy nor does it create many disciplinary problems. They have stated that CL doesn't waste their time for studies and are also against the view that in CL some members never do works assigned to them but put it on others. On the whole students have found CL to be a very effective, enjoyable and interesting method as revealed by Agashe (2000). They have clearly indicated that CL gives them a higher self-efficacy about their chances of being successful, increases their intrinsic motivation to learn school subject matter and participate more actively in classroom activities, and also

exhibit more self-regulated learning, which goes in line with the findings of Omrod (2004).

5.5 IMPLICATIONS OF THE STUDY

According to NCF (2005), the first educational aim is a commitment to democratic values of equality, justice, freedom, concern for others' well being, secularism, respect for human dignity and rights. The present academic environment of our schools however does not seem to promote this aim as our classroom environments are still competitive in nature. Most of the time students work independently and compete with one another for marks, awards and recognition. As a result students are more concerned about their own well being than others. So it's high time that the competitive nature of our classrooms be changed and cooperation be brought in. One such method supporting the same is cooperative learning. CL gives students chances to interact with others as they learn. They work in groups on academic tasks with a common goal. CL not only helps in achieving academic gains but also social gains as suggested by NCF (2005). The present study clearly indicates how CL helped in producing a significant improvement in science achievement of students when compared to students taught using conventional method of teaching. Along with gain in achievement, CL also helped in developing the five essential elements namely Positive Interdependence, Face to Face Promotive Interaction, Individual Accountability, Appropriate Use of Collaborative Skills and Group Processing among students. In this method, students learned through cooperation rather than competition, which is what, is being stressed by NCF (2005). CL helped students interact with each other as they learned new concepts. They shared ideas and worked together on a common goal. As a result, along with acquiring knowledge they also achieved the benefits of social participation thereby showing significant improvement in their leadership skills, communication skills, decision making skills, trust building skills and skills of resolving conflicts. They started respecting each other, accepting their ideas, listening to others and also became individually accountable. In the present era of globalization, where more stress is on a skilled workforce, CL is an apt method for promoting the same. Implementing CL in schools would help develop some of the essential skills needed for students to face the challenges of globalization in future. If

students learn to work in groups in schools it would also prepare them for work and social tasks they would face in their future. The findings of the study clearly support the same. Along with improving on their achievement in science, students also improved significantly on their social aspect, which is the need of the present society. It was also seen from the findings that students enjoyed learning through CL and displayed a positive reaction towards CL. They preferred CL over their traditional method of teaching and expressed interest to learn other subjects also using CL. The findings of this study therefore support CL as an effective strategy for improving science achievement and also developing the five essential elements of CL. The study also indicates that CL was liked by students, which is very essential, because for any method to be a success students should enjoy and approve it. It can be seen that within a period of six months CL showed its effectiveness. Teachers can therefore try this in classrooms. This study also shows that it is not essential to implement all CL techniques in a class to make CL a success. Teachers new to CL can start with simple techniques as used in present study. The five essential elements of CL developed in students over the period of six months and this is a positive sign for teachers. Initially though there were problems in grouping students and controlling noise, as the study progressed it was overcome. Assessing students on the five essential elements was also little difficult initially but with the advent of time it could also be done properly. With the passage of time students realized the benefits of CL and developed interest in it and as a result they cooperated very well. This helped in dealing with the above mentioned problems and thus led to successful implementation of CL. This study therefore reveals that CL can definitely be promoted as an instructional strategy in science in our classrooms and can be also tried in other subjects at all levels.

The discussion presented in this chapter explicitly supports the effectiveness of CL in teaching science and advocates the importance of CL as a teaching strategy for science in schools. The recommendations based on the findings and suggestions for future research are included in the final chapter. The major findings of the present study are also summarized in this chapter.

Chapter 6
Summary and Major Findings

CHAPTER 6

SUMMARY AND MAJOR FINDINGS

The present chapter deals with the summary of the study along with the major findings. It also gives recommendations on the basis of these findings and suggestions for further research.

6.0 INTRODUCTION

In the present era, globalization has made its impact on all sectors of the society and education is no exception. What is needed at the hour is a globally competent workforce. Learners need to be having global skills that would help them survive and compete in the global world. Opportunities for present generation students often depend as much on their communication and collaboration skills as they do on pure academic skills. The changing scenario of workplace requires responsibility and self-management, as well as interpersonal and project-management skills that demand teamwork and leadership. According to UNESCO (1996), children should be taught to understand other people's reactions by looking at things from their point of view. Where this spirit of empathy is encouraged in schools, it has a positive effect on young persons' social behaviour for the rest of their lives. From early childhood, education should focus on the discovery of other people in the first stage of education. In the second stage it should encourage involvement in common projects. Thus one of the essential tools for education in the twenty first century must be a suitable forum for dialogue and discussion. One such strategy promoting this aspect is Cooperative Learning. Cooperative learning involves students working together in small groups to accomplish shared goals. It is widely recognized as a teaching strategy that promotes socialization and learning among students from kindergarten through college and across different subjects. The most widely used definition of cooperative learning in education is probably that of Johnson & Johnson (1994). According to them, Cooperative Learning is an instruction that involves students working in teams to accomplish a common goal, under conditions that include the five essential elements of Positive Interdependence, Face to face promotive interaction, Individual Accountability, Appropriate use of Collaborative Skills and Group Processing.

Lyeman & Foyle (1988) call it a method of promoting academic achievement that is not expensive to implement. Mergendollar & Packer (1989) say that cooperative learning promotes active learning- students learn more when they talk and work together than when they listen passively. It motivates, leads to academic gains, fosters respect for diversity and advances language skills. Cooperative learning has been proved to be effective in all subject areas and science is no exception. Science enables pupils to be involved in group work, where they have the opportunity to share ideas and cooperate with each other in collaborative practical activity. According to Rutherford & Ahlgren (1990), "The collaborative nature of scientific and technological work should be strongly reinforced by frequent group activity in the classroom. Scientists and engineers work mostly in groups and less often as isolated investigators. Similarly, students should gain experience sharing responsibility for learning with each other. In the process of coming to common understandings, students in a group must frequently inform each other about procedures and meanings, argue over findings and assess how the task is progressing. In the context of team responsibility, feedback and communication become more realistic and of a character very different from the usual individualistic textbook- homework-recitation approach." Dickens (2005) says that to model real science in the making, instructional activities and situations should engage students in more student-to-student discussion of scientific ideas and more cooperative group work. There have been many studies conducted abroad on the effect of cooperative learning in science and almost all have found cooperative learning to have a positive impact on science learning. But in spite of this, not many studies have been conducted on cooperative learning in India. Even if National Curriculum Framework (2005) has stressed on group activities and discussion with peers and teachers to be made important components in science pedagogy, cooperative learning has still not become a common instructional technique in science in our country. This might be because teachers don't have proper awareness regarding cooperative learning and its implementation in classroom. According to Umasree (1999), students are rarely given opportunities to do things or take the initiative in classes. The student participation is limited only to seeking clarification on their teaching points. Lecture method is used in seventy percent of the cases observed. Similar findings were also reported by Ramkumar (2003). So this calls for research to be done on

these aspects. The findings of such studies can help teachers to make a move from the traditional methods of teaching and use cooperative learning more frequently and easily. It is in this context that the present study was taken up.

6.1 STATEMENT OF THE PROBLEM

The study is titled as "A Study on the Effectiveness of a Strategy based on Cooperative Learning for Science Teaching in Class VII".

6.2 OBJECTIVES OF THE STUDY

1) To develop a strategy based on cooperative learning for teaching of science in class VII.
2) To study the effectiveness of the strategy based on cooperative learning in science for class VII students in terms of:-
   (a) their academic achievement
   (b) gender
   (c) units of science
   (d) the five essential elements of cooperative learning, that is, Positive Interdependence, Face-to-face promotive interaction, Individual Accountability, Collaborative skills which is further subdivided into leadership skills, communication skills, trust building skills, decision making skills and skills of resolving conflicts, and group processing.
3) To study the reaction of students to the strategy based on cooperative learning in science.

6.3 HYPOTHESES OF THE STUDY

1) There will be no significant difference between mean scores of achievement of the students who studied through cooperative learning strategy and that with conventional method.
2) There will be no significant difference between mean scores of achievement of experimental group students with respect to
   (c) Gender
   (d) Units of science

3) There will be no significant difference in positive interdependence of students before and after implementation of cooperative learning.
4) There will be no significant difference in face to face promotive interaction of students before and after implementation of cooperative learning.
5) There will be no significant difference in individual accountability of students before and after implementation of cooperative learning.
6) There will be no significant difference in the collaborative skill of leadership of students before and after implementation of cooperative learning.
7) There will be no significant difference in the collaborative skill of communication of students before and after implementation of cooperative learning.
8) There will be no significant difference in the collaborative skill of trust building of students before and after implementation of cooperative learning.
9) There will be no significant difference in the collaborative skill of decision making of students before and after implementation of cooperative learning.
10) There will be no significant difference in the collaborative skill of resolving conflicts of students before and after implementation of cooperative learning.
11) There will be no significant difference in group processing of students before and after implementation of cooperative learning.

6.4 METHODOLOGY OF THE STUDY

6.4.1 POPULATION

The study was carried out in Ernakulam district in the state of Kerala. There are 105 English medium schools with upper primary classes in Ernakulam following Kerala State Board Syllabus. All class VII students of Ernakulam district (approximately 8400 students) formed the population of the study.

6.4.2 SAMPLE

First, the English medium schools with upper primary classes and following Kerala State Board Syllabus that are ready to provide facilities for implementing the developed strategy were listed. From this, two schools were randomly selected and from these two schools, students of class seven from one school were randomly selected as experimental

group and the other as control group. All students in the class were included. There were thirty six students in the experimental group and thirty nine in the control group. Thus in a way this becomes cluster sampling. Cluster sample is a variation of the simple random sample that is particularly appropriate when the population of interest is infinite, when a list of the members of the individuals is widely scattered.

6.4.3 DESIGN OF THE STUDY

Study is quasi experimental in nature. The Pretest-Posttest Non Equivalent-Groups Design was used. Random selection of students is not possible because of practical limitations. That is why this design is chosen. This design is often used in classroom experiments when experimental and control groups are such naturally assembled groups as intact classes, which may be similar. Here the Dependent variable is science achievement and the five essential elements of cooperative learning. The independent variable is the strategy based on cooperative learning.

O_1 X O2	O_1O_3= Pretests	X= Experimental group
O_3 C O4	O_2O_4= Posttests	C= Control group

First pretest was given to both experimental and control group. Then experimental group was given intervention. Finally posttest was administered to both the groups. Any experimental design will have threats to its experimental validity i.e. to internal validity and external validity. The presence of control group will take care of the threats to internal validity like maturation, history and testing. To make up for experimenter bias a teacher from that school was asked to assess the students for the five essential elements of cooperative learning using rating scale along with the investigator. In threats to external validity, interference of prior treatment is not applicable here. For dealing with potential threat, investigator directly observed classes to make sure that the process was carried out as intended by investigator. Thus every effort was made to minimize threats wherever possible and accordingly interpret results.

6.4.4 TOOLS

6.4.4.1 ACHIEVEMENT TEST

Achievement test was designed based on the selected five chapters of science. The same test was used in parallel form for the pre-test and post-test. First, the instructional objectives were prepared for each chapter. This would describe the type of performance pupils are expected to demonstrate. Then the course content was outlined which indicates the areas in which each type of performance is to be shown. Objective and short answer type questions were used. Based on these the blue print was prepared for each chapter and then test items were designed. Answer keys were also prepared to maintain objectivity of scoring. The developed test was then given to experts for validation in terms of content, instruction, objectives etc. and based on the suggestions, same was modified. A pilot study was also conducted on ten students in schools other than the sampled schools.

6.4.4.2 RATING SCALE FOR ASSESSING THE FIVE ESSENTIAL ELEMENTS OF CL

A five-point rating scale was developed for assessing students in cooperative learning. The scale checked categories for positive interdependence, individual accountability, face-to-face promotive interaction, use of collaborative skills and group processing. Collaborative skills were further subdivided into skills of leadership, communication, trust building, decision making and resolving conflicts. A field diary was used along with rating scale. Participant observation was also done. The tool was given to experts and based on their suggestions it was finalized.

6.4.4.3 RATING SCALE FOR KNOWING STUDENTS' REACTION TOWARDS CL

For knowing students' reaction towards cooperative learning a rating scale was developed. This was also send to experts for their suggestions and then finalized. There were twenty eight items and three options- sometimes, always and never. Students ticked the option that they felt indicated their experience in CL. This was send to experts for their suggestions and then finalized.

6.4.5 DATA COLLECTION

Data was collected for one term of the year i.e. six months. In one term there are five chapters to be taught in science. First the pre-test was administered to both the groups. Then the respective five chapters in science were taught to the experimental group using the strategy based on cooperative learning techniques. For this, first the content to be taught was analyzed thoroughly and then appropriate techniques chosen accordingly. The control group was taught by their class teacher using regular classroom teaching. After that, post-test was administered to all students of both control and experimental group. The field diary and rating scale were used in between for assessing students on the five essential elements of cooperative learning while learning. The class teacher of the experimental group also rated students on the five essential elements of CL along with the investigator. After the intervention the rating scale for knowing students reaction towards CL was administered to the experimental group.

6.4.6 DATA ANALYSIS

In the present study, existing or intact groups were involved but treatments were assigned to them randomly and to take care of that, ANCOVA was used for analysis. For a study based on a pretest- posttest control group design, covariance is a superior method for controlling for pretest differences. Difference in achievement of boys and girls and shapter wise analysis of data were also done using ANCOVA. Rating scale was used to assess students on the five essential elements of Cooperative Learning- Positive Interdependence, Face to face promotive interaction, Individual accountability, Appropriate use of collaborative skills and Group processing. Scoring was done accordingly and the corresponding average means of all the elements during each rating was found. A graph was plotted for each of the elements using the mean values of the nine elements corresponding to each rating. The development of the essential elements was thus seen but in order to see if the increase is significant or not the Wilcoxon Signed Rank Test was used. Data on students' reaction to CL was analyzed using percentage.

6.5 MAJOR FINDINGS

- There was a significant difference between mean scores of achievement of the students who studied through cooperative learning strategy and that with conventional method. Experimental group students scored higher than control group students and thus cooperative learning helped in increasing science achievement of students than the traditional method of teaching.
- There was no significant difference between mean scores of achievement of experimental group students with respect to gender. It can be therefore concluded that cooperative learning does not influence gender and it produces similar positive results for both boys and girls.
- There was a significant difference between mean scores of achievement of experimental group students with respect to chapters. It was seen that in the first four chapters, scores were almost similar and it was in the fifth chapter that they scored higher. The fifth chapter was on Biodiversity and while teaching its concepts using cooperative learning techniques it could be seen that students showed more interest in learning them.
- It was seen that there was a significant difference in positive interdependence of experimental group students before and after implementation of cooperative learning. Cooperative learning helped students develop positive interdependence in them.
- There was a significant improvement in face to face promotive interaction of students while undergoing cooperative learning. Students developed face to face promotive interaction while learning through cooperative learning techniques and the difference in initial and final values of the same was significant.
- A significant improvement was found in individual accountability of students after implementation of cooperative learning. Cooperative learning helped make the students more individually accountable than they were before implementation of cooperative learning.
- It was found that there was a significant difference in leadership skills of experimental group students after undergoing cooperative learning. Students developed leadership skills in them after learning through cooperative learning techniques and the improvement was significant.

- Cooperative learning also had a positive impact on communication skills of students. It bought a significant development in communication skills of the experimental group students. There was a significant difference in communication skills of students before and after implementation of cooperative learning.
- It was found that the trust building skills of experimental group students improved after undergoing cooperative learning. A significant difference was found in trust building skills of students before and after undergoing cooperative learning.
- There was a significant difference in decision making skills of experimental group students before and after cooperative learning. Students developed decision making skills after implementation of cooperative learning. They showed a significant improvement in skill of decision making after learning through cooperative learning techniques.
- Cooperative learning helped students resolve conflicts among themselves. A significant difference was found in the skill of resolving conflicts of experimental group students before and after cooperative learning. Before implementing cooperative learning, only few students made attempts to resolve conflicts in their groups but after implementing cooperative learning all students showed a significant improvement in the skill of resolving conflicts.
- Finally, cooperative learning also helped students to develop the element of group processing. There was a significant difference in group processing element of experimental group students before and after implementation of cooperative learning. Group processing element of cooperative learning improved significantly in students after undergoing cooperative learning.
- After implementation of cooperative learning, students' reaction towards cooperative learning was determined using rating scale. It was found that students favoured cooperative learning and showed a positive reaction towards learning through cooperative learning.

6.6 RECOMMENDATIONS

On the basis of the findings of this study the following recommendations are given:

- CL should be promoted as one of the major teaching strategies for science in schools.
- Policy makers and School authorities should frequently conduct workshops and training programmes on CL and its implementation for teachers and encourage teachers for the same.
- Teachers should be given opportunities to discuss with experts in the field of CL whenever needed. This would help teachers to clear doubts on CL and its implementation.
- Policy makers and school authorities should see to it that appropriate tools needed for assessing students in CL be designed by a panel of experts and be given to teachers of all schools. Teachers should also be given training for constructing valid tools for CL and its five essential elements, i.e. positive interdependence, face to face promotive interaction, individual accountability, appropriate use of collaborative skills and group processing, during workshops and training programmes. This would help reduce burden of teachers and also maintain uniformity in assessments made by all teachers.
- Syllabus should be framed in such a way that it gives ample scope for implementing CL along with being able to be completed on time.
- Policy makers and School authorities should also see to it that in schools the number of students in a class is reduced (thirty-forty) because only then proper implementation of CL will be possible.
- Regular monitoring of CL implementation in schools should also be done. An expert committee should be set up for the same by policy makers with the support of school authorities. The committee should make timely visits to schools and submit report on the issues and problems being faced while implementing CL. This will help bring to limelight the major hindrances coming in the way of CL and expert guidance can be sought for remedial measures for the same.
- Recognition and rewards should be given to teachers who implement CL successfully and come up with innovative ideas for the same. The techniques and guidelines used

by such teachers should be made available to teachers of all schools for reference by higher authorities.

- Teachers should also be given a common platform wherein they can share their CL experiences with each other and clarify doubts on the same.
- Policy makers and school authorities should design handbook on CL and distribute it to all teachers.
- Higher authorities should also try to locate and collaborate with those educational institutes abroad, wherein CL is being carried out effectively and regularly. Interaction with such institutes and educationists who practice CL regularly will help get a clearer picture on the ground reality of implementing CL.
- School authorities and teachers should build a strong alliance with parents by explaining to them the importance of CL as well as the challenges to be addressed while implementing it.
- Teachers should become aware of students' adjustment problems while working in a group and provide ample guidance for the same.
- Teachers should address problems faced by students during CL in class by exploring students' concerns and, if necessary, meet with the school authorities, school counselor and parents of identified students to confront this issue.
- Teachers new to CL can start with those techniques of CL with which they feel most comfortable. During the initial stage teachers should be more flexible with CL and make students feel comfortable. Students should be given time to understand and get adjusted with CL techniques.
- School counselors should collaborate with school officials to identify students experiencing problems with CL.
- School counselors should conduct classroom guidance topics on working in groups and resolving conflicts in groups.
- School counselors should also practice different forms of relaxation techniques with students, as this will help them handle conflicts that arise in group works more easily.
- Students should be given orientation on CL and its implementation, its advantages and the challenges to be faced while implementing CL.
- Parents should make that sure their children attend school regularly.

- They should evaluate their children's academic progress over a period of time rather than on one single test score.
- Parents should talk with their children and encourage them to do their best.
- They should not compare their child's performance with that of others.
- Parents should be proactive and contact school officials if they have issues concerning CL.
- Apart from science, CL can also be used for teaching other subjects and at different class levels as it can be clearly seen from the review of related literature that CL has been found to be an effective teaching strategy for all subjects and at all levels.

6.7 SUGGESTIONS FOR FURTHER RESEARCH

The present study was an effort to find out effectiveness of CL strategy in science teaching of class seven students in Kerala. There are however many other situations wherein one can further explore the effectiveness of CL. The following are a few suggestions for further studies that can be taken upon CL.

- The effectiveness on CL can be studied in other subjects.
- Studies can be conducted at various grade levels
- Similar studies can be conducted in other states.
- The effect of CL as an instructional strategy can be carried out in Central Board of Secondary Education (CBSE) and Indian Certificate of Secondary Education (ICSE) schools. The development of five essential elements of CL with respect to type of schools and gender can also be studied.
- The present study was conducted on English medium students. Studies can be taken up in schools with regional language as medium of instruction.
- Studies with increased duration can be taken up.
- Research maybe conducted to study the level of concept retention of students undergoing CL and traditional method of teaching.
- The effect of CL on low, average and high achievers can be studied.
- Research can also be undertaken to study the extent to which the five essential elements of CL are retained in students after completion of CL.

- Studies maybe undertaken to see if CL helps in developing in students, life skills, social skills, soft skills and skills other than those that come in the five essential elements of CL.
- The present study only used six techniques of CL (Jigsaw, STAD, TGT, Group Investigation, Round robin Brainstorming and Think Pair Share). Effectiveness of other techniques of CL can also be studied.
- A comparative study can be undertaken with respect to the effectiveness of different techniques of CL. It can be studied whether any one technique is more effective than another one.
- The effectiveness of CL techniques with respect to different subjects can also be studied.

6.8 CONCLUSION

It can be therefore seen from the present study that CL helped in increasing science achievement of students than the traditional method of teaching. It helped students develop positive interdependence, face to face promotive interaction and individual accountability in them. The study revealed that students significantly improved on appropriate use of collaborative skills like leadership, communication, trust building, decision making and resolving of conflicts. It could however be seen that cooperative learning does not influence gender and it produces similar positive results for both boys and girls. The study also showed that students achieved more in fifth chapter when compared to the other four chapters. It cannot be however concluded that CL was more effective in fifth chapter and so students achieved more as there is no supportive evidence for the same. The findings of the study just indicate that there has been a difference in chapter wise achievement scores of students and that it was evident in fifth chapter. Further work could be conducted in this area to find out if CL influences the units being taught.

The study clearly shows that CL is an effective teaching strategy which not only helps in academic gains but also in developing the social aspects of the learners. It helps in building the desired global skills in learners, which at present, is the need of the hour. Implementing CL and assessing students in CL, however, needs a lot of patience and time

and is not an easy task. Only with the joint efforts of school authorities, teachers, students and parents, can these goals of CL be achieved. So it is high time that more researches be done to investigate these areas in depth. The present study is a step made in this regard. The findings of such studies can help teachers, parents, students and others involved in the educational field to cope with the present problems and issues being faced while implementing CL in classrooms, as well as while assessing students in CL, and thus exploit the benefits of CL to the maximum.

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Appendices

APPENDIX A

CHAPTER 1: GREEN COVER

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
1) Methods of cultivation	09.06.10 & 10.06.10	Students (i) Compares advantages and disadvantages of methods (ii) Differentiates between them (iii) Infers which method is better and why (iv) Summarizes all points (v) Concludes which method is better	Teacher narrated the example of two farmers using different methods of cultivation. Asked students to discuss on how these methods differ, which method is better and why. Gave hints on crop rotation and intercropping.	Technique of Round Robin Brainstorming was used. Students were made to sit in groups of five. One student was made recorder. Each student expressed his ideas and views on the example of the two farmers. All the points of each student regarding methods of cultivation, which method is better and why were noted	After the allotted time teacher asked questions to each group and based on that evaluated them on content. Field diary was used to note down activities and progress of every group. Rating scale was used for assessing students in five essential elements of CL during the group work.

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
				down by a recorder in the group. Group discussion followed. Students reached final answer that crop rotation and intercropping are better methods of cultivation.	
2) Methods to produce improved varieties of plants	11.06.10 & 14.06.10	Students (i) Discusses on the method, cites examples (ii) Develops curiosity (iii) Develops skill of observation and experimenting (iv) Compares different	Teacher briefed on each method to produce improved varieties of plants. Then the topics were given to each group to learn on.	STAD technique was be used. Students were divided into groups of four. After teacher presented the topic, students in each group studied the topics on budding, grafting, layering and tissue	At the end of class, teacher asked questions to all group members to assess students. During assessment group members were not allowed to help each other. Group scoring highest marks

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
		techniques		culture and made sure that all their group members also learnt it. Students were also made to do practical for budding and grafting techniques.	was given points in class chart.
3) Hybridization	15.06.10	Students (i) Discuss and identify characteristics of pea plants given (ii) Compare the characteristics (iii) Develops skill in observing (iv) Suggests and infers characteristics of	Teacher asked students to go through the activity given in the text book on hybrid variety plants. Teacher gave hints and clue for the same. Asked students to discuss and complete the task in pairs.	Think Pair Share technique was used. Students were divided into pairs. Each pair worked on the task allotted and found out characteristics of hybrid variety plants and thus understood the concept of	After pairs completed the given task, each pair read out their answers in class. After all pairs read their answers teacher gave right answer and common discussion followed to rectify wrong answers and

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
		hybrid variety plants		hybridisation.	clear doubts.
4) Agricultural Research Institutions and Improved variety of seeds	16.06.10, 21.06.10 & 22.06.10	Students (i) Discuss and identify various agricultural research institutions and their achievements. (ii) Lists and cites examples of improved variety of seeds. (iii) Reads various articles related to topic (iv) Develops curiosity and independent thinking	Teacher divided the class into groups of six. Gave project to each group. Students were asked to collect information about research institutions and their achievements in the field of agriculture and whether these achievements made were properly utilised in their locality. Teacher gave guidance on how to collect information. Teacher	The technique of Group Investigation was used. Class was divided into groups of six. Each group worked on the topic and submitted report. In each group, each member worked on different subtopics of project. Students got to know the various agricultural research institutions and their achievements and to what extent it is being	Groups were given one week time to carry out their work. After submission of report, grades were assigned accordingly. Findings were presented by each group in class and discussion followed. Groups with highest grades were given prizes. Students were assessed on the five essential elements of cooperative learning

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
		(v) Analyses whether achievements of agricultural research institutions are properly utilised in locality. (vi) Draws inference on the same	also asked students to find out improved variety of seeds developed as a result of research works.	made use of in their localities.	using the rating scale during the group work.

CHAPTER 2: WATER TO BE CONSERVED

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
1) Rainwater into the Earth, Landslide	23.06.10 & 24.06.10	Students (i) Discuss and list various factors that allow penetration of rainwater into soil as well as those that prevent penetration (ii) Classifies factors into natural and manmade (iii) Identifies and proposes reasons why penetration of rainwater is not uniform in all parts	Teacher gave a brief introduction on rain and puddles of water in many places after rain. Asked students to recollect scenes from locality and school premises when it rains and where rainwater goes. Students were asked to discuss on factors that help seeping of rainwater into soil and vice	Class was divided into groups of five. Jigsaw was used. Each student in a group was assigned a particular subtopic. Students of all groups with same subtopic came together and discussed on how to teach it to other members. After that they got back to original groups and taught each other their sub topics. Students found and listed out various factors that helped seeping of rainwater	Teacher asked questions to all members of the group and based on their answers grades were given. Students were asked questions from subtopics assigned to other group members and not the one assigned to them.

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
		of the earth. (iv) Analyses causes of landslides and gives suggestions on how to minimise it	versa. Teacher gave examples of landslides from local regions and asked students to find out probable reasons for it and give their suggestions for minimising landslides.	into soil as well as prevent seeping. They understood how landslides were caused and came up with suitable suggestions for preventing/minimising the same.	
2) Various methods adopted to prevent soil erosion and promote penetration of	25.06.10 & 29.06.10	Students (i) Discuss and read on the content (ii) Identifies methods used to prevent soil erosion (iii) Analyses the	Teacher gave brief explanation on the content. Gave sources from where students can collect information.	Group investigation was used. Class was divided into groups of six. Each group discussed on the topic and decided how to collect information. Each member of the group made	Groups were given two days time to complete their assignment. Each group submitted their report and one member of each group

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
rainwater into the soil.		various methods		contribution. Students got to know various methods adopted like dykes, planting trees, loosened soil, terraced land and so on to prevent soil erosion and promote penetration of rainwater into soil.	presented their report in class. Based on their report and presentation, points were given. Class discussion followed.
3) Hydroelectric power, Reservoir, Advantages & Disadvantages of dams	30.06.10, 01.07.10 & 02.07.10	Students (i) Discuss on how electricity is produced from power of water (ii) Compares functioning of hydroelectric power	Teacher explained the content and after that divided the class into groups of four. Then each group was given time to learn the content.	STAD was used. Students were divided into groups of four. After teacher presented the topic each group learnt it and made sure that all group members have learnt it. Students understood the concept of	After the given time each group was asked questions by the teacher. Each member of the group had to answer and based on that performance marks were given.

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
		station with the experiment they conducted (iii) Draws inference on harm caused by construction of dams to human beings and animals (iv) Suggests advantages and disadvantages of dams		hydro electric power and how power is produced from force of flowing water to generate electricity. They learnt what dams are made for, its advantages and disadvantages.	Prizes were given to groups scoring highest marks.
4) Distillation, Conventional Methods of water purification,	06.07.10, 07.07.10, 08.07.10 & 09.07.10	Students (i) Discuss on the topic (ii) Identifies and lists various methods of water pollution	Teacher divided the class into groups of five and assigned each member of the group a subtopic.	Jigsaw was used. Students were divided into groups of five. Each member of the group learnt a particular subtopic i.e., distillation, conventional methods of	At the end of the class questions were asked to all group members. Each member was questioned from other

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
How water pollution can be checked, Water Consumption		(iii) Classifies and compares different methods of water purification (iv) Analyses water pollution and consumption in their locality. (v) Gives suggestion for the same (vi) Draws inference on water consumption	Gave a brief explanation on the topics.	water purification, modern methods, how water pollution can be checked and so on. Students with same subtopics got together and learnt it. After that they got back to their original groups and taught other members of their group that subtopic. Students made sure that all group members have learnt all subtopics assigned to them.	subtopics and not the one allotted to him. This made sure that all members have learnt all subtopics. After that points were given to groups based on their performance. Rating scale was used to assess the development of five essential elements of cooperative learning. Students were assessed when they are carrying out their group activities.

CHAPTER 3: WHEN HEAT ACTS

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
1) How clothes become dry, Factors that help in drying of clothes, Evaporation	16.07.10 & 19.07.10	Students (i) Discuss on content (ii) Identifies factors that help in drying of clothes (iii) Suggests reasons for the same	Teacher gave a brief introduction on the topic. Gave hints and clues related to factors that help in drying of clothes.	Technique of Round Robin Brainstorming was used. Students were divided into groups of five. One student was made recorder. Each student gave his/ her views on drying of clothes and listed out factors that helped in drying of clothes like heat, wind, surface area, atmospheric temperature evaporation and humidity. All points were noted down by the recorder and finally	After all groups completed their discussion each group was asked to present their answers. Class discussion followed. The correct answers were noted down.

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
				summarised.	
2) Thermal Expansion in solids, liquids and gases	21.07.10, 22.07.10 & 23.07.10	Students (i) Observe and discuss on the findings (ii) Establishes relationship between heat and expansion of solids, liquids and gases (iii) Proposes reasons for the same (iv) Compares thermal expansion in the three (v) Defines thermal	Teacher briefed the students on the topic. Gave hints on how to carry out activities. Asked each group to prepare a report on the activity with proper explanations.	Group Investigation technique was used. Students were divided into groups of six. Each group carried out the activities on solids, liquids and gases based on the instructions given in the text book. They found out that heat causes all substances to expand.	One member from each group presented their results in class. Class discussion followed. Each group submitted their report and based on the report and performance of students the groups were evaluated and given marks. Prizes were given accordingly.

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
		expansion			
3) Difference in Density	26.07.10 & 27.07.10	Students (i) Discuss and define density (ii) Analyses and compares density difference in solids, liquids and gases (iii) Interprets formula of density (iv) Draws inference on difference in density of solids, liquids and gases	Teacher explained the concept of density and difference in density of solids, liquids and gases. Demonstrated activities for the same and asked students to note down observations and summarise the results.	The technique of STAD was used. Students were divided into groups of four. After teacher explained the topics each group discussed on the topic. Group members ensured that each member has learnt and understood the topics taught. Each member of the group made a note on the topics taught and activities conducted on density and difference in density of solids, liquids and gases. They learnt the concept of	After completion of specific time teacher questioned each member of all groups. Based on the performance of each member, groups were given grades.

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
				density and concluded that in solid state density is higher.	
4) Sea breeze and Land breeze, Atmospheric pressure, Fluid pressure	28.07.10, 02.08.10, 03.08.10 & 04.08.10	Students (i) Discuss and identify reasons for occurrence of sea breeze and land breeze (ii) Compares sea breeze with land breeze (iii) Defines atmospheric pressure (iv) Makes interpretations and	The topics were briefed by the teacher. Certain hints were given on how to discuss and understand topics. Teacher explained the activities to know the pressure of gases and fluids. Teacher helped students by giving clues/hints while carrying out activities.	Jigsaw was used. Students were divided into groups of five. Each student of a group was given a separate subtopic like sea breeze, land breeze, atmospheric pressure and fluid pressure. Students who got the sub topic sea breeze teamed up together to learn. Similarly students who got atmospheric pressure as a subtopic came together and so on. After learning their	After group study each member of the group was asked questions from subtopics assigned to his teammates. Based on the performance of each member the groups were given marks and rewards. Students were assessed on the five essential elements of cooperative learning

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
		draws inference from activities conducted to know pressure exerted by gases and fluids.		topics and conducting activities to find out pressure exerted by fluids and gases, students returned to their original groups. They then taught their group members what they learnt. Each member made sure that his team members have understood and learnt the topic assigned to him.	using rating scale while they carried out their group work.
5) Mullaperiyar Dam	05.08.10 &10.08.10	Students (i) Discuss on dams and water pressure (ii) Identifies and analyses reasons of threat faced by	Teacher briefly explained the issues on Mullaperiyar Dam. Gave details of sources from where students could get information	Group Investigation technique was used. Students were divided into groups of six. Each group collected details on Mullaperiyar Dam from	After groups submitted the reports group leaders made presentations. Class discussion followed. Grades were given based on how members

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
		dams (iii) Predicts how raising of water level affects dam (iv) Gives suggestions to overcome threats	on the same. Explained to students how to carry out project work.	newspaper and internet. Each member of the groups was allotted some work. All points were summarised by groups and report was prepared on Mullaperiyar Dam and threats faced by dam due to rising of water level. Suggestions were given by groups on how to deal with the threat.	of each group contributed and answered in class. The groups scoring highest grades were given prizes. Students were assessed on the five essential elements of cooperative learning using rating scale while they carried out their group work.

CHAPTER 4: THE WORLD OF SOUND

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
1) How is sound produced?	11.08.10 & 12.08.10	Students (i) Discuss on the topic (ii) Observe the experiment using tunic fork (iii) Infers how sound is produced (iv) Establishes relation between vibration of tuning fork and sound produced	Teacher briefed students on the experiment using tunic fork. Gave hints on how to relate between vibration of fork and sound produced.	Technique of Think-Pair-Share was used. Class was divided into pairs. Each pair worked on the experiment and noted down findings on how sound is produced and on relation between vibration of fork and sound produced. Each pair then presented their findings in class that sound is produced when there is vibration of fork.	After each pair made their presentation class discussion followed. Results were discussed and doubts clarified.
2) Musical instruments,	13.08.10, 16.08.10 & 17.08.10	Students (i) Compare different	Teacher gave few clues on the	Jigsaw was used. Students were divided into groups of	After group study each member of the group

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
human voice, loudness		musical instruments (ii) Identifies and classifies instruments on the basis of how they are used (iii) Discusses on hw human voice is produced	classification of musical instruments on the basis of how they are used. Briefed on how human voice is produced and also on control of voice.	five. Each student in a group was given a separate sub topic. Students who got the sub topic classification of musical instruments teamed up together to discuss on that. Similarly students who got human voice teamed up and so on. After discussion and learning in groups they returned back to their original groups and taught their sub topics to their group members. They classified instruments on the basis of how they are used. They learnt how human voice is produced and that intensity of	was asked questions from subtopics assigned to his teammates. Based on the performance of each member, the groups were given grades.

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
				sound is called loudness. Each member made sure that his team members have understood and learnt the topic assigned to him.	
3) When sound strikes on objects, Echo	18.08.10 & 19.08.10	Students (i) Discuss on the topic (ii) Conduct the experiment on echo using pipes, mirror and tuning fork (iii) Observes and notes down findings (iv) Infers about reflection of sound from experiment (v) Defines echo	Teacher guided students on how to conduct the experiment on reflection of sound. Gave hints on how to define echo and how it is formed.	Group investigation was used. Students were divided into groups of six. Each group conducted the experiment. They wrote down the procedure of experiment and observations on reflection of sound and how echoes are formed.	After groups submitted the reports, group leaders made presentations. Class discussion followed. Marks were given based on how members of each group contributed and answered in class. The groups scoring highest marks were given

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
					points in class chart.
4) SONAR, ultra sound scan, reducing echo, how do we hear	30.08.10, 31.08.10 & 02.09.10	Students (i) Discuss and explain to each other the concept of SONAR and ultra sound scan (ii) Compares different materials in the experiment on reflection of sound to find out in which one reflection is least. (iii) Interprets from	Teacher briefly explained the concept of SONAR and ultra sound scan. Guided students and gave hints on how to arrive at results from experiment on reflection of sound using different materials. Gave clues on how reflection of sound can be reduced.	Technique of STAD was used. Students were divided into groups of four. After teacher explained the topics each group discussed on the topic. Each member made sure that every member of his group understood the concept of SONAR and ultra sound scan and that reflection of sound can be reduced by making surface of walls rough, spreading carpet on floor, arranging enough	After completion of specific time teacher questioned each member of all groups. During that time group members were not allowed to help each other. Based on the performance of each member, groups were given grades.

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
		experiment when reflection will be least (iv) Gives suggestions on how reflection of sound can be reduced (v) Interprets how we hear sound		windows, curtains, upholstery seats and so on.	
5) Different media through which sound travels	03.09.10 & 08.09.10	Students (i) Discuss and conduct experiment using match box , water and pipe (ii) Makes inference related to movement of sound through	Teacher guided students in conducting the experiment using matchbox, water and pipe.	Technique of group investigation was used. Students were divided into groups of six. Each group conducted the experiment and found out that sound travels through solid, liquid and gas. They made a report based on	Each group presented their report in class. Class discussion followed. Based on their performance grades were given. Rating scale was used to assess students on

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
		different media		their observations and findings.	the five essential elements of cooperative learning during the entire process.
6) Noise Pollution, laws to control noise pollution, violation of laws, preventing sound pollution	09.09.10 & 13.09.10	Students (i) Discuss on noise pollution (ii) Identifies laws of noise pollution (iii) Reads and analyses necessity of such laws (iv) Cites examples of where these laws are violated in their locality	Teacher briefly explained noise pollution and its laws. Guided students on how to collect information from newspaper and internet to prepare report on noise pollution.	Group investigation technique was used. Class was divided into groups of six. Each group discussed on the topic and assigned each member different sub topics to work on. After collecting information group members prepared report on noise pollution and its laws. They developed awareness on noise pollution and gave	Groups prepared the report on noise pollution and group leader presented the report. After the presentation of all groups discussion followed during which each member of the group had to answer questions. The group performing well was

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
		(v) Gives suggestions on how to prevent noise pollution		suggestions to minimise it.	given prize. Students were assessed on the five essential elements of cooperative learning using the rating scale while they carried out their group work.

CHAPTER 5: LET US GROW TOGETHER

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
1) Human activities that harmfully effect existence of organisms, Levelling of hill slopes, filling of paddy fields, deforestation	16.09.10 & 17.09.10	Students (i) Recognises and discusses on the different human activities that affect existence of organisms (ii) Identifies the problems caused by the same (iii) Interprets how destruction of one type of organism affects others	Teacher briefed students on the topic. Gave certain clues on how to analyse the human activities and the harm it causes.	The technique of Round Robin Brainstorming was used. Students were divided into groups of five. One student was made recorder. Each student in the group gave his ideas and views on how human activities affect the existence of organisms and how destruction of one type of organism affects the other. All points were noted down by the recorder and finally summarised.	Teacher asked questions to each member of the group after the group work was completed. Based on their performance scores were assigned. Groups scoring highest scores were given points in class chart.

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
2) Food chain, decomposers, importance of decomposers, ecosystem, biodegradable and non biodegradable wastes	22.09.10, 23.09.10, 24.09.10 & 28.09.10	Students (i) Discuss and establish relation between organisms in food chain (ii) Classifies organisms under different links in food chain. Classifies biodegradable and non biodegradable wastes (iii) Defines decomposers and bio-wastes (iv) Predicts what would happen if there was no decomposition	Teacher briefly narrated how food chains are formed. Gave an outline on decomposers and ecosystem. Gave few examples of biodegradable and non biodegradable wastes to help students get an idea on the same.	Jigsaw technique was used. Students were divided into groups of five. Each member of the group was allotted a separate sub topic. Students who got food chain as a subtopic from each group teamed up together to study it. Similarly students who were allotted other subtopics got together and learnt. After studying in these groups students got back to their original groups and taught group members their subtopic.	After all groups finished learning questions were asked to each member of the group. Questions were asked from sub topics which were allotted to other members. Based on this performance marks and rewards were be given.

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
		(v) Proposes reasons for decrease in number of rat snakes which were common in their locality (vi) Identifies problems caused by dumping wastes in rivers (vii) Cites examples of different types of ecosystems		They learnt what decomposers are, its importance, the different ecosystems and the difference between biodegradable and non biodegradable wastes.	
3) Bio pollutants, Compost, Wastes used to prepare compost	30.09.10, 01.10.10, 04.10.10, 05.10.10 & 06.10.10	Students (i) Discuss the concept of bio pollutants and compost (ii) Proposes reasons for accumulation of bio wastes	Teacher briefed students on the concept of bio pollutants and compost. Explained how compost is prepared and gave	STAD was used. Students were divided into groups of four. After teacher finished briefing on the topics group members discussed and learnt the topics. Each group member expressed	After the allotted time questions were asked to each member of the group. During that time no group member was

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
		(iii) Identifies bio wastes seen in school and locality (iv) Analyses how compost is made (v) Gives suggestions on how to prepare compost in school (vi) Predicts the benefits to environment by preparation of compost .	clues on how compost can be prepared for school garden.	his ideas and clear doubts on bio pollutants and compost preparation. They learnt how bio wastes in their school surroundings could be converted to manure by preparing compost.	allowed to help each other. Based on their answers groups were given grades and rewards. Students were assessed on the five essential elements of cooperative learning using the rating scale during the group work.
4) Plastic in soil and water, When plastic burns, Plastic pollutants	07.10.10, 08.10.10 & 11.10.10	Students (i) Identify and explain the harm caused by plastic pollutants to water and soil (ii) Gives suggestions on	Teacher guided students in discussion on how plastics pollute our environment and how burning of plastics	RoundRobin Brainstorming was used. Students were divided into groups of five. Each group had a recorder who noted down all suggestions given by each	After the given time each group presented their results in class. Class discussion followed. Each

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
		measures to be taken to reduce the amount of plastic pollutants	affect our lives. Gave hints on how to reduce plastic pollutants.	member on plastic pollutants. Each group discussed and wrote down how burning of plastic pollutes air and how plastic pollutants cause harm to water and soil. They noted down the measures to be taken to reduce the amount of plastic pollutants.	member of the group was asked questions. Based on their performance scores and recognition was be given. Students were assessed on the five essential elements of cooperative learning using rating scale while they carried out their group work
5) Harmful effects of human	12.10.10 & 15.10.10	Students (i) Discuss, identify and	Teacher guided students on how to	Group investigation technique was used.	Report was presented in class by a group member

CONTENT	DATE	OBJECTIVES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION
interference in nature		list the human activities that affect the existence of other organisms (ii) Analyses how these activities affect the existence of other organisms (iii) Gives suggestions to minimise the harmful effects of human interference in nature	prepare report on the different harmful human activities that affect the existence of other organisms. Gave hints on how to minimise the harmful effects of human interference in nature.	Students were divided into groups of six. Each group divided the topic into subsections and each member of the group was given a subsection to work on. After collecting information individually the members got back to their groups and prepared a report in group on how different human activities like deforestation and dumping of plastic wastes in water affect the existence of other organisms and how it can be minimised.	after the given time period. Class discussion followed. Based on the report and presentation grades were assigned. Students were assessed on the five essential elements of cooperative learning using rating scale while they carried out their group work.

At the end of each chapter the technique of TGT was also conducted.

APPENDIX B

DRAFT OF TEST PAPER- 1ST TERM

SUBJECT: SCIENCE MAXIMUM MARKS: 100

CLASS : VII TIME: 3 hrs

General Instructions

1) This question paper has four sections (I, II, III AND IV).
2) Read all questions carefully.
3) All questions are compulsory.
4) Feel free to ask doubts if any.
5) This test is a part of a thesis work. The data will be strictly confidential and the marks will be used only for research purpose.

I. FILL IN THE BLANKS WITH AN APPROPRIATE WORD

(1X20=20 marks)

1) A branch of malgoa mango is organically joined with a local variety. This technique is called _____.
2) A system of communication where signs are used instead of sounds is _____.
3) Any one method adopted in your house to avoid water pollution is _____.
4) If soil stores water beyond its capacity the bond between rock and soil becomes weak causing _____.
5) Hybridization is a technique to produce high quality _____.
6) The quantity of any substance contained in its unit volume is called _____.
7) Two factors that help in drying of clothes are_____ and _____.
8) Voice is produced by vibration of _____in the larynx located in throat of human beings.
9) Green plants prepare food by _____.
10) The two essential factors required for the existence of life on earth are _____and _____.
11) When mud, sand, biological substances etc mix with water it gets coloured. This is called _____
12) A device which functions by utilizing air pressure is _____.

13) Unit of loudness is _____.

14) An example of an ecosystem is _____ .

15) Intercropping is not possible along with cultivation of _____.

16) The power generated from force of water stored in dams is called _____.

17) The measure of water in atmosphere is called _____.

18) Food wastes, garbage and other biological wastes can be converted into manure by the process of _____.

19) Speed of sound in solid is 4816m/s. sound travels 14 times faster in solid than in air. Then its speed in air is _____.

20) An example of hybrid variety rice is _____.

II. TRUE OR FALSE (1X20=20 marks)

Write 'T' for true or 'F' for false in the given box.

21) ☐ Cultivation of coconut and plantain together is an example of crop rotation.

22) ☐ One litre of water and one litre of kerosene will have the same weight.

23) ☐ Distillation helps to remove impurities from solids and make them pure.

24) ☐ Plastic is a biodegradable waste.

25) ☐ In cooing of pigeons loudness is high.

26) ☐ A healthy branch of an improved variety of plant that grows downwards is good for layering.

27) ☐ Water in reservoir has potential energy.

28) ☐ Rate of evaporation decreases as atmospheric pressure increases.

29) [ ] Plants prepare food by themselves and are called consumers.

30) [ ] Sound cannot travel in vacuum.

31) [ ] Coconut is a major crop.

32) [ ] Convectional current occurs only in liquids.

33) [ ] Very bad quality water can be used for drinking after thorough purification.

34) [ ] The safest way to get rid of plastic wastes is by burning it.

35) [ ] In silent zones including hospitals and schools sound limit is 55dB during day time and 40dB in night.

36) [ ] Hybridization is done between two plants belonging to same species.

37) [ ] Dams are constructed in between two plains through which water flows.

38) [ ] Clothes become dry during night also.

39) [ ] The part of a mosquito that is vibrated when it produces sound is its vocal cord.

40) [ ] Compost is made from non biodegradable wastes.

III. CHOOSE THE CORRECT ANSWER (1X20=20 marks)

Corresponding to the right answer write (a), (b), (c) or (d) in the given blank.

41) Ultrasonic sound is produced by _____.

(a) eagle (b) owl (c) bats (d) cricket

42) Energy formed due to movement is _____.

(a) potential energy (b) gravitational energy (c) kinetic energy (d) strain

43) Grafting is widely used in _____.

(a) Rubber (b) jasmine (c) pineapple (d) mango

44) As we go up atmospheric pressure _____.

(a) Decreases (b) increases (c) remains same (d) becomes zero

45) Among the following_____ is a decomposer.

(a) Fungus (b) mushroom (c) virus (d) moss

46) Which one of the following is not an agricultural research centre in Kerala?_____

(a)National Seed Corporation (b) Regional Research Centre

(c)Regional Seed Corporation (d) Central Tuber Crops Research Institute

47) The salinity of sea water is not due to _____.

(a) Sodium (b) zinc (c) calcium (d) magnesium

48) Density of ice is _____ water.

(a) Greater than (b) less than (c) twice that of (d) same as

49) Sound travels fastest in _____.

(a) Solids (b) liquids (c) gases (d) vacuum

50) An example of non- biodegradable substance is _____.

(a) Fallen leaves (b) bones (c)glass (d) coconut shells

51) Which of the following is a type of layering? _____

(a) Air layering (b) Branch Layering (c) Ring Layering (d) Stem Layering

52) Germs in water are killed by using _____.

(a) Alum (b) UV rays (c) chlorine (d) potassium

53) In summer the telephone lines will be _____.

(a) Tight (b) hanging (c) soft (d) hard

54) Ear ossicles are capable of _____ the loudness of sound received.

(a) Increasing (b) decreasing (c) increasing or decreasing (d) neither increasing nor Decreasing

55) The _____ of organisms and their surroundings together form ecosystem.

(a) Independence (b) intradependence (c) interdependence (d) self dependence

56) Which one of the following is not a method to produce improved varieties of plants? _____

(a) Layering (b) budding (C) intercropping (d) grafting

57) Major portion of water on earth is _____.

(a) sea water (b) underground water (c) glaciers (d) lakes

58) Bio wastes become _____ when they are continuously dumped in the same place.

(a)Bio manure (b) Bio remnants (c) bio pollutants (d) bio garbage

59) Sea breeze is the _____ wind blowing from sea to land.

(a) cold (b) hot (c) strong (d) mild

60) Which among the following can be categorized into a single group? _____

(a) Veena, guitar, mandolin (b) drums, flute, shehnai (c) violin, sarod, tabla

(d) Veena, guitar, beaugle

IV. ANSWER THE FOLLOWING QUESTIONS VERY BRIEFLY (2-3 LINES) IN THE SPACE PROVIDED

(2X20=40 marks)

61) A farmer plants wheat in his field and gets a good yield. But after harvesting his crops instead of cultivating the same crop he cultivates crops which belong to pea family in the field. What could be the reason for this?

62) How can you purify water in your homes?

63) Group the following musical instruments on the basis of

(a) How they are used-: Tabla, Jass, Veena, Shehnai, Flute, Violin, Clairnet, Guitar and Drums

(b) Hindustani, Carnatic, Western-: Veena, Tabla, Harmonium, Jass, Guitar, Mandolin, Sitar and Mridangam

64) Give an example of an ecosystem from your surroundings/ locality.

65) Why do clothes spread in hot sun dry fast?

66) Observe the two pea plants carefully. Draw the hybrid variety of these two plants.

67) In a hilly area of Wayanad during heavy rains people loose their homes and have their farms destroyed due to mixture of water and soil separating from rocks and flowing through slopes. How can this problem be overcome or minimized?

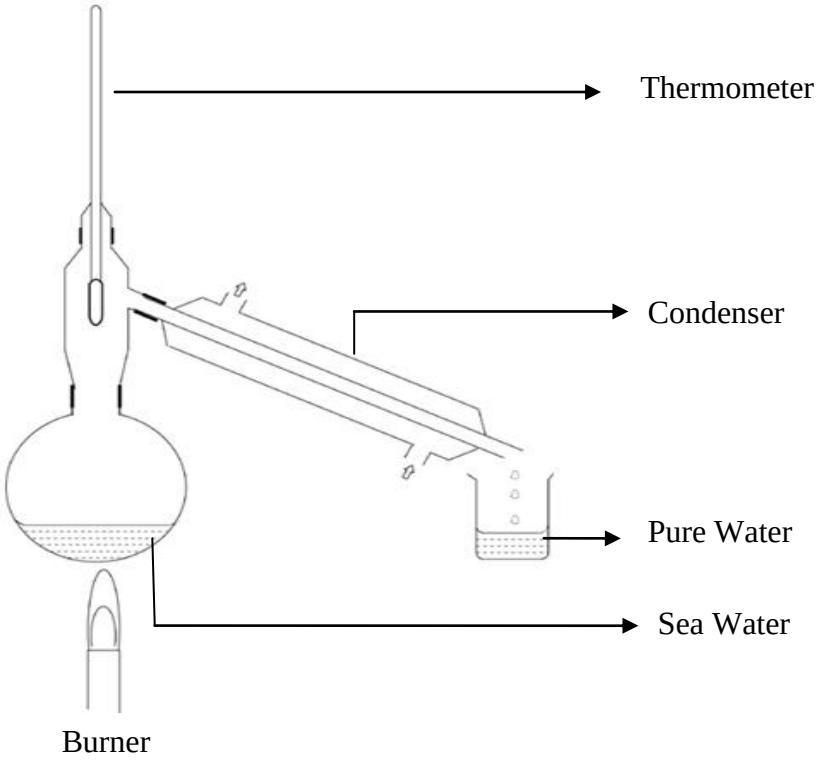
68) Aluminum has weight 270g and silver 1050g. If both Aluminum and Silver of same volume ($100cm^3$) is taken then which would be denser?

69) Certain times it is not necessary to see your friends to recognize them. You can identify them separately just by listening to their voices. How is this possible? Explain.

70) Based on the food relation among the animals given below group them into two. Connect them using arrow marks.
Grass, Lion, Tapioca, Snake, Deer, Rat

71) Observe the picture of the plant given below carefully. How can we grow such a plant with flowers of different colours?

72) Explain the following diagram. Name the process carried out here.



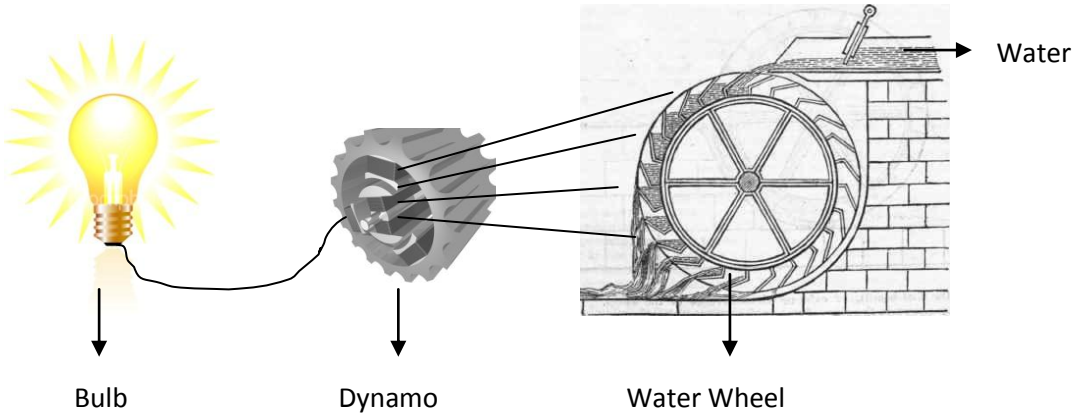
73) Discuss the functioning of any one device which functions by utilizing air pressure.

74) An aeroplane has just taken off from an airport. After one hour how can you determine its distance from the land? What is the principle behind this?

75) How can bio wastes seen in surroundings of your school be converted to manure?

76) In the same village farmer A gets a good yield and farmer B gets a low yield for the same crop. What could be the reasons for this difference in harvest? How can farmer B get a good harvest?

77) Observe the given diagram. What makes the bulb glow here?

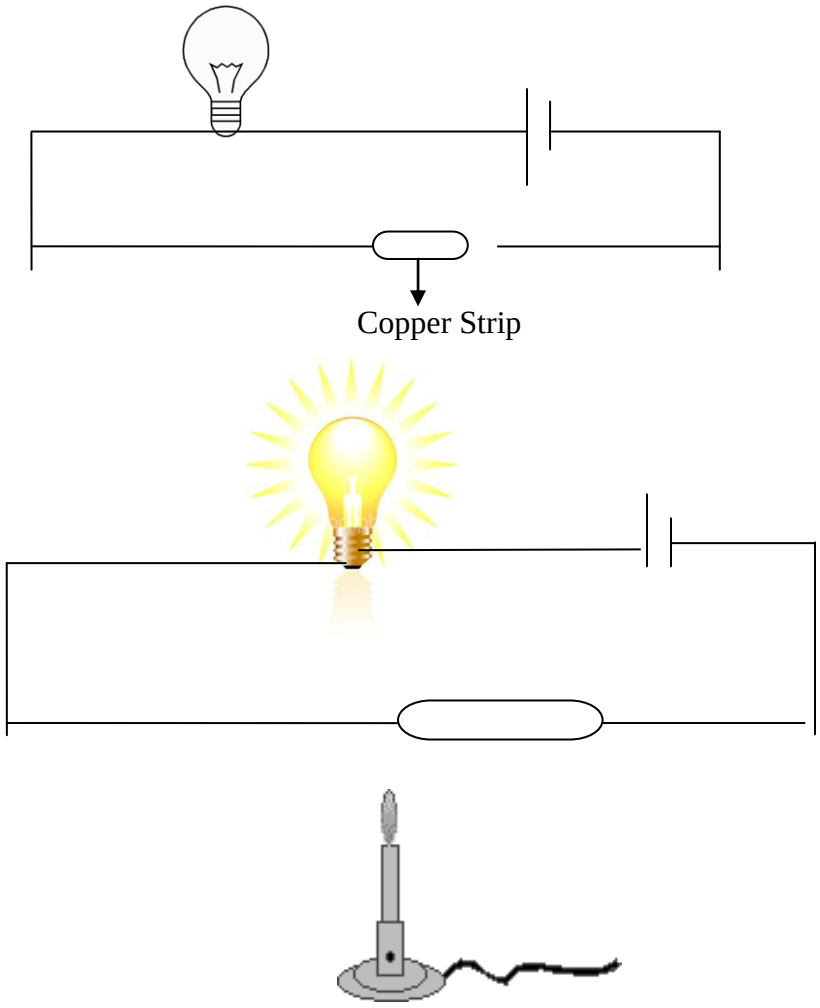


78) How is ultra sound scan done?

79) There was a pond near Ramu's house. There were many aquatic organisms/plants in it. Lot of birds especially Kingfisher used to come. One day some people filled the

pond with sand. After that Ramu saw that the kingfisher never came. How does filling of pond affect this bird? Which aquatic organisms/ plants would have lost its life due to this?

80) Observe the following diagrams. What is the difference between the two? What do you infer from this?



APPENDIX C

FINAL TEST PAPER- 1ST TERM

SUBJECT: SCIENCE MAXIMUM MARKS: 100

CLASS : VII TIME: 3 hrs

General Instructions

1) This question paper has four sections (I, II, III AND IV).
2) Read all questions carefully.
3) All questions are compulsory.
4) Feel free to ask doubts if any.
5) This test is a part of a thesis work. The data will be strictly confidential and the marks will be used only for research purpose.

I. FILL IN THE BLANKS WITH AN APPROPRIATE WORD (1X20=20 marks)

1) A branch of malgoa mango is organically joined with a local variety. This technique is called _____.
2) A system of communication where signs are used instead of sounds is _____.
3) Any one method adopted in your house to avoid water pollution is _____.
4) If soil stores water beyond its capacity the bond between rock and soil becomes weak causing _____.
5) Hybridization is a technique to produce high quality _____.
6) The quantity of any substance contained in its unit volume is called _____.
7) Convection is caused by the difference in _____.
8) Voice is produced by vibration of _____in the larynx located in throat of human beings.
9) Green plants prepare food by _____.
10) The two essential factors required for the existence of life on earth are _____and _____.
11) When mud, sand, biological substances etc mix with water it gets coloured. This is called _____
12) A clinical thermometer is an example of thermal expansion in _____.

13) Unit of loudness is _____.

14) An example of an animal belonging to the last link of a food chain is _____ .

15) Intercropping is not possible along with cultivation of _____.

16) The power generated from force of water stored in dams is called _____.

17) The measure of water in atmosphere is called _____.

18) To common examples of biowastes are _____ and _____.

19) Speed of sound in solid is 4816m/s. sound travels 14 times faster in solid than in air. Then its speed in air is _____.

20) An example of hybrid variety rice is _____.

II. TRUE OR FALSE **(1X20=20 marks)**

Write 'T' for true or 'F' for false in the given box.

21) ☐ Cultivation of coconut and plantain together is an example of crop rotation.

22) ☐ One litre of water and one litre of kerosene will have the same weight.

23) ☐ Distillation helps to remove impurities from solids and make them pure.

24) ☐ Plastic is a biodegradable waste.

25) ☐ In cooing of pigeons loudness is high.

26) ☐ A healthy branch of an improved variety of plant that grows downwards is good for layering.

27) ☐ Water in reservoir has potential energy.

28) ☐ Rate of evaporation decreases as atmospheric pressure increases.

29) ☐ Plants prepare food by themselves and are called consumers.

30) ☐ Sound cannot travel in vacuum.

31) [ ] Coconut is a major crop.

32) [ ] Convectional current occurs only in liquids.

33) [ ] Very bad quality water can be used for drinking after thorough purification.

34) [ ] The safest way to get rid of plastic wastes is by burning it.

35) [ ] In silent zones including hospitals and schools sound limit is 55dB during day time and 40dB in night.

36) [ ] Hybridization is done between two plants belonging to same species.

37) [ ] Dams are constructed in between two plains through which water flows.

38) [ ] Clothes become dry during night also.

39) [ ] The part of a mosquito that is vibrated when it produces sound is its vocal cord.

40) [ ] Compost is made from non biodegradable wastes.

III. CHOOSE THE CORRECT ANSWER (1X20=20 marks)

Corresponding to the right answer write (a), (b), (c) or (d) in the given blank.

41) Ultrasonic sound is produced by _____.

(a) eagle (b) owl (c) bats (d) cricket

42) Energy formed due to movement is _____.

(a) potential energy(b) gravitational energy (c) kinetic energy (d) strain

43) Grafting is widely used in _____.

(a) Rubber (b) jasmine (c) pineapple (d) mango

44) As we go up atmospheric pressure _____.

(a) Decreases (b) increases (c) remains same (d) becomes zero

45) Among the following_____ is a decomposer.

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46) Which one of the following is not an agricultural research centre in Kerala?_____

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47) The salinity of sea water is not due to _____.

(a) Sodium (b) zinc (c) calcium (d) magnesium

48) Density of ice is _____ water.

(a) Greater than (b) less than (c) twice that of (d) same as

49) Sound travels fastest in _____.

(a) Solids (b) liquids (c) gases (d) vacuum

50) An example of non- biodegradable substance is _____.

(a) Fallen leaves (b) bones (c)glass (d) coconut shells

51) Which of the following is a type of layering? _____

(a) Air layering (b) Branch Layering (c) Ring Layering (d) Stem Layering

52) Germs in water are killed by using _____.

(a) Alum (b) UV rays (c) chlorine (d) potassium

53) In summer the telephone lines will be _____.

(a) Tight (b) hanging (c) soft (d) hard

54) Ear ossicles are capable of _____ the loudness of sound received.

(a)Increasing (b) decreasing (c) increasing or decreasing

(d) neither increasing nor decreasing

55) The _____ of organisms and their surroundings together form ecosystem.

(a)Independence (b) intradependence (c) interdependence

(d) self dependence

56) Which one of the following is not a method to produce improved varieties of plants? _____

(a) Layering (b) budding (C) intercropping (d) grafting

57) Major portion of water on earth is _____.

(a) sea water (b) underground water (c) glaciers (d) lakes

58) Bio wastes become _____ when they are continuously dumped in the same place.

(a) Bio manure (b) Bio remnants (c) bio pollutants (d) bio garbage

59) Sea breeze is the _____ wind blowing from sea to land.

(a) cold (b) hot (c) strong (d) mild

60) Which among the following can be categorized into a single group? _____

(a) Veena, guitar, mandolin (b) drums, flute, shehnai (c) violin, sarod, table

(d) Veena, guitar, beaugle

IV. ANSWER THE FOLLOWING QUESTIONS VERY BRIEFLY (2-3 LINES) IN THE SPACE PROVIDED (2X20=40 marks)

61) A farmer plants wheat in his field and gets a good yield. But after harvesting his crops instead of cultivating the same crop he cultivates crops which belong to pea family in the field. What could be the reason for this?

62) How can you purify water in your homes?

63) Group the following musical instruments on the basis of

(a) How they are used-: Tabla, Jass, Veena, Shehnai, Flute, Violin, Clairnet, Guitar and Drums

(b)Hindustani, Carnatic, Western-: Veena, Tabla, Harmonium, Jass, Guitar, Mandolin, Sitar and Mridangam

64) Give an example of an ecosystem from your surroundings/ locality.

65) Why do clothes spread in hot sun dry fast?

66) Observe the two pea plants carefully. Draw the hybrid variety of these two plants.

67) In a hilly area of Wayanad during heavy rains people loose their homes and have their farms destroyed due to mixture of water and soil separating from rocks and flowing through slopes. How can this problem be overcome or minimized?

68) Aluminum has weight 270g and silver 1050g. If both Aluminum and Silver of same volume ($100cm^3$) is taken then which would be denser?

69) Rahim was walking from his school to home. When he reached the gate, he heard the voices of two of his cousins. He immediately recognized them without seeing them just by listening to their voices. How is this possible?

70) Based on the food relation among the animals given below group them into two. Connect them using arrow marks.
Grass, Lion, Tapioca, Snake, Deer, Rat

71) Observe the picture of the plant given below carefully. How can we grow such a plant with flowers of different colours?

72) Draw the labelled diagram for the process of distillation.

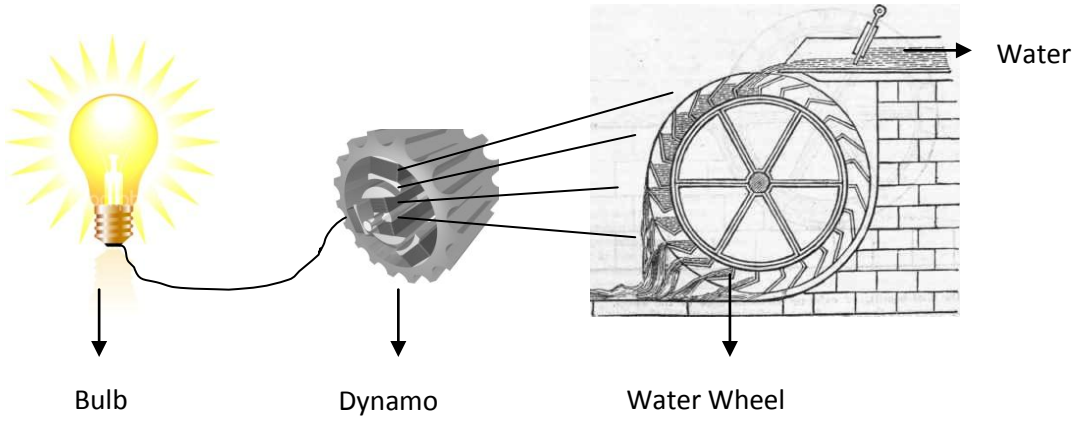
73) Discuss the functioning of any one device which functions by utilizing air pressure.

74) An aeroplane has just taken off from an airport. After one hour how can you determine its distance from the land? What is the principle behind this?

75) How can bio wastes seen in surroundings of your school be converted to manure?

76) In the same village farmer A gets a good yield and farmer B gets a low yield for the same crop. What could be the reasons for this difference in harvest? How can farmer B get a good harvest?

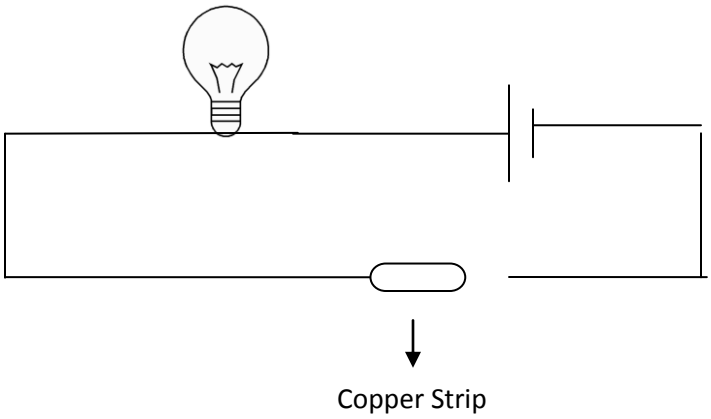
77) Observe the given diagram. What makes the bulb glow here?



78) How is ultra sound scan done?

79) There was a pond near Ramu's house. There were many aquatic organisms/plants in it. Lot of birds especially Kingfisher used to come. One day some people filled the pond with sand. After that Ramu saw that the kingfisher never came. How does filling of pond affect this bird? Which aquatic organisms/ plants would have lost its life due to this?

80) Observe the following diagram. What would happen if the copper strip is heated? Draw the modified diagram of the same showing the change that will take place.



APPENDIX D

DRAFT OF RATING SCALE FOR ASSESSING THE FIVE ESSENTIAL ELEMENTS OF COOPERATIVE LEARNING

	1	2	3	4	5
	Never	Rarely	Occasionally	Frequently	Always
POSITIVE INTERDEPENDENCE					
1. Building on each other's ideas					
2. Allowing each person to respond before speaking again					
3. Listening to all before reaching Conclusion					
4. Sharing responsibility for tasks evenly					
5. Positive attitude about task and work of others					
6. Encourages and supports the efforts of others					
FACE TO FACE PROMOTIVE INTERACTION					
1. Listening to others without interrupting them					
2. Stating differences when there is disagreement					
3. Asking people to explain their Reasoning					
4. Asking in-depth questions					
5. Seeking elaboration					
6. Discussing concepts to be learnt					
7. Explaining					
8. Providing constructive praise and criticism					
INDIVIDUAL ACCOUNTABILITY					
1. Accepts assigned role responsibly					
2. Participates on clean up willingly					

	1	2	3	4	5
	Never	Rarely	Occasionally	Frequently	Always
3. Contributes ideas and suggestions to group					
4. Produces quality/relevant work					
5. Completion of assigned work on time					
6. Punctuality/regular attendance					
7. Helping group plan its activities					
APPROPRIATE USE OF COLLABORATIVE SKILLS					
1) Leadership					
1. Performing assigned role and Helping others to do so					
2. Valuing and recognizing contributions of all team members					
3. Effectively managing time					
4. Involves all group members in Decision making					
5. Treating everyone with respect					
6. Summarizing results and next steps before finishing					
7. Maintaining focus and keeping to the point in conversations					
2) Communication					
1) Addressing others by name					
2) Looking at the person speaking					

	1	2	3	4	5
	Never	Rarely	Occasionally	Frequently	Always
3) Actively listening to others					
4) Freely shares own ideas					
5) Interacts and discusses with all members					
6) Poses questions to all members					
3) Trust building					
1. Depending on each others ideas					
2. Accepting others suggestions/answers					
3. Adding to others ideas					
4) Decision making					
1. Summarizing results					
2. Pulls together all ideas into a single position					
3. Directing the group in reaching Consensus					
4. Defends/ rethinks ideas relating to the group's goals					
5) Resolving conflicts					
1. Controlling emotional reactions					
2. Disagreeing in an agreeable way					
3. Makes necessary compromises					
4. Effectively controls anger					
5. Suggesting solutions to conflicts					
GROUP PROCESSING					

	1	2	3	4	5
	Never	Rarely	Occasionally	Frequently	Always
1. Setting group goals and objectives that everyone understands					
2. Reflecting on what changes need to be done					
3. Assessing their team					
4. Establishing clearly defined work plans to reach the goals					
5. Making sure every member participates fully					
6. seeking and promoting consensus on teams goals and work plans to reach these goals					

APPENDIX E

FINAL RATING SCALE FOR ASSESSING THE FIVE ESSENTIAL ELEMENTS OF COOPERATIVE LEARNING

	1	2	3	4	5
	Never	**Rarely**	**Occasionally**	**Frequently**	**Always**
POSITIVE INTERDEPENDENCE					
1. Building on each other's ideas					
2. Listening to all before reaching conclusion					
3. Sharing responsibility for tasks evenly					
4. Positive attitude about task and work of others					
5. Encourages and supports the efforts of others					
FACE TO FACE PROMOTIVE INTERACTION					
1. Listening to others without interrupting them					
2. Stating differences when there is disagreement					
3. Asking people to explain their reasoning					
4. Asking in-depth questions & discussing					
5. Providing constructive praise and criticism					
INDIVIDUAL ACCOUNTABILITY					
1. Accepts assigned role responsibly					
2. Participates on clean up willingly					
3. Contributes ideas and suggestions to group					
4. Produces quality/relevant work					
5. Completion of assigned work on time					

	1	2	3	4	5
	Never	**Rarely**	**Occasionally**	**Frequently**	**Always**
6. Punctuality/regular attendance					
APPROPRIATE USE OF COLLABORATIVE SKILLS					
1) Leadership					
1. Performing assigned role and helping others to do so					
2. Involving, valuing and recognizing contributions of all team members					
3. Effectively managing time					
4. Summarizing results and next steps before finishing					
5. Maintaining focus and keeping to the point in conversations					
2) Communication					
1. Addressing others by name					
2. Looking at the person speaking					
3. Actively listening to others					
4. Interacts and discusses with all members					
3) Trust building					
1. Depending and adding on each others ideas					
2. Accepting others suggestions/answers					
4) Decision making					
1. Pulls together all ideas into a single position					

	1	2	3	4	5
	Never	**Rarely**	**Occasionally**	**Frequently**	**Always**
2. Directing the group in reaching consensus					
3. Defends/ rethinks ideas relating to the group's goals					
5) Resolving conflicts					
1. Controlling emotional reactions					
2. Disagreeing in an agreeable way					
3. Makes necessary compromises					
4. Suggesting solutions to conflicts					
GROUP PROCESSING					
1. Setting group goals and work plans that everyone understands					
2. Seeking and promoting consensus on teams goals and work plans to reach these goals					
3. Assessing their team					
4. Reflecting on what changes need to be done					

APPENDIX F

DRAFT OF RATING SCALE FOR KNOWING STUDENTS' REACTION TOWARDS CL

General Instructions

- Read all statements on Cooperative Learning (CL) carefully.
- Put a tick mark corresponding to each statement indicating your experience regarding the same.
- Feel free to ask clarifications on the statements.

STATEMENTS	Yes	No
1) Peer interaction helped me obtain a deeper understanding of the material		
2) It fostered a positive attitude in me towards learning		
3) Aroused my interest towards the subject		
4) helped me to take on more responsibility for learning		
5) It became easier for me to learn difficult concepts this way		
6) Helped me to learn from others what I didn't know		
7) Enhanced my social skills		
8) Enhanced my communication skills		
9) Promoted my interaction with all members of class		
10) Helped me to learn new skills by viewing other students work		
11) Enhanced my learning		
12) Helped me to get better grades		
13) Created many disciplinary problems		
14) Promoted my friendship with other students		
15) It is too noisy		
16) Helped me in getting to know every member of the class		
17) Developed in me trust towards others		
18) Takes too much time		
19) Some members never do their work and put it on others		
20) Helped raise my self-esteem and self-confidence		
21) Made me independent		

STATEMENTS	Yes	No
22) Developed leadership qualities in me		
23) It helped me to develop respect towards others		
24) Helped me to make decision effectively		
25) Helped me in resolving conflicts easily		
26) I Developed spirit of team work		
27) I enjoyed cooperating with team members		
28) I would like to study other subjects also using cooperative learning		

APPENDIX G

FINAL RATING SCALE FOR KNOWING STUDENTS' REACTION TOWARDS CL

General Instructions

- Read all statements on Cooperative Learning (CL) carefully.
- Put a tick mark corresponding to each statement indicating your experience regarding the same.
- Feel free to ask clarifications on the statements.

Statements	Sometimes	Always	Never
1) Peer interaction helped me to obtain a deeper understanding of the material			
2) Group efforts in learning helped me to foster positive attitude towards learning			
3) I discovered that CL enhanced my social skills			
4) Cooperative efforts helps me to take on more responsibility for learning			
5) CL paves easier way for me to learn difficult concepts			
6) I feel that CL helps us learn from each other what we don't know			
7) Team efforts arouses my interest in studying the subject			
8) Group efforts enhanced my communication skills			
9) Working in teams promotes me to interact with all other members of class			
10) Group work helps me learn new skills by viewing other students work			
11) CL enhanced my learning skills			
12) CL helped me get better grades			
13) I am of the view that CL creates many disciplinary problems			
14) I find that CL promotes friendship among students			
15) I am against CL that makes the class too noisy			
16) CL helped me know every member of the class closely			
17) CL developed in me trust towards others			
18) CL wastes much precious and valuable time for my studies			
19) I found that some members never do works assigned to them but put it on others			

Statements	Sometimes	Always	Never
20) CL helped to raise self-esteem and self-confidence in me			
21) CL makes me feel more independent			
22) CL helped me develop and gain leadership qualities			
23) CL promotes and develops in me respect for others			
24) I find that CL helps me make good and effective decisions			
25) CL helps me to easily resolve conflicts that arise during the learning process			
26) I understand that CL has the power to develop spirit of team work			
27) I enjoyed cooperating with team members			
28) I would like to study other subjects also using cooperative learning			

APPENDIX H

SCORING OF RATING SCALE FOR THE FIVE ESSENTIAL ELEMENTS OF CL

No	Q1.1	Q1.2	Q1.3	Q1.4	Q1.5	Q1.6	Q2.1	Q2.2	Q2.3	Q2.4	Q2.5
1	3	3	3	4	4	5	3	3	4	4	5
2	1	1	1	2	2	3	1	1	1	2	2
3	3	3	4	4	5	5	2	2	3	3	4
4	4	4	4	5	5	5	3	4	4	4	5
5	1	1	1	1	2	2	2	2	2	3	3
6	2	2	2	3	3	4	1	1	1	2	3
7	1	1	1	2	3	4	1	1	2	3	3
8	2	2	3	3	4	4	2	2	3	3	4
9	1	1	1	2	2	3	1	1	1	2	3
10	1	1	2	2	3	4	1	1	1	2	3
11	2	2	3	3	4	5	3	3	3	4	5
12	3	3	4	4	4	5	4	4	4	4	4
13	2	2	3	3	4	5	1	1	2	2	3
14	1	1	1	2	3	4	1	1	2	3	4
15	1	2	3	3	4	4	3	3	3	4	4
16	1	1	1	2	2	3	1	1	2	2	3
17	1	1	2	3	3	4	1	1	2	2	3
18	1	1	1	1	2	2	1	1	1	1	2
19	3	3	4	4	5	5	4	4	4	4	5
20	2	2	2	2	3	3	2	2	3	3	4
21	2	3	3	3	4	4	3	3	4	4	4
22	2	2	2	3	3	4	3	3	3	4	4
23	1	2	2	3	3	3	2	2	3	3	3
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27	1	1	1	2	2	3	1	1	1	2	2
28	3	3	3	4	4	5	3	3	4	4	5
29	3	4	4	5	5	5	3	4	4	5	5
30	1	1	1	2	3	3	1	1	2	2	3
31	1	1	1	2	2	3	2	2	3	3	4
32	1	2	2	3	3	4	1	1	2	3	3
33	3	3	3	4	4	5	3	3	4	4	5
34	1	1	1	2	2	3	1	1	1	2	3
35	2	2	3	3	4	4	3	3	3	4	4
36	3	3	4	4	5	5	3	3	4	5	5

Q2.6	Q3.1	Q3.2	Q3.3	Q3.4	Q3.5	Q3.6	Q4.1	Q4.2	Q4.3	Q4.4	Q4.5
5	2	2	3	3	4	5	1	1	2	2	2
3	1	1	1	2	3	3	1	1	1	1	2
5	3	3	4	4	5	5	1	1	2	2	3
5	2	3	3	4	4	5	1	1	2	3	3
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3	1	1	1	2	3	3	1	1	1	2	2
4	1	1	1	2	3	3	1	1	1	2	3
4	2	2	3	3	4	4	2	2	3	3	3
3	1	1	2	2	3	3	1	1	2	2	3
4	1	1	1	2	2	3	1	1	1	2	3
5	3	3	3	3	4	4	2	2	2	3	3
5	3	3	4	4	4	5	3	3	3	4	4
4	1	1	2	2	2	3	1	1	2	2	3
4	1	1	1	3	4	4	1	1	1	2	3
5	3	3	3	4	4	5	2	2	2	3	3
4	1	1	2	2	3	3	1	1	1	2	2
4	1	1	1	2	2	3	1	1	1	2	2
3	1	1	1	1	2	2	1	1	1	1	1
5	4	4	5	5	5	5	4	4	4	4	5
5	2	2	2	3	3	4	1	1	1	2	2
5	3	3	3	4	4	4	2	2	3	3	3
5	1	2	2	3	4	5	1	1	2	2	3
4	1	1	1	2	2	3	1	1	1	2	2
5	3	4	4	5	5	5	1	1	2	2	3
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5	3	3	4	4	5	5	1	2	2	3	3
5	3	3	4	4	4	5	2	2	3	3	3

Q4.6	Q5.1	Q5.2	Q5.3	Q5.4	Q5.5	Q5.6	Q6.1	Q6.2	Q6.3	Q6.4	Q6.5
3	2	3	3	4	4	5	3	3	3	4	4
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2	1	1	1	2	2	3	1	1	1	2	2
4	2	2	3	3	4	4	3	3	3	4	5
4	3	3	4	4	4	5	1	1	2	2	3

Q6.6	Q7.1	Q7.2	Q7.3	Q7.4	Q7.5	Q7.6	Q8.1	Q8.2	Q8.3	Q8.4	Q8.5
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5	1	1	2	2	3	3	1	2	2	3	3
3	1	1	1	2	3	3	1	1	2	3	3
5	1	1	2	3	3	4	1	1	2	2	3
4	1	1	2	2	3	3	2	3	3	3	4

Q8.6	Q9.1	Q9.2	Q9.3	Q9.4	Q9.5	Q9.6	Q10.1	Q10.2	Q10.3	Q10.4	Q10.5
4	1	1	2	2	3	4	1	1	1	2	2
4	1	1	1	1	2	2	1	1	1	1	1
5	1	1	2	3	3	4	1	1	2	3	3
5	1	2	2	3	3	4	1	1	2	2	3
3	1	1	1	1	2	2	1	1	1	1	1
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3	1	1	1	1	1	2	1	1	1	1	1
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Q10. 6	Q11. 1	Q11. 2	Q11. 3	Q11. 4	Q11. 5	Q11. 6	Q12. 1	Q12. 2	Q12. 3	Q12. 4	Q12. 5
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3	3	3	4	4	5	5	3	4	4	4	5
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3	3	3	3	3	4	5	3	3	3	3	4
2	1	1	1	1	2	3	1	1	2	2	3
2	1	1	1	2	2	3	1	2	2	3	3
3	3	3	4	4	4	5	3	3	4	4	4
3	4	4	4	4	5	5	4	4	4	4	5
3	1	1	2	2	3	4	1	1	2	2	3
3	1	1	2	3	4	5	1	1	2	3	4
3	2	2	3	3	4	4	3	3	4	4	5
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2	2	2	3	3	4	5	2	2	3	3	4
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3	3	3	4	4	4	5	3	4	4	4	5
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2	2	2	3	3	4	4	3	3	3	4	4
3	3	3	3	4	5	5	3	3	4	4	5
2	1	1	2	2	3	3	1	1	2	2	3
2	3	3	4	4	5	5	4	4	4	5	5
3	3	4	4	5	5	5	3	4	4	5	5

Q12.6	Q13.1	Q13.2	Q13.3	Q13.4	Q13.5	Q13.6	Q14.1	Q14.2	Q14.3	Q14.4	Q14.5
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4	2	2	2	3	3	4	1	1	1	2	3
5	3	3	3	4	5	5	3	3	3	4	4
4	1	1	2	2	3	3	1	1	1	2	2
4	1	2	2	3	4	5	1	1	2	3	3
5	3	4	4	4	5	5	3	4	4	4	4
5	4	4	4	5	5	5	4	4	4	4	5
3	3	3	4	4	5	5	3	3	3	4	4
5	1	1	2	3	4	5	1	1	2	3	3
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5	1	1	2	3	3	4	1	1	1	2	2
3	1	1	1	2	2	3	1	1	1	1	2
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5	3	4	4	5	5	5	3	3	3	3	4
5	2	3	3	4	4	5	1	2	2	2	3
3	2	2	3	4	4	5	1	1	2	2	3
5	3	4	4	4	5	5	2	2	3	3	3
5	3	4	4	5	5	5	2	2	3	3	3
3	1	2	2	3	3	4	1	1	1	2	2
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4	1	1	2	2	3	3	1	2	2	3	3
5	3	3	4	4	5	5	2	2	2	3	3
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3	1	1	1	2	2	3	1	1	1	2	2
5	3	4	4	5	5	5	2	2	2	3	3
5	4	4	4	5	5	5	3	4	4	5	5

Q14. 6	Q15. 1	Q15. 2	Q15. 3	Q15. 4	Q15. 5	Q15. 6	Q16. 1	Q16. 2	Q16. 3	Q16. 4	Q16. 5
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3	1	1	2	2	3	4	4	4	4	5	5
5	4	4	4	5	5	5	4	4	5	5	5
5	4	4	4	4	5	5	4	4	5	5	5
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3	2	2	2	3	3	4	4	4	4	5	5
3	1	1	1	2	3	4	4	4	4	4	5
5	3	3	4	4	5	5	4	4	5	5	5
3	1	1	1	2	2	3	2	2	3	3	4
4	1	2	3	3	4	5	4	4	5	5	5
5	4	4	4	4	5	5	4	5	5	5	5
5	4	4	4	4	4	5	4	4	5	5	5
5	3	3	4	4	5	5	4	4	5	5	5
4	1	1	2	3	4	5	2	2	2	3	4
4	2	2	3	3	3	4	4	4	5	5	5
3	1	1	1	2	3	4	3	3	3	4	4
3	1	1	2	2	3	4	3	3	4	4	5
2	1	1	2	2	2	3	1	2	2	3	4
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3	2	2	3	3	4	4	4	4	4	5	5
4	3	4	4	5	5	5	4	4	5	5	5
3	3	3	3	4	4	5	4	4	5	5	5
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5	3	4	4	5	5	5	4	4	4	5	5
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3	3	3	3	4	4	4	4	4	5	5	5
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3	1	1	2	2	3	4	4	4	4	5	5
3	3	4	4	4	5	5	4	4	4	5	5
5	3	3	4	4	4	5	4	4	5	5	5

Q16. 6	Q17. 1	Q17. 2	Q17. 3	Q17. 4	Q17. 5	Q17. 6	Q18. 1	Q18. 2	Q18. 3	Q18. 4	Q18. 5
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5	2	3	3	3	4	4	1	1	2	3	3
5	3	3	4	4	5	5	2	3	3	3	4
5	1	1	1	1	2	2	1	1	1	1	2
5	1	2	2	2	3	3	1	1	2	2	3
5	1	1	1	2	3	3	1	1	1	2	3
5	2	2	3	3	4	5	1	1	2	2	3
5	1	1	1	1	2	2	1	1	1	1	1
5	1	2	2	3	3	4	1	1	2	2	3
5	3	3	3	3	4	4	2	2	3	3	3
5	2	3	3	3	4	4	2	2	3	3	4
5	1	1	2	2	3	3	1	1	2	2	3
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5	1	1	2	2	3	3	1	1	2	2	3
4	1	1	1	1	1	2	1	1	1	1	1
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5	1	1	1	1	2	2	1	1	1	1	1
5	1	2	3	3	3	4	1	2	2	3	3
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5	2	2	2	3	3	4	2	2	2	3	3
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5	1	1	1	2	2	3	1	1	1	1	2
5	2	2	2	3	3	4	2	2	2	3	3
5	3	3	4	4	4	4	3	3	3	3	4

Q18.6	Q19.1	Q19.2	Q19.3	Q19.4	Q19.5	Q19.6	Q20.1	Q20.2	Q20.3	Q20.4	Q20.5
4	2	2	2	3	3	4	1	1	2	2	3
3	1	1	1	2	2	3	1	1	1	2	2
4	1	1	2	2	3	4	1	1	2	2	3
4	1	1	2	3	3	4	1	1	2	2	3
2	1	1	1	1	2	3	1	1	1	2	2
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4	1	1	1	1	2	3	1	1	1	1	2
3	1	1	2	2	3	3	1	1	2	2	3
2	1	1	1	2	2	3	1	1	1	2	2
3	1	1	1	2	2	3	1	1	1	2	2
4	2	2	3	3	4	4	1	1	2	2	2
4	1	1	2	2	3	3	1	1	2	2	3
3	1	2	2	3	3	4	1	1	2	2	2
4	1	1	1	2	3	3	1	1	1	2	2
3	1	1	2	2	3	4	1	1	2	2	3
3	1	1	1	2	2	3	1	1	1	2	2
4	1	1	1	2	2	3	1	1	1	2	2
2	1	1	1	1	2	2	1	1	1	1	1
4	2	2	2	3	3	4	2	2	2	3	3
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4	1	1	2	2	3	3	1	1	2	3	3
4	1	1	2	2	3	3	1	1	1	2	3
2	1	1	1	2	2	3	1	1	1	2	2
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3	1	1	1	2	3	3	1	1	1	2	2
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3	1	1	2	2	3	3	1	1	1	2	2
3	1	1	2	2	3	3	1	1	2	2	3
4	2	2	3	3	3	4	1	1	2	2	3
2	1	1	2	2	3	3	1	1	1	2	2
4	1	1	2	2	3	3	1	2	2	3	3
4	3	3	3	4	4	4	3	3	3	3	4

Q20.6	Q21.1	Q21.2	Q21.3	Q21.4	Q21.5	Q21.6	Q22.1	Q22.2	Q22.3	Q22.4	Q22.5
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3	1	1	2	3	3	4	1	2	2	3	4
4	2	3	3	3	4	4	3	4	4	4	5
3	1	1	1	2	2	3	1	1	2	2	3
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3	1	1	2	2	3	3	1	1	2	3	4
3	1	1	1	2	2	3	1	1	2	2	3
3	1	1	1	2	2	3	1	2	3	3	4
3	1	1	2	2	3	4	3	3	4	4	5
3	1	2	2	3	3	4	1	2	2	3	3
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3	1	1	2	2	2	3	1	2	2	3	4
3	1	1	1	2	2	3	1	1	1	3	4
3	1	1	1	2	2	3	1	1	2	3	4
1	1	1	1	1	1	2	1	1	2	3	4
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2	1	1	1	1	2	2	1	1	2	2	3
4	1	1	2	3	3	4	1	2	3	4	4
3	1	1	2	2	3	3	1	1	2	2	3
3	1	1	1	2	2	3	1	1	2	3	3
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3	2	2	3	3	4	4	2	3	3	4	5
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Q22. 6	Q23. 1	Q23. 2	Q23. 3	Q23. 4	Q23. 5	Q23. 6	Q24. 1	Q24. 2	Q24. 3	Q24. 4	Q24. 5
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5	3	4	4	5	5	5	3	4	4	4	5
4	2	2	3	3	4	5	1	1	2	2	3
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4	1	2	3	3	4	5	1	2	3	3	4
5	2	3	3	4	4	5	1	2	3	3	4
5	3	3	4	4	5	5	3	4	4	4	5
4	1	2	3	3	4	4	1	2	2	3	4
4	2	2	2	3	3	4	2	2	3	3	4
4	1	1	2	3	4	5	1	1	1	3	4
5	1	2	3	3	4	5	1	2	3	4	4
5	2	2	2	3	4	5	1	1	1	2	3
5	2	2	3	3	4	5	1	1	2	3	4
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4	3	3	4	4	5	5	1	1	2	3	3
4	2	2	3	3	4	5	3	3	4	4	5
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Q24. 6	Q25. 1	Q25. 2	Q25. 3	Q25. 4	Q25. 5	Q25. 6	Q26. 1	Q26. 2	Q26. 3	Q26. 4	Q26. 5
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5	2	3	3	4	5	5	3	4	4	4	5
3	1	1	2	2	2	3	1	2	2	2	3
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5	2	2	3	3	4	5	2	2	3	3	4
5	1	1	2	2	3	4	1	1	1	2	2
5	1	2	3	3	4	5	1	2	2	3	3
5	3	4	4	5	5	5	3	3	3	4	4
4	1	2	2	3	4	5	3	3	3	3	4
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5	1	2	2	3	4	5	2	2	3	3	4
4	1	1	1	2	3	4	1	1	1	2	3
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5	2	2	3	3	4	5	3	3	3	4	4
5	3	3	4	4	5	5	3	3	3	4	4
4	1	1	2	2	3	4	1	1	1	2	2
3	1	1	1	2	2	3	1	1	1	1	2
5	2	3	4	4	5	5	2	2	3	3	4
3	2	2	3	4	5	5	2	2	3	3	3
4	1	1	2	2	3	3	1	2	2	3	3
4	1	1	2	2	3	3	3	3	3	4	4
5	2	3	3	4	4	5	2	2	3	3	4
5	2	3	3	4	5	5	2	2	3	4	4
4	2	2	2	3	4	4	1	1	1	2	2
5	2	2	3	4	4	5	3	3	3	4	4
5	2	3	4	5	5	5	2	3	3	4	4

Q26. 6	Q27. 1	Q27. 2	Q27. 3	Q27. 4	Q27. 5	Q27. 6	Q28. 1	Q28. 2	Q28. 3	Q28. 4	Q28. 5
4	3	3	3	4	4	5	1	1	2	2	3
3	3	3	3	4	4	5	1	1	1	2	2
5	3	4	4	4	5	5	1	1	2	3	3
5	3	3	4	5	5	5	2	2	2	3	3
3	3	3	3	4	4	5	1	1	1	1	2
4	2	2	3	3	3	4	1	1	1	2	2
4	1	1	1	3	4	4	1	1	1	2	2
5	2	2	3	3	4	5	1	1	2	2	3
3	1	1	1	1	2	3	1	1	1	1	2
4	2	2	3	3	4	4	1	1	1	2	2
4	3	3	3	4	4	5	2	2	2	3	3
4	3	3	3	4	4	4	2	2	2	2	3
3	1	1	2	2	3	4	1	1	1	2	2
4	1	1	2	2	3	4	1	1	1	2	3
4	2	2	3	3	4	5	1	1	2	2	3
3	3	3	3	4	4	4	1	1	1	2	2
3	1	1	2	2	3	4	1	1	1	1	2
3	1	1	1	2	3	4	1	1	1	1	1
5	4	4	4	4	5	5	3	3	3	4	4
3	1	2	2	2	3	3	1	1	1	1	1
4	3	3	3	4	4	5	1	1	2	2	3
3	2	3	3	4	4	5	1	1	1	2	3
3	1	1	2	3	3	4	1	1	1	2	2
5	3	3	3	4	4	4	2	2	2	3	3
5	2	2	3	3	4	4	2	2	2	3	3
3	1	2	2	3	3	4	1	1	1	2	2
2	1	1	2	3	3	4	1	1	1	1	2
4	2	3	3	4	4	5	1	1	2	2	3
4	3	3	3	4	4	5	1	1	2	2	3
3	2	3	3	4	4	5	1	1	1	2	2
5	3	3	4	4	5	5	1	1	1	2	2
4	2	3	3	4	4	5	1	1	2	2	3
5	3	3	3	4	4	5	1	1	2	2	3
3	2	2	3	3	4	4	1	1	1	2	2
5	3	3	4	4	5	5	1	1	2	2	3
5	2	2	3	3	4	5	2	2	3	3	3

Q28. 6	Q29. 1	Q29. 2	Q29. 3	Q29. 4	Q29. 5	Q29. 6	Q30. 1	Q30. 2	Q30. 3	Q30. 4	Q30. 5
3	1	1	2	2	3	4	1	1	1	2	2
3	1	1	1	1	2	2	1	1	1	1	2
4	2	2	3	3	4	4	1	2	2	3	3
4	1	2	2	3	3	4	1	2	2	3	3
2	1	1	1	1	2	2	1	1	1	1	1
3	1	2	2	3	3	4	1	1	1	2	2
3	1	1	1	1	2	2	1	1	1	1	1
3	1	1	1	2	2	3	1	1	1	1	2
2	1	1	1	1	2	2	1	1	1	1	1
3	1	1	1	1	2	2	1	1	1	1	1
3	2	2	3	3	3	4	2	2	3	3	4
3	1	1	2	2	3	3	1	1	2	2	2
3	1	1	2	2	3	4	1	1	2	2	3
3	1	1	1	2	3	4	1	1	1	2	3
3	1	1	2	2	2	3	1	1	2	2	3
3	1	1	1	1	2	2	1	1	1	1	2
2	1	1	1	1	2	2	1	1	1	1	1
2	1	1	1	1	2	3	1	1	1	1	1
4	2	2	3	3	4	5	1	1	2	2	3
2	1	1	1	1	1	1	1	1	1	1	1
3	1	1	1	1	2	2	1	1	2	2	3
3	1	1	1	1	2	2	1	1	1	2	2
3	1	1	1	1	2	2	1	1	1	2	2
3	1	2	2	2	3	3	1	1	1	2	2
4	2	2	3	3	3	4	1	1	2	2	3
3	1	1	1	2	2	2	1	1	1	2	2
3	1	1	1	1	1	2	1	1	1	1	1
4	1	1	2	2	3	3	1	1	2	2	2
3	1	1	2	2	3	3	2	2	3	3	4
3	1	1	1	1	2	2	1	1	1	2	2
3	1	1	1	1	2	2	1	1	1	1	2
3	1	1	1	2	2	3	1	1	1	2	2
3	1	1	2	3	3	4	1	1	2	2	2
3	1	1	1	1	2	2	1	1	1	1	2
3	1	1	2	2	3	3	1	1	1	2	3
4	1	1	2	3	3	4	1	1	2	2	3

Q30.6	Q31.1	Q31.2	Q31.3	Q31.4	Q31.5	Q31.6	Q32.1	Q32.2	Q32.3	Q32.4	Q32.5
3	3	3	3	4	4	5	3	3	3	4	4
2	1	1	2	3	3	4	1	1	1	2	2
4	1	1	2	3	3	4	1	1	2	2	3
4	3	3	3	4	4	5	2	2	3	3	4
2	2	2	3	3	4	5	2	2	3	3	4
3	1	1	2	3	3	4	1	1	2	2	3
1	1	1	1	2	3	4	1	1	1	2	3
2	2	2	3	3	4	5	1	1	2	3	3
1	1	2	3	3	4	4	1	1	2	2	3
2	1	1	1	2	3	3	1	1	1	2	2
4	3	3	4	4	4	5	1	1	2	2	3
3	3	3	4	4	4	5	1	2	2	3	4
4	1	1	1	2	2	3	1	1	1	2	2
4	1	1	1	3	4	4	1	1	1	2	3
3	2	2	2	3	4	4	1	1	2	2	3
2	2	2	2	3	4	5	1	1	1	2	3
2	1	1	2	3	4	4	1	1	2	2	3
1	1	1	1	2	2	3	1	1	1	2	2
4	4	4	4	5	5	5	4	4	5	5	5
1	2	3	3	4	4	5	1	2	3	3	3
3	2	2	3	3	3	4	1	2	2	2	3
3	3	3	4	4	5	5	2	2	3	3	4
3	1	1	1	2	2	3	1	1	1	2	2
3	3	3	4	4	4	5	3	3	3	4	4
3	1	1	2	3	3	4	1	2	2	3	3
2	1	1	2	2	3	4	1	1	2	2	3
1	1	1	2	2	3	3	1	1	1	2	2
3	2	3	3	4	5	5	1	1	2	2	3
4	1	1	2	2	3	4	1	1	2	2	3
3	1	1	2	2	3	3	1	1	2	2	3
2	3	3	4	4	5	5	2	2	3	3	4
3	1	2	2	3	3	4	1	1	2	2	3
3	3	3	4	4	5	5	2	2	3	3	4
2	1	1	2	2	3	4	1	1	2	2	3
3	1	1	2	3	3	4	1	1	2	2	3
3	1	2	2	3	3	4	1	1	2	2	3

Q32.6	Q33.1	Q33.2	Q33.3	Q33.4	Q33.5	Q33.6	Q34.1	Q34.2	Q34.3	Q34.4	Q34.5
5	3	3	4	4	5	5	1	1	2	3	3
3	1	1	2	3	3	3	1	1	1	2	3
4	1	1	2	2	3	4	2	2	3	3	4
5	2	2	3	3	4	5	2	2	3	3	4
4	2	2	3	3	4	4	1	1	1	2	2
4	1	1	2	2	3	4	1	1	2	2	2
4	1	1	1	2	3	4	1	1	1	1	2
4	1	1	2	3	4	5	1	1	2	2	3
4	1	1	2	2	3	3	1	1	1	1	2
3	1	1	1	2	3	4	1	1	2	2	3
3	1	1	2	2	3	3	1	2	2	3	3
5	3	4	4	5	5	5	1	1	2	2	3
3	1	1	2	2	3	4	1	1	1	2	2
4	1	1	1	2	3	4	1	1	2	3	4
4	1	1	2	2	3	4	1	1	2	3	3
4	1	1	1	2	3	4	1	1	1	2	2
4	1	1	2	2	3	4	1	1	2	2	3
3	1	1	2	2	3	3	1	1	1	2	2
5	4	4	5	5	5	5	1	1	2	2	3
4	2	3	3	3	4	4	1	1	1	2	2
3	2	2	3	3	4	4	1	1	2	2	3
5	3	3	4	4	5	5	1	1	1	2	2
3	1	1	2	2	3	3	1	1	1	2	2
5	3	3	4	4	5	5	1	1	2	2	3
4	1	1	2	3	4	4	1	1	1	2	3
3	1	1	2	2	3	4	1	1	2	3	3
3	1	1	1	2	2	3	1	1	1	1	2
3	2	3	3	3	4	4	1	1	2	2	3
4	1	1	2	3	3	4	1	2	2	3	3
3	1	1	2	2	3	4	1	1	2	2	3
4	3	3	3	4	4	5	1	1	1	2	3
3	1	1	2	3	3	4	1	1	2	2	2
4	2	3	3	3	4	4	1	1	2	2	3
3	1	2	2	3	4	4	1	1	2	3	3
4	1	2	2	3	3	4	1	2	2	3	3
3	1	1	2	3	4	4	1	1	2	2	3

Q34.6	Q35.1	Q35.2	Q35.3	Q35.4	Q35.5	Q35.6	Q36.1	Q36.2	Q36.3	Q36.4	Q36.5
4	2	2	3	3	3	4	2	2	2	3	3
3	1	1	1	2	2	3	1	1	1	1	2
4	2	2	3	4	4	5	2	2	3	3	4
5	2	3	3	3	4	4	2	3	3	3	4
3	1	1	1	2	2	3	1	1	1	2	3
3	1	1	2	3	3	4	1	1	2	2	3
2	1	1	1	2	2	3	1	1	1	1	2
4	1	1	1	2	2	2	1	1	1	2	2
2	1	1	1	1	1	2	1	1	1	1	1
4	1	1	1	1	1	2	1	1	2	2	3
4	1	1	2	2	3	3	1	2	2	3	3
3	2	2	3	3	3	3	2	2	2	3	3
3	1	1	1	2	3	4	1	1	1	2	2
4	1	1	1	2	3	4	1	1	1	2	3
4	1	1	2	2	2	3	1	1	2	2	3
3	1	1	1	2	2	3	1	1	1	2	2
3	1	1	1	1	2	2	1	1	1	1	2
3	1	1	1	1	1	1	1	1	1	1	1
4	2	3	3	4	4	5	2	2	2	3	3
3	1	1	1	1	1	2	1	1	1	1	2
3	1	2	2	2	3	3	1	2	2	2	3
3	1	1	2	2	3	3	1	1	2	2	3
3	1	1	2	3	3	3	1	1	2	3	3
3	2	2	2	3	4	4	2	2	2	3	4
3	2	2	3	3	3	4	2	2	3	3	4
4	1	1	1	1	2	2	1	1	1	1	2
2	1	1	1	1	1	2	1	1	1	1	2
3	1	1	2	2	3	3	2	2	2	3	3
4	2	2	3	3	4	4	1	2	2	3	3
3	1	1	1	2	2	3	1	1	1	2	2
3	1	1	1	2	2	3	1	1	1	1	2
3	1	2	2	3	3	4	1	2	2	3	3
3	2	2	3	3	3	4	2	2	3	3	3
4	1	1	2	2	3	3	1	1	2	2	3
4	1	2	2	3	3	3	2	2	3	3	3
3	1	2	2	3	3	4	1	1	1	2	2

Q36.6	Q37.1	Q37.2	Q37.3	Q37.4	Q37.5	Q37.6	Q38.1	Q38.2	Q38.3	Q38.4	Q38.5	Q38.6
4	1	1	2	2	3	4	1	1	2	2	3	4
2	1	1	1	1	2	2	1	1	1	2	2	2
5	1	2	3	3	4	5	1	2	3	3	4	5
4	1	2	3	3	4	4	1	2	3	3	4	4
3	1	1	1	1	1	2	1	1	1	1	1	2
4	1	1	2	3	3	4	1	1	2	3	4	4
3	1	1	1	1	1	2	1	1	1	1	1	2
3	1	1	1	2	2	2	1	1	1	2	2	2
2	1	1	1	1	2	2	1	1	1	1	2	2
3	1	1	1	1	1	2	1	1	1	1	2	2
3	1	1	2	2	2	3	1	1	2	2	3	3
4	1	1	2	2	3	3	1	2	2	3	3	4
3	1	1	2	2	3	4	1	1	2	2	3	4
3	1	1	1	2	2	3	1	1	1	2	3	3
3	1	1	2	2	3	3	1	1	2	3	3	4
3	1	1	1	1	2	2	1	1	1	2	2	2
2	1	1	1	1	2	2	1	1	1	1	2	3
1	1	1	1	1	1	1	1	1	1	1	1	2
3	1	1	1	2	2	3	1	2	2	3	3	4
2	1	1	1	1	1	1	1	1	1	1	1	1
3	1	1	1	1	2	2	1	1	2	2	3	4
3	1	1	1	2	3	3	1	1	2	3	3	3
3	1	1	1	1	1	1	1	1	1	1	2	2
4	1	1	1	2	2	3	1	1	2	2	3	3
4	1	2	2	3	3	4	1	1	2	3	3	4
2	1	1	1	1	2	2	1	1	1	1	2	2
2	1	1	1	1	1	1	1	1	1	1	2	2
4	1	1	2	3	4	4	2	2	3	3	4	4
4	1	1	2	3	3	4	1	2	3	3	4	4
3	1	1	1	1	2	2	1	1	1	1	2	2
2	1	1	1	1	1	2	1	1	1	1	2	2
4	1	2	2	3	3	4	1	2	2	3	3	4
4	1	2	2	3	3	4	1	2	2	3	3	4
3	1	1	1	1	2	2	1	1	1	2	2	3
4	1	1	2	2	3	4	1	2	2	3	3	4
3	1	1	1	2	3	3	1	2	2	3	3	4

MEAN VALUES OF EACH RATING OF THE FIVE ESSENTIAL ELEMENTS OF CL

Q1.1	Q1.2	Q1.3	Q1.4	Q1.5	Q1.6	Q2.1	Q2.2
11	12	15	17	19	23	7	7
5	5	5	9	12	14	5	5
10	11	15	16	21	23	6	7
11	14	16	19	21	23	10	11
6	6	7	8	12	12	6	6
6	7	7	12	14	17	5	5
5	5	7	11	15	18	5	5
10	10	15	15	19	20	6	6
5	5	8	11	14	16	8	8
5	5	7	10	14	18	5	5
13	13	14	17	20	21	5	5
15	15	18	19	20	23	8	8
6	7	11	12	15	19	5	5
5	5	7	13	18	21	5	5
12	13	14	18	19	22	9	9
5	5	8	10	13	16	8	8
5	5	8	12	13	18	5	5
5	5	5	5	8	11	5	5
19	19	21	22	25	25	8	9
8	8	9	11	14	17	8	8
12	13	16	17	19	21	7	7
9	10	12	15	18	21	7	7
6	7	9	12	13	17	5	5
11	12	15	17	20	21	7	7
12	14	15	19	19	21	9	10
5	5	6	11	12	16	5	5
5	5	5	10	10	13	7	7
12	13	16	18	20	23	7	7
12	15	17	20	22	22	7	7
5	5	8	11	14	16	6	6
8	8	11	13	14	17	7	7
6	9	11	15	16	21	7	8
12	13	15	18	20	23	7	8
5	5	6	11	12	15	5	5
11	12	15	17	20	22	7	7
14	14	19	20	21	24	6	8
8.67	9.31	11.47	14.19	16.56	19.17	6.53	6.75
Rating1	Rating2	Rating3	Rating4	Rating5	Rating6		

Q2.3	Q2.4	Q2.5	Q2.6	Q3.1	Q3.2	Q3.3	Q3.4
10	13	15	19	20	22	25	27
6	8	10	14	9	10	13	16
11	15	16	20	22	23	24	29
15	16	18	21	21	23	25	25
7	8	11	13	8	8	9	14
7	12	12	16	16	17	18	23
7	9	13	16	10	10	10	15
9	12	17	19	19	19	21	23
9	10	13	14	7	7	10	12
6	9	13	17	9	12	15	19
9	12	15	18	20	23	25	25
9	13	14	18	24	24	25	26
9	13	15	18	15	15	20	21
8	14	16	21	7	7	12	18
10	14	15	19	16	16	21	22
8	11	13	15	9	9	10	15
6	10	12	15	10	10	15	17
6	6	10	11	6	7	8	12
11	13	17	21	24	25	29	30
9	9	12	14	12	14	15	20
11	13	17	18	19	22	24	26
9	12	15	18	15	17	20	22
6	10	11	14	9	10	13	16
8	11	13	17	18	19	23	24
12	14	15	19	18	21	24	26
7	8	13	15	8	9	12	15
7	8	13	13	8	8	9	13
9	12	15	18	19	22	24	30
11	13	16	19	19	24	25	30
7	10	11	14	14	18	20	22
7	11	12	15	13	14	18	20
11	13	16	18	17	17	20	23
9	13	14	18	19	21	23	25
6	10	12	15	9	9	12	15
9	12	15	18	19	21	22	26
10	12	15	18	20	23	25	29
8.64	11.36	13.89	16.83	14.67	16.00	18.44	21.42

Q3.5	Q3.6	Q4.1	Q4.2	Q4.3	Q4.4	Q4.5	Q4.6
29	30	10	10	12	15	16	19
19	24	5	5	5	10	12	14
29	30	6	7	11	13	16	19
30	30	9	11	14	15	19	21
15	20	5	5	5	7	10	13
24	27	5	6	9	10	13	15
20	24	5	5	5	7	12	16
27	30	6	6	11	11	16	17
16	21	5	5	5	8	9	13
21	26	5	6	7	11	12	16
27	30	9	9	13	13	16	19
29	30	7	9	12	13	17	18
25	27	5	6	10	11	14	16
23	29	5	5	7	12	15	17
25	27	7	7	11	12	14	17
18	24	5	5	5	10	11	16
21	26	5	5	7	10	12	16
14	18	5	5	5	5	6	9
30	30	12	12	13	16	17	21
21	25	5	5	5	5	7	10
28	29	5	7	11	14	15	19
25	28	7	7	10	11	16	17
19	22	5	5	5	9	10	14
27	29	10	11	14	14	18	19
28	29	6	9	11	14	15	18
18	21	5	5	5	10	13	14
14	17	5	5	5	6	10	11
30	30	8	9	12	14	16	20
30	30	8	10	12	16	17	21
26	27	5	5	8	10	13	15
23	23	6	6	8	11	13	15
26	28	7	7	10	12	15	16
29	30	10	10	14	15	17	20
18	21	5	5	6	9	11	14
28	28	8	9	11	14	16	18
29	30	14	14	15	17	19	20
23.92	26.39	6.67	7.17	9.14	11.39	13.83	16.47

Q5.1	Q5.2	Q5.3	Q5.4	Q5.5	Q5.6	Q6.1	Q6.2
10	11	13	15	17	19	6	6
7	7	11	12	16	18	4	4
10	12	14	16	18	20	6	7
11	15	15	17	20	20	6	7
5	5	9	9	12	15	4	5
6	7	10	12	14	17	4	4
5	5	9	13	16	20	2	2
5	5	9	12	16	20	4	4
4	6	10	10	14	18	2	2
5	9	12	13	16	20	3	4
12	14	16	17	20	20	6	6
4	8	9	12	15	17	6	6
7	7	10	11	14	17	3	3
4	4	6	12	16	19	2	2
4	8	10	13	16	20	4	4
5	5	5	10	14	18	4	4
5	5	9	11	15	19	2	2
4	4	7	9	12	15	2	2
8	12	15	17	19	20	7	7
4	4	7	9	11	15	2	4
6	10	12	15	16	20	5	5
7	7	11	11	15	17	3	5
6	6	10	13	14	17	2	2
8	9	12	13	17	19	6	6
9	12	15	17	20	20	5	5
4	5	8	10	14	18	2	3
4	4	5	9	11	15	2	2
8	10	13	15	18	20	4	5
9	11	13	16	18	18	5	5
4	4	8	9	12	15	3	5
5	6	9	10	12	15	6	6
6	10	11	15	16	20	4	5
8	11	13	15	18	20	5	5
6	8	9	13	15	18	3	3
10	11	14	16	18	20	6	6
7	11	13	16	19	20	4	5
6.44	8.00	10.61	12.86	15.67	18.31	4.00	4.39

Q6.3	Q6.4	Q6.5	Q6.6	Q7.1	Q7.2	Q7.3	Q7.4
6	7	8	9	3	3	5	6
4	6	7	8	3	3	3	4
8	8	10	10	4	5	7	9
8	9	10	10	4	6	6	9
5	6	7	8	3	3	3	3
5	6	6	8	3	4	4	7
2	5	7	8	3	3	3	4
6	6	8	10	3	3	4	5
2	3	4	6	3	3	3	3
5	6	7	8	3	3	3	4
6	8	8	9	6	6	8	9
6	7	8	8	4	4	6	6
4	5	6	7	3	3	5	6
4	4	6	8	3	3	3	6
6	6	8	9	3	3	6	6
4	6	7	7	3	3	3	4
3	4	5	7	3	3	3	3
3	4	6	7	3	3	3	3
8	8	9	10	6	6	8	9
4	4	6	6	3	3	3	3
6	7	8	9	3	3	5	5
5	6	7	8	3	3	3	5
4	5	6	7	3	3	3	5
6	8	8	9	4	5	5	7
6	7	8	9	5	5	7	8
3	5	5	7	3	3	3	6
3	4	5	6	3	3	3	3
6	7	8	9	3	3	6	6
6	7	7	9	4	4	7	7
5	7	7	8	3	3	3	5
7	8	9	10	3	3	3	4
6	7	8	9	3	3	4	6
6	8	8	10	3	3	6	7
4	5	6	7	3	3	3	4
7	8	9	10	3	3	5	6
6	7	8	10	4	4	7	8
5.14	6.22	7.22	8.33	3.39	3.53	4.50	5.58

Q7.5	Q7.6	Q8.1	Q8.2	Q8.3	Q8.4	Q8.5	Q8.6
8	10	10	10	12	15	16	19
6	7	4	4	6	10	11	13
10	12	5	5	9	10	13	16
9	12	9	9	12	13	16	20
5	6	7	7	10	11	14	16
7	10	4	4	8	9	11	15
5	6	4	4	4	7	11	14
7	8	5	5	9	11	14	18
5	5	4	5	8	8	12	13
5	7	4	4	5	8	11	14
10	11	6	7	10	11	13	15
8	9	8	10	12	14	16	18
8	11	4	4	5	8	9	13
9	11	4	4	5	10	14	16
8	9	5	5	8	10	13	16
6	7	5	5	5	9	12	16
5	6	4	4	8	9	13	15
4	6	4	4	5	8	9	12
11	13	13	13	16	17	18	19
3	4	6	9	10	12	13	16
8	8	6	7	10	10	13	14
7	8	9	9	12	13	16	18
6	8	4	4	5	8	9	12
8	9	10	10	13	14	16	18
9	11	4	5	7	11	13	15
6	7	4	4	8	9	12	15
4	6	4	4	5	7	9	11
8	10	6	8	10	11	15	15
10	10	4	5	8	10	12	16
6	8	4	4	8	8	12	13
6	7	9	9	11	13	16	17
7	9	4	5	8	10	11	14
8	10	8	9	12	12	16	16
6	7	4	5	8	10	13	15
9	9	4	6	8	11	12	16
9	11	4	5	8	10	13	14
7.11	8.56	5.64	6.14	8.56	10.47	12.97	15.36

Q9.1	Q9.2	Q9.3	Q9.4	Q9.5	Q9.6
6	6	9	10	12	16
4	4	4	6	8	9
6	8	12	13	16	20
6	10	12	12	16	16
4	4	4	6	7	10
4	4	8	11	13	16
4	4	4	5	6	10
4	4	4	8	8	9
4	4	4	4	6	8
4	4	5	5	7	9
4	5	8	9	11	12
6	7	9	11	12	14
4	4	6	8	11	15
4	4	4	8	11	13
4	4	8	9	11	13
4	4	4	7	8	10
4	4	4	4	8	9
4	4	4	4	4	5
6	8	8	12	12	15
4	4	4	4	5	6
4	6	7	7	11	12
4	4	7	9	12	12
4	4	6	8	9	9
6	6	7	10	13	14
6	7	10	12	13	16
4	4	4	4	8	8
4	4	4	4	6	7
6	6	9	11	14	15
5	7	10	12	14	16
4	4	4	6	8	10
4	4	4	5	7	9
4	8	8	12	12	16
6	8	10	12	12	16
4	4	6	7	10	11
5	7	9	11	12	15
4	6	6	10	11	14
4.56	5.25	6.56	8.22	10.11	12.08

APPENDIX I

LIST OF EXPERTS

Sl.No.	Name	Address
1	Dr. Sibu G Netto	Assistant Director Distance Education Council Indira Gandhi National Open University New Delhi
2	Dr. Josen George	Assistant professor (Physical Science) Avila College of Education Edacochin Kochi
3	Ms. Mary Vinaya	Assistant Professor Department of Physics St. Teresa's College Ernakulam
4	Ms. Seeja Vinod	Assistant professor (Physical Science) SNM Training College Moothakunnam Ernakulam
5	Mr. Subin Paul	Lecturer in Physical Science Avila College of Education Edacochin Kochi
6	Ms. Nimila Joy	Lecturer in Zoology St. Alberts College Ernakulam
7	Ms. Niji Philomina C.A	Science Teacher LMCC Higher Secondary School Ernakulam
8	Ms.Reena	Science Teacher Kendriya Vidyalaya 1 Ernakulam
9	Ms. Sensy Carvalho	Science Teacher St. Joachims Upper Primary School Ernakulam

APPENDIX J

LIST OF SCHOOLS

Sl.No.	NAME OF SCHOOL	LOCATION
1	Government Upper Primary School	Edapally
2	SRV Upper Primary School	Ernakulam
3	Government UPS for Girls	Ernakulam
4	Holy Family Eurasian UPS	Pachalam
5	Little Flower UPS	Cheranalloor
6	Little Flower UPS	Kaloor
7	S.I Upper primary School	Kaloor
8	Sri Rudravilasam UPS	Ernakulam
9	St. Antonys UPS	Panangad
10	St. Francis UPS	Pizhala
11	St. John Bosco UPS	Ernakulam
12	St.Marys UPS	Kumbalam
13	St.Marys UPS	South Chittoor
14	St. Marys UPS	Thevara
15	St. Marys UPS	West Cheranalloor
16	St. Joachims UPS	Kaloor
17	St. Josephs UPS	Kadavanthara
18	St. Josephs UPS	Karithala
19	St. Josephs UPS	Ponnarimangalam
20	St. Sebastians UPS	Ponjikara
21	SRV High School	Ernakulam
22	Government Girls High School	Ernakulam
23	Government Vocational HSS	North Edapally
24	Government Higher Secondary School	Elamakkara
25	Government Fisheries Technical High School	Thevara
26	Government Vocational HSS	Kadamakuddy
27	Government High School	Vennala
28	Government High School	Panampilly Nagar
29	Model Technical HSS	Kaloor
30	Al Farooquiya High School	Cheranalloor
31	St. George High School	Edapally
32	St. Pius GHS	Edapally
33	St. Teresa's GHS	Ernakulam
34	Darul Uloom High School	Ernakulam
35	St. Alberts High School	Ernakulam
36	St. Marys GHSS	Ernakulam
37	St. Augustines High School	Ernakulam
38	Lady Mount Carmel Convent HSG	Pachalam
39	St. Antonys HSS	Kacheripady
40	Higher Secondary School of Jesus	Kothad
41	St. Josephs High School	Pachalam

Sl.No.	NAME OF SCHOOL	LOCATION
42	R.P.M High School	Kumbalam
43	Vocational Higher Secondary School	Panangad
44	CCPLM Anglo Indian High School	Perumanoor
45	St. Thomas GHSS	Perumanoor
46	Hidayat Islam High School	Ponnarimangalam
47	Sacred Heart High School	Thevara
48	Sree Narayana High School	Thrikanarvattom
49	St. Marys High School	Vallarpadam
50	ACS English Medium High School	Kaloor
51	Our Lady of Carmel GHS	Palluruthy
52	St. Antonys UPS	Perumpadappu
53	St. Sebastians High School	Palluruthy
54	SDPY High School	Palluruthy
55	St. Augustines High School	Aroor
56	St. Peters High School	Kumbalanbji
57	Santa Cruz High School	Fort Kochi
58	St. Marys Anglo Indian High School	Fort Kochi
59	St. De Britto High School	Fort Kochi
60	St. Josephs UPS	Manassery
61	Fatima High School	Fort Kochi
62	St. Sebastians High School	Chellanam
63	T.D High School	Mattancherry
64	Shri Cochin Gujarati Vidyalaya High School	Mattancherry
65	Government GHS	Mattancherry

APPENDIX K

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COOPERATIVE LEARNING IN TEACHER EDUCATION

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Abstract

In the present world globalization has made its impact on all sectors of the society and education is no exception. What is needed at the hour is a globally competent workforce. People need to be having global skills that would help them survive and compete in the global world. It's high time that innovations be brought about in the field of education so as to improve the quality of education and produce global citizens. There are many factors which play a very important role for the same and one such important factor is the teacher. Teachers, whether at school level or higher educational level, form the backbone of the educational system of a country. Without quality teachers no educational system can function successfully. So while trying to shape an educational system to meet with the global standards it is important that the education of teachers be given equal importance. Only if teachers are skilled and trained globally, can they impart the same to their students. A lot of innovative and creative techniques have to be implemented for effective curriculum transaction in teacher education. Instructional strategies should be so designed that it actually helps teacher educators to develop the global skills genuinely and also help them impart it to their students. For this one of the essential tools needed is a suitable forum for dialogue and discussion and one such strategy promoting this aspect is cooperative learning. Cooperative learning is grounded in the belief that learning is most effective when students are actively involved in sharing ideas and work cooperatively to complete academic tasks. Thus by using cooperative learning approach in teacher education, rich learning experiences can be provided, thereby helping to strengthen the quality of our future teachers.

Key words : *Teacher Education, Instructional Strategies, Skills, Dialogue and Discussion, Cooperative Learning*

INTRODUCTION

In the present world globalization has made its impact on all sectors of the society and education is no exception. What is needed at the hour is a globally competent workforce. People need to be having global skills that would help them survive and compete in the global world. It's high time that innovations be brought about in the field of education so as to improve the quality of education and produce global citizens. There are many factors which play a very important role for the same and one such important factor is the teacher. Teachers, whether at school level or higher educational level, form the backbone of the educational system of a country. Without quality teachers no educational system can function successfully. So while trying to shape an educational system to meet with the global standards it is important that the education of teachers be given equal importance. Teacher education plays a very vital role in the making of a quality teacher. Teacher education programmes should provide teachers with skills and competencies to meet the diverse learning situations. Only if teachers are skilled and trained globally, can they impart the same to their students. Thus diverse and innovative teaching strategies are necessary in order to teach different kinds of things and to help each of the many different teacher education students learn most effectively. The UNESCO (1996) in its report "Learning to Live Together" states that one of the tasks of education is to teach pupils and students about human diversity and to instill in them an awareness of the similarities and interdependence of all people. From early childhood, it should focus on the discovery of other people in the first

stage of education. In the second stage it should encourage involvement in common projects. Thus one of the essential tools for education in the twenty first century must be a suitable forum for dialogue and discussion. One such strategy promoting this aspect is Cooperative Learning (CL).But unless teachers have a sound knowledge on cooperative learning and have practical experience using it, they will not be able to implement it in their classrooms. Thus it's high time that innovative techniques like cooperative learning be incorporated in teacher education thereby helping to strengthen the quality of future teachers.

CONCEPT OF COOPERATIVE LEARNING

Cooperative learning involves students working together in small groups to accomplish shared goals. One can see that several definitions of cooperative learning have been formulated. But the most widely used definition of cooperative learning in higher education is probably that of Johnson & Johnson (1994). According to them, cooperative learning is an instruction that involves students working in teams to accomplish a common goal, under conditions that include the following five essential elements :

1. **Positive Interdependence-** Team members are obliged to rely on one another to achieve the goal. If any team members fail to do their part, everyone suffers consequences.
2. **Individual Accountability-** All students in a group are held accountable for doing their share of the work and for mastery of all of the material to be learned.
3. **Face-to-face Promotive Interaction-** Although some of the group work may be parceled out and done individually, some must be done interactively, with group members providing one another with feedback, challenging reasoning and conclusions, and perhaps most importantly, teaching and encouraging one another.
4. **Appropriate Use of Collaborative Skills-** Students are encouraged and helped to develop and practice trust-building, leadership, decision-making, communication, and conflict management skills.
5. **Group Processing-** Team members set group goals, periodically assess what they are doing well as a team, and identify changes they will make to function more effectively in the future.

So it can be seen that Cooperative Learning is not simply a synonym for students working in groups. Simply placing pupils in groups and telling them to work together does not ensure cooperative learning. For that, the above five elements have to be taken care of.

Studies from the research literature suggest that cooperative learning in its many forms has a variety of positive and measurable outcomes on students at a variety of cognitive levels and in a variety of disciplines. Johnson et al. (1987) conducted a Meta analysis of 122 studies of cooperative learning done between 1942 and 1981. It was found that cooperative learning tends to promote higher achievement than does competition or individual work, with this finding holding for all age levels, all subject areas, and a variety of tasks. The same results were obtained by Slavin (1991) who identified 70 studies that evaluated various cooperative learning methods for periods of 4 week or longer. Sharan & Sharan (1987) report that CL builds cooperative skills, such as, communication, interaction, cooperative planning, sharing of ideas, decision making, listening, taking turns and exchanging and synthesizing ideas. In teacher education, Veenman et al., (2002) studied the implementation effects of a course on cooperative learning for student teachers. It was seen that a course on CL can have a positive effect on the cooperative instructional skills of student teachers. The majority of the student teachers subscribed to cooperative learning to achieve both academic and social goals and also showed a readiness to use cooperative learning methods in their future lessons. The pupils taught by the treatment student teachers also showed positive attitudes towards working in groups and rated the benefits of working in groups relative to working alone quite positively.

COOPERATIVE LEARNING IN TEACHER EDUCATION

In India, according to Mangla (2010), one serious defect in teacher education is an overemphasis on theory and inadequate attention to the practical aspect of teacher's preparation. This is supported by Singh (2010) who says that the innovative methods and latest evaluation techniques are theoretically touched in several institutions of teacher education and the practice aspect is too poor to tackle the modern classroom problems. As per National Curriculum Framework (NCF, 2005), teacher education programmes today have little engagement with the numerous recent innovative educational experiments. Focusing more on only conventional methods and theoretical aspects will not help student teachers to develop the skills and competencies needed to face the real challenges of teaching. So it's high time that innovations are brought about in the instructional methods of teacher education and practical aspects be dealt with properly. The National Curriculum Framework for Teacher Education (NCFTE, 2009) states that the most dominant practice of teacher education today is students working individually on assignments, in- house tests, field work and practice teaching. It further states that this practice has to be changed and that students should be encouraged to work in teams and group presentations be encouraged. One such strategy supporting this is cooperative learning. But unless the teacher and learner have a thorough understanding of the strategies and are actively involved in it, the maximum benefit cannot be obtained. And when a new teaching technique like cooperative learning is to be implemented it is very essential that the teachers are well versed with the same so as to avoid confusions. But according to Panitz (2000), current teacher training methodologies do not promote CL. Teachers are not trained to facilitate learning in small groups and are therefore not familiar with what CL involves. Many teachers do not know how or where to start with the application of CL methods in their classrooms. Jaiswal & Agarwal (2007) report that the most common mode of teaching in teacher training institutions of our country is through lectures alone. They further point out that using lecture method in a training setup and expecting student teachers to adopt child centred approach in their own classrooms is neither realistic nor desirable and hence they need to be trained and facilitated to handle learner centred pedagogy. But for this teachers have to be trained in this method in their teacher education programmes from the very beginning. To help student teachers use CL effectively in their future classrooms, it must be demonstrated and practiced during their course. Unless the student teachers learn about CL, experience it, practice it and personally know its values, they will be reluctant to use this technique in their future classrooms. Thus CL must be made a part of the syllabus as well as instructional strategy in the teacher education programme. Syllabus should be so designed that cooperative learning, its theory, techniques, methods of implementation and assessment techniques be included as an important unit. This will take care of the content part of CL becoming known to student teachers. Regarding its practice, CL techniques should be made an integral part of the instructional strategies being used in teacher education classrooms. Along with that student teachers should be made to teach using CL techniques during practice teaching. According to Mangla (2010), practice teaching is done under tension and artificiality in our teacher education programmes and student teachers are not encouraged to use innovative methods. So this has to be changed and CL should be promoted as one of the instructional strategies for practice teaching.

IMPLEMENTING COOPERATIVE LEARNING IN CLASSROOMS

CL techniques are very specific cooperative learning strategies which the teachers use to organize interactions between students. There are many such techniques that can be used in classrooms. These techniques are simple to use and can be used in any of the subjects of teacher education curriculum though it will be most useful in methodology classes where science, mathematics, social studies and language are taught. Working in groups and performing activities together will have more relevance in these methodology classes. It will help students learn the concepts more easily in an

interesting way. Some of the commonly used cooperative learning techniques are as given below:-

- ***Jigsaw*** - Developed by Aronson (1978).Groups with five students are set up. Each group member is assigned some unique material to learn and then to teach to his group members. To help in the learning process, students across the class working on the same sub-section get together to decide what is important and how to teach it. After practice in these "expert" groups the original groups reform and students teach each other. Tests or assessment follow. Some simple sub-units or concepts can be taught easily using jigsaw. Here each student gets a chance to understand his material well and at the same time teach it to his group members. This will help each one in mastering the concept more easily because explaining to another person what one has learnt helps in increased retention of the same. Jigsaw would be best suited for teaching methodology classes in teacher education.
- ***Student Teams-Achievement Divisions (STAD)*** – Developed by Slavin (1978). In this students are assigned to four-member learning teams that are mixed in performance level, gender and ethnicity. The teacher presents a lesson, and then students work within their teams to make sure that all team members have mastered the lesson. Finally, all students take individual quizzes on the material, at which time they may not help one another. Students' quiz scores are compared to their own past averages, and points are awarded on the basis of the degree to which students meet or exceed their own earlier performance. These points are then summed to form team scores, and teams that meet certain criteria may earn certificates or other rewards. This can be used for some difficult concepts where the teacher's briefing on the topic is also needed. The teacher can outline the difficult part and simplify it by giving suitable and only brief explanations regarding the same. Once students have got the idea, then the topic can be given to them in groups as above. This technique also would be apt for methodology classes.
- ***Group Investigation*** – Developed by Sharan & Lazarowitz (1978). This is a general classroom organization plan in which students work in small groups using cooperative inquiry, group discussion, and cooperative planning and projects. In this method, students form their own two- to- six- member groups. After choosing subtopics from a unit that the entire class is studying, the groups break their subtopics into individual tasks and carry out the activities that are necessary to prepare group reports. Each group then makes a presentation or display to communicate its findings to the entire class.

  This is mainly used for project works or assignments. Project works in science classes and assignments in language classes are the most applicable ones for the same.
- ***Teams - Games - Tournaments (TGT)*** – Developed by De Vries and Slavin (1978). It is used at the conclusion of each chapter. The usual heterogeneous groups are split up temporarily. Students are put into homogeneous ability groups of three or four students for a competition, using the list of questions at the end of the chapter. Students randomly select a numbered card corresponding to the question they are to answer. Their answers can be challenged by the other students and winner keeps the card. Students earn points (one point for each card won) to bring back to their regular teams, a team average is taken, and the teams' averages are announced and all congratulated. This can be used at the end of all chapters for any subject in teacher education very easily. Helps students to recollect all that they have learnt from the beginning of the chapter thus helping them strengthen their memory more sharply.
- ***Think-Pair-Share*** – Developed by Frank Lyman (1981). Involves a three step cooperative structure. During the first step individuals think

silently about a question posed by the instructor. Individuals pair up during the second step and exchange thoughts. In the third step, the pairs share their responses with other pairs, other teams, or the entire group. This is one of the simplest of all techniques and can be used for the introduction of new topics or concepts. The teacher can pose some question regarding the new topic or narrate a situation related to the same. Then students can be made to arrive at the new topic using this technique. This technique is easily applicable to all subjects in teacher education.

- ***Round Robin Brainstorming*** – Developed by Kagan (1992). Class is divided into small groups (4 to 6) with one person appointed as the recorder. A question is posed with many answers and students are given time to think about answers. After the "think time", members of the team share responses with one another round robin style. The recorder writes down the answers of the group members. The person next to the recorder starts and each person in the group in order give an answer until time is called. This again is a technique which can be used in the introduction of new topics or concepts and can be easily used in all subjects.

ASSESSING COOPERATIVE LEARNING

Implementing cooperative learning successfully does not ensure its success. For that it is very essential to know whether students have benefited from the technique and if yes to what extent and how. All these questions come under the important and difficult task of assessment. Instructors new to cooperative learning often find it very difficult to assess students in CL situations because here it is not mere the achievement that has to be assessed which could be easily done by a paper-pencil test. Assessing students in CL means assessing them on the five essential elements of CL, namely, positive interdependence, individual accountability, face-to-face promotive interaction, appropriate use of collaborative skills and group processing. So teachers have to be given a lot of training for the same. The five essential elements of cooperative learning are not those that can be measured by the academic achievement of students. Also it is not necessary that students who score high in paper-pencil test will always develop cooperative learning skills. Even if their academic scores are not much high they might have progressed a lot in the five essential elements of cooperative learning. So there needs to be a different kind of assessment for the same. Some approaches that can be used for assessing students in cooperative learning activities include checklist, rating scale, rubric, field diary, activity sheets, portfolios, group work questionnaire, group assignments and group presentation. Rating scale and checklist can be prepared based on the following points :

- To check positive interdependence it can be seen whether students are building on each others ideas, listening to all before reaching conclusions, sharing responsibility for tasks evenly, positive attitude about task and work of others and encouraging and supporting the efforts of others.
- Individual accountability can be assessed on the following: accepting assigned roles responsibly, completion of assigned work; produces quality/relevant work, participating on clean up willingly and punctuality/regular attendance.
- For checking face to face promotive interaction the following can be looked for: criticizing ideas without criticizing people, listening to others, seeking elaboration, asking in-depth questions and providing constructive praise and criticism.
- Collaborative skills can be assessed on the following: leadership skills, communication skills, trust building skills, decision making skills and resolving conflicts.
- Finally to assess group processing it can be seen how groups set goals, seek and promote consensus on teams goals and work plans to reach these goals, assess their team and think of changes to be made in future.

A rating scale developed based on above mentioned points for assessing the five essential elements of cooperative learning is as given :

	1	2	3	4	5
	Never	Rarely	Occasionally	Frequently	Always
Positive Interdependence					
1) Building on each other's ideas					
2) Listening to all before reaching conclusion					
3) Sharing responsibility for tasks evenly					
4) Positive attitude about task and work of others					
5) Encourages and supports the efforts of others					
Face to Face Promotive Interaction					
1) Listening to others without interrupting them					
2) Stating differences when there is disagreement					
3) Asking people to explain their reasoning					
4) Asking in-depth questions & discussing					
5) Providing constructive praise and criticism					
Individual Accountability					
1) Accepts assigned role responsibly					
2) Participates on clean up willingly					
3) Contributes ideas and suggestions to group					
4) Produces quality/relevant work					
5) Completion of assigned work on time					
6) Punctuality/regular attendance					
Appropriate use of Collaborative Skills					
a) Leadership					
1) Performing assigned role and helping others to do so					
2) Involving, valuing and recognizing contributions of all team members					
3) Effectively managing time					
4) Summarizing results and next steps before finishing					
5) Maintaining focus and keeping to the point in conversation					

b) Communication					
1) Addressing others by name					
2) Looking at the person speaking					
3) Actively listening to others					
4) Interacts and discusses with all members					
c) Trust building					
1) Depending and adding on each others ideas					
2) Accepting others suggestions/answers					
d) Decision making					
1) Pulls together all ideas into a single position					
2) Directing the group in reaching consensus					
3) Defends/rethinks ideas relating to the group's goals					
3) Resolving conflicts					
1) Controlling emotional reactions					
2) Disagreeing in an agreeable way					
3) Makes necessary compromises					
3) Suggesting solutions to conflicts					
Group Processing					
1) Setting group goals and work plans that everyone understands					
2) seeking and promoting consensus on teams goals and work plans to reach these goals					
3) Assessing their team					
4) Reflecting on what changes need to be done					

Training in assessment should be given during the time of practice teaching. Student teachers should be made to teach using cooperative learning techniques and make assessments. This will give them hands on experience for the same and will find it easy to make assessments in future classrooms. Also implementing cooperative learning successfully does not require adopting every technique. Each one can choose those techniques with which they feel most comfortable and then go for other techniques when they get used to the current ones. This will help in easy and successful implementation of cooperative learning in any classroom.

CONCLUSION

Today with globalization on its merge what is needed for future success is a knowledge society that constantly develops new ideas, technologies, methods, products and services. And in building such knowledge societies, teachers play a very vital role. So teacher education programmes must provide teachers with all the skills and understanding needed for the same. Only if teachers are globally skilled can they impart it to their students. So student teachers have to be trained effectively and for this innovative teaching strategies are needed. One such effective teaching strategy which would promote academic as well as social success is cooperative learning. It is widely recognized as a teaching strategy that promotes socialization and learning among students from kindergarten through college and across different subjects. Thus cooperative learning should be made an integral part of teacher education programmes in the near future.

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No.AC/PhDCWCerti/33/ 713
Day & Date: Wednesday, 19 December 2012

19 DEC 2012

To,
The Dean,
Faculty of Education & Psychology,
The M. S. University of Baroda

Subject: Issuance of Ph.D. Course Work completion Certificate.

Sir/Madam,

Please find an enclosed certificate towards completion of Ph.D. Course work of the below specified Research Scholar:

Name of the Research Scholar: Ms. Mary Vineetha Thomas

Registration Number: 485

Registration Date: 03/03/2010

Ph.D. course work certificate number: 33

Since the certificate being a pre-requisite for the submission of the synopsis, you are requested to arrange to send the certificate to the Research Scholar concerned through the concerned guide for further necessary actions.

Thanking you,

Yours faithfully,

Deputy Registrar (Academic)
For Registrar (Offg.)
The M. S. University of Baroda

Enclosure:
Ph.D. Course Work completion Certificate of Ms. Mary Vineetha Thomas.

Copy to:
- Section Examination

Ph.D. file of student

Faculty of Education and Psychology, Baroda.
Inward No. FEP/ 1092
Date 21/12/12

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CERTIFICATE

[As per O.Ph.D. 2 under UGC (Minimum Standards and Procedure for Awards of M.Phil./Ph.D. Degree) Regulation, 2009 for 15 Credits to be earned by Ph.D. Scholars]

This is to certify that **Ms. Mary Vineetha Thomas,** Research Scholar, registered under UGC (*Minimum Standards and Procedure for Awards of M.Phil./Ph.D. Degree) Regulation, 2009,* vide Registration Certificate Number 485 dated 03/03/2010, for pursuing Ph.D. on has undertaken and completed the course work with the Grade O.

STATEMENT OF CREDITS EARNED

Name of Research Scholar: **Ms. Mary Vineetha Thomas** *(F)*

Faculty/Institution: Faculty of Education & Psychology

Department: Education

Paper Number	Course Title	Course Credits	Grade Earned
Core Courses – 09 Credits *[Offered At University Level]*			
I.	Introduction to Research & Research Writings	3	A
II.	Introduction to Basic Computer Functions & Application for Research Purposes	3	O
III.	Quantitative Research Techniques & Data Analysis	3	A
Departmental Courses – 06 Credits *[Offered at Departmental Level]*			
IV.	Review and Report of Research	3	A
V.	Theoretical/Conceptual frameworkof the Research Problem	3	A
		Overall Grade	**O**

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Registrar (OSD)

33

Grade Conversion Table and Grade Calculation Formula

Grade	Grade Points	Range
O	10	Above 9.01
A	9	8.01 – 9.00
B	8	7.01 – 8.00
C	7	6.01 – 7.00
D	6	5.01 – 6.00
E	5	4.01 – 5.00
F	4	Below 4.00

$$Overall\ Grade = \frac{\sum (Grade\ Points \times Credits)}{\sum Credits}$$