STUDENTS MATHEMATICS ACHIEVEMENT USING COOPERATIVE LEARNING APPROACH: THE CASE OF BORODA SECONDARY SCHOOL

MSc THESIS

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Students Mathematic Achievement Using Cooperative Learning Approach: The Case of Boroda Secondary School

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This is to certify that this thesis was prepared by Mohammed Yusuf, entitled **"**Students Mathematics achievement using Cooperative learning approach in Boroda Secondary School" and submitted in partial fulfillment of the requirement for the degree of Masters of Science in Mathematics compiles with the regulation of the university and meets the accepted standards with respect to originality and quality.

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DEDICATION

This work is dedicated to my parents, my wife Furdosa, my daughter Emantu and my sons Ammar and Shueybi.

STATEMENT OF THE AUTHOR

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BIOGRAPHY

The author was born on May 1986 in Eastern Hararghe zone, Gorogutu District. He attended elementary education at Burka and Boroda elementary schools. He attended secondary and preparatory education at Deder secondary and preparatory school. Then, he joined Dilla University and graduated with a BEd degree in Mathematics in 2008. To pursue his further study and improve his qualification, he joined a postgraduate program at Haramaya University for Masters of Science in mathematics with specialization in Optimization.

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ABBREVIATIONS AND ACRONYMS

ANOVA	Analysis of Variance
CG	Control Group
CL	Cooperative Learning
CLA	Cooperative Learning Approach
EG	Experimental Group
MS	Mean Square
NCTM	National Council of Teachers of Mathematics
SD	Standard Deviation
SPSS	Statistical Package for Social Sciences
SS	Sum of Squares

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ABSTRACT

The purpose of this study was to improve students' mathematics achievement using cooperative learning approach. In addition, the study investigated students' perception about CLA in mathematics classroom. A survey questionnaire was conducted to determine students' perception while a t-test was used to determine their achievement before and after the treatment. As a result, the design of this study was a survey and control-experimental group design. Boroda secondary school was selected purposively as area of the study. The total target population under consideration was 192 grade 9 students out of which 64 students were selected purposively based on their ability level. The selected students then divided in to two equal groups. Both groups consisted equal number of higher, medium and lower achievers. The two groups were randomly named as control group (CG) and experimental group (EG). Students in EG were exposed to STAD techniques of cooperative learning approach while students in CG were taught using traditional lecture method. Data obtained from the questionnaire and achievement test were analyzed using descriptive and an independent-sample t-test. The findings of the study revealed that students who were exposed to cooperative learning approach performed better than students who were taught using traditional lecture method on the post-test although both groups performed poorly on the pre-test. The results further indicated that students belonging to EG perceived cooperative learning approach positively after the treatment although it was negative before the treatment. Therefore, from the findings of the current study, it can be concluded that cooperative learning approach using Students Teams-Achievement Divisions (STAD) significantly improved students' mathematics achievement and develop positive perception than traditional lecture method. Consequently, the study recommends the use of STAD technique in mathematics classroom rather than traditional lecture method.

Keywords: *Mathematics Achievement, Cooperative learning Approach*

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1. INTRODUCTION

1.1. Background of the study

Cooperative learning approach (CLA) is a student-centered, instructor-facilitated instructional strategy in which a small group of students is responsible for their own learning and the learning of all group members and it is recommended as very useful strategy for mathematics teaching in secondary school (Slavin, 2010). Students interact with each other in the same group to acquire and practice the elements of a subject matter in order to solve a problem, complete a task or achieve a goal (Johnson & Holubes, 1994). Raising learners' achievement in mathematics has become a matter of increased focus in recent years (Pisa, 2003).

CLA is one aspect of learning strategies that enables learners to apply their skills to both familiar and unfamiliar mathematical problems and thereby giving them the ability to use stated theories and also create their own knowledge before applying them. Such tasks also promote learners' conceptual understanding, foster their ability to reason and communicate mathematically.

According to Johnson *et al*. (2013), in order to improve students' mathematics achievement through CLA, five basic CL elements must be carefully structured. The first element of a cooperative lesson is positive interdependence in which students must believe that they are linked with others in a way that one cannot succeed unless the other members of the group succeed (and vice versa), that is, they "sink or swim" together. The second element of a cooperative lesson is face-to-face, promotive interaction where students help, assist, encourage, and support each other's efforts to learn. The third element is individual accountability, where the performance of each individual student is assessed and the results given back to the group and the individual. The fourth element of a cooperative lesson is social skills in which students develop decision-making, trust-building, communication, leadership ability and conflict management skills. And finally, the fifth element of a cooperative lesson is group processing. Such processing enables learning groups to focus on group maintenance, facilitates the learning of social skills, ensures that members receive feedback on their

participation, and reminds students to practice the small group skills required to work cooperatively.

Consequently, cooperative classroom consists of the integrated use of three types of cooperative learning groups. Cooperative learning groups may be used to teach specific content (formal cooperative learning groups), to ensure active cognitive processing of information during direct teaching (informal cooperative learning groups), and to provide students with long-term support and assistance for academic progress (cooperative base groups). Hence, using cooperative formal, informal, and base groups in combination in any assignment and any curriculum for any age, they provide an overall structure for learning.

Many studies have shown that problem solving through cooperative learning strategy promotes students learning and mathematics achievement (Johnson *et al*., 2000; Slavin, 2010). According to Brandon & Hollingshead (1999), cooperative learning increases the development of critical thinking skills and promotes greater transfer of learning. In addition, as cited in Cheng & Warren (2000), Robyn *et al*. (2003) stated that cooperative learning aids in the development of social skills such as communication, presentation, problem solving, leadership, delegation and organization. As a result, the importance of improving students' mathematics achievement through CLA was stated in several literatures.

Cooperative learning (CLA) might help students to realize the importance of asking for help when solving problems, prevents the giving up rate in case of non routine problems, develops cognitive ability, emphasizes the application of mathematical knowledge, improves creativity and improving problem solving skills (Bay, 2000).

Sezer (2010) indicated that if mathematics is about problem solving, students ought to be encouraged to make connections between mathematical ideas, able to construct mathematics learning by being active cooperatively rather than simply memorizing formulas. This can be achieved by exploring, justifying, representing, discussing, describing, investigating, and predicting mathematical concepts, instead of just listening to what teacher has to say on the material.

In Ethiopian, cooperative learning strategy was implemented in public schools starting from primary to secondary and preparatory by the name locally known as 'one-to-five' group organization. The method was implemented with the objective of enhancing students' educational achievements in particular and improving quality of education in general (MOE, 2013). However, the finding by Sisay *et al*. (2015) revealed that students participation was low in cooperative learning and the practice of cooperative learning was challenged by different problem like lack of awareness and motivation both in the side of teachers and students, as well as dependence of lower achievers on higher achievers, unequal sharing of work among group members, inappropriate group organization, uncomfortable seating arrangement of students, insufficient support and follow up from teachers.

Similarly, a 'one-to-five' group formation CL strategy has been implemented in Baroda secondary school in 2013 and as a result this strategy has been used in mathematics classrooms since then. However, students performance in mathematics is not that much satisfactory as expected to be. In fact this unsatisfactory student's mathematics performance occurred not because cooperative learning is ineffective but the way it was implemented might be defective. For example, the average mathematics scores of grade 9 students in regular mathematics examination for the past six consecutive years indicated the gradual decline as illustrated in Table 1 below.

Table.1.1: Boroda secondary school grade 9 mathematics results

Year	2013	2014	2015	2016	2017	2018
Average	53.7	50.2	47.5	43.14	39.09	36.3

Source: Boroda secondary school grade 9 students result document, 2018.

From students mathematics average scores indicated in Table 1, it can be seen that unless some means or ways are found to improve students low achievement in mathematics, the gradual decline in students score may be continue in a similar trends.

Therefore, it was this problem which triggered the researcher to research strategy to improve students' mathematics achievement using cooperative learning approach in Boroda secondary school.

1.2. Statement of the problem

Cooperative learning approach, as a pedagogical strategy, has been widely researched since its establishment in the 1992s and is often advocated as an effective classroom practice (Schoefnfel, 1992). Problem solving approach of cooperative learning enhances learning to take place and it provides smooth learning environment which motivate learners to overcome their conception in communicating and expressing their points of view in the instructional process that enables learners to apply their skills to both familiar and unfamiliar mathematical problems in order to improve their achievement in mathematics.

In Ethiopia, the problem of students underachievement was a serious concern that should be solved as the country needed knowledgeable man power. As far as the researcher knows, the teaching-learning processes in the Ethiopian secondary schools were highly teacher - centered which does not help quality learning as the traditional lecture method rarely, if any, supports learner engagement in inquiry, discussion, and expository learning. To address the problem of poor performance, the ministry of education (MOE, 2013) devised a CL strategy in the form of 'one-to-five' group organization hopping to improve students' achievement particularly in the field of science and mathematics. However, the problem of underachievement couldn't be solved and the intended outcomes couldn't be attained as it was expected to be though the CL was implemented (Mohammed, 2014). As a result, Mohammed indicated that the gap between the societal expectations and the actual performance of secondary school students in Ethiopia has still become a serious concern among many concerned bodies.

In the same manner, the problem of students' underachievement has also become a concern of Boroda secondary school communities. This might be true as grade 9 students' mathematics score illustrated in Table 1 above in one way or another may reflect these concerns. Despite the implementation of a one-to-five group formation strategy in mathematics classrooms, the

expected improvement in students' performance couldn't be achieved in the indicated school. The result shows that students' achievement in mathematics gradually declining from year to year rather than showing improvement though CL was widely believed that it can bring better outcomes in education system and enhance students' performance particularly in mathematics lesson. So, what went wrong with our one-to-five group organization CL technique? As far as the researcher knows, no tangible studies were carried on to assess the problem or provide any other alternative strategies to alleviate the problem related to students' poor achievement that Boroda secondary school faced in this regard. Due to these reasons, the researcher wanted to conduct research on this topic of research.

Therefore, the purpose of this thesis was to improve students' mathematics achievement using cooperative learning approach in Boroda secondary school. Accordingly, the study answered the following basic research questions.

1.3. Research questions

The present research sought answers to the following questions:

1. Is there any statistically significant difference in mathematics achievement between students who were taught using cooperative learning approach and those who were taught using traditional lecture method?
2. What is students' perception about cooperative learning approach in mathematics classroom?

1.4. Objectives of the study

1.4.1. General objective

The general objective of this study was to improve students' mathematics achievement using cooperative learning approach: The case of Boroda secondary school.

1.4.2. Specific objectives

This research tried to achieve the following specific objectives.

1. To determine whether there is any statistically significant difference in mathematics achievement between students who were taught using cooperative learning approach and those who were taught using traditional lecture method.
2. To identify students perception about cooperative learning approach in mathematics classroom.

1.5. Significance of the study

The results of the study may have great importance in improving Boroda secondary school grade 9 students mathematics achievement through cooperative learning approach. Moreover, this study may also benefit students and teachers of similar schools. Further, the findings of the current study may help to fill the gap that existed between students' perception and the use of cooperative learning approach on improving mathematics achievement.

1.6. Delimitation of the study

This study was delimited to improving students' mathematics achievement using cooperative learning approach. Students Teams Achievement Division (STAD) method of cooperative learning technique was used as an intervention during the study. The present study further investigated students' perception toward cooperative learning approach. Moreover, the study was focused on East Hararge Zone of Oromia Region, Boroda secondary school, grade 9 students. The duration of the study was seven weeks in total.

1.7. Limitation of the study

The present study was conducted only in one school and on one grade level. Consequently, the sample of the study and the time the study had taken were so small that it might or might not effective in a broad context.

1.8. Operational definition of key terms

I. **Achievement**: Students ability to better score on mathematics post test.

II. **Cooperative learning**: Setting students in small teams each consisting of four members based on their ability levels so that they can learn mathematics together in group.

III. **Cooperative learning approach**: Engaging grade 9 students in STAD method of CL in order for them to be able to perform mathematics.

IV. **Perception**: Grade 9 students' interest, participation in CLA, and awareness of the role of CLA.

V. **Traditional lecture method:** Teaching students in the usual non-cooperative lecture method.

2. REVIEW OF RELATED LITERATURE

2.1. Concept and definition of cooperative learning

Cooperative learning can be defined as principles and strategies for enhancing the value of student- student interactions. Cooperative learning does not mean that students must do everything in groups. While group activities play a significant role in learning, whole class Instruction and Individual work continues to have an important place in education. A key point is that cooperative learning represents much more than just asking students to share their desks together & work as a group. Collaboration is not easy, guidance of one form or another will often be useful (George, 2000).

More over Cooperative learning: a successful Teaching strategy in which small teams, each with students of different levels of ability use a Varity of learning activities to improve their understanding of subjects. The use of cooperative learning in the class room, as an instructional strategy had been a topic of study for many years. Cooperative learning involves groups of students working to complete a common task (Siegel, 2005) .

Cooperative learning is a character by frequent student cooperation (Whicker *et al*., 2010). The smaller the group, the better the students result. The students working in a groups are higher performance out comes than students working alone, but this efficient was not due to the cooperation, but the cooperation increased the likely hood of engagement in the types of the talk that support learning. When working with a partner, forms of elaborated talk are more relevant than when working alone.

The National council of Teachers of mathematics (NCTM) expressed that learning with understanding is essential to enable students to solve the new kinds of problems they will inevitably face in the future, because not all students regularly participate in the whole class discussions, Teachers need to monitor their participation to ensure that some are not left entirely out of the discussion for long periods (NCTM, 2000). The use of small groups will allow the students an opportunity to share important thoughts ideas to a small group of peers, thus improving confidence in sharing of ideas & communicating about mathematical ideas.

Cooperative learning also gives students the chance to analyze & evaluate the mathematical thinking &strategies, another key concept NCTM promotes this can be done in a non threatening environment; the interaction with other students can help deepen the level of understanding of all students. The communication of mathematical idea helps to develop reasoning skills & better understanding of mathematical procedures.

Teachers also find satisfaction with the incorporation of cooperative learning groups. The use of small groups requires fundamental changes not only in the organization of the class room but also in ways of learning. There are many different research based models of cooperative learning. One popular model is the Johnson &Johnson model. This model defines five essential elements: (a) group processing, (b) face to face interaction, (c) individual accountability, (d) positive group interdependence and (e) social skills instruction (Spencer *et al*., 2009). What is nice is that no one model must be followed precisely to have a positive influence in the class room. In fact, teachers will adapt research based models for use in their classroom. Through the mechanism of assimilation, teachers should recognize the information that they receive about cooperative learning to fit their existing schema of teaching.

2.2. Types of cooperative learning

According to Johnson & Johnson (2013) cooperative learning is an approach of organizing classroom activities into academic and social learning experiences. Students must work in groups to complete the two sets of tasks collectively. Everyone succeeds when the group succeeds. According to them, there are three types of Cooperative Learning;

Formal: This approach is structured, facilitated, and monitored by the educator over time and is used to achieve group goals in task work (for example, completing a unit). Any course material or assignment can be adapted to this type of learning, and groups can vary from 2 to 6 people with discussions lasting to a lesson. Types of formal cooperative learning strategies include Jigsaw, assignments that involve group problem solving and decision making, laboratory or experiment assignments, and peer review work (such as editing writing assignments). Having experience and developing skill with this type of learning often facilitates informal and base learning.

Informal: This approach incorporates group learning with passive teaching by drawing attention to material through small groups throughout the lesson or by discussion at the end of a lesson, and typically involves groups of two (such as turn-to-your-partner discussions). These groups are often temporary and can change from lesson to lesson (very much unlike formal learning where two students may be lab partners throughout the entire semester contributing to one another knowledge of science). Discussions typically have four components that include formulating a response to questions asked by the educator, sharing responses to the questions asked with a partner, listening to a partner's response to the same question, and creating a new well-developed answer. This type of learning enables the student to process, consolidate, and retain more information learned.

Group Base: These are peer groups that gather together over as long term (such as over the course of a year, or several years such as in high school or post-secondary studies) to develop and contribute to one another's knowledge mastery on a topic by regularly discussing material, encouraging one another, and supporting the academic and personal success of group members. Base group learning is effective for learning complex subject matter over the course or semester and establishes caring, supportive peer relationships, which in turn motivates and strengthens the students' commitment to the group education while increasing self-esteem and self worth. Base group approaches also make the students accountable to educating their peer group in the event that a member was absent for a lesson.

2.3. Basic elements of cooperative learning

Many teachers believe that they are implementing cooperative learning when in fact they are missing its essence. In order for a lesson to be cooperative, five basic elements must be carefully structured (Johnson *et al*, 2013).

The first element of a cooperative lesson is positive interdependence. Students must believe that they are linked with others in a way that one cannot succeed unless the other members of the group succeed. The most important type of positive interdependence is goal interdependence. All cooperative learning starts with a mutually shared group goal.

The second element of a cooperative lesson is face-to-face, promotive interaction where students help, assist, encourage, and support each other's efforts to learn. Students promote each other's learning by orally explaining to each other how to solve problems, discussing with each other the nature of the concepts and strategies being learned, teaching their knowledge to each other, and explaining to each other the connections between present and past learning.

The third element is individual accountability, where the performance of each individual student is assessed and the results given back to the group and the individual. It is important that group members know (a) who needs more assistance in completing the assignment and (b) they cannot "hitch-hike" on the work of others. Common ways of structuring individual accountability include giving an individual test to each student and randomly selecting one student's work to represent the efforts of the entire group.

The fourth element of a cooperative lesson is social skills. Groups cannot function effectively if students do not have and use the needed leadership, decision-making, trust-building, communication, and conflict-management skills. These skills have to be taught just as purposefully and precisely as academic skills. Many students have never worked cooperatively in learning situations and, therefore, lack the needed social skills.

Finally, the fifth element of a cooperative lesson is group processing. Here each group member success will be evaluated. Such processing enables learning groups to focus on group maintenance, facilitates the learning of social skills, ensures that members receive feedback on their participation, and reminds students to practice the small group skills required to work cooperatively (Johnson, 1999; Johnson & Johnson, 2017; and Johnson *et al*., 2013).

2.4. Methods of cooperative learning

There are different methods of cooperative learning which uses collaborative approach in learning. According to Slavin (2010), modern methods of cooperative learning include:

Group investigation: In group investigation, students form interest groups within which to plan and implement an investigation, and synthesize the findings into a group presentation for

the class. The teacher's general role is to make the students aware of resources that may be helpful while carrying out the investigation. It includes four important components: investigation, interaction, interpretation and intrinsic motivation. Investigation refers to the fact that groups focus on the process of inquiring about a chosen topic. Interaction is a hallmark of all cooperative learning methods, required for students to explore ideas and help one another learn. Interpretation occurs when the group synthesizes and elaborates on the findings of each member in order to enhance understanding and clarity of ideas. Finally, intrinsic motivation is kindled in students by granting them autonomy in the investigative process.

Slavin (2010) pointed out that, implementation of group investigation can be processed in six steps. First, the teacher presents a multi-faceted problem to the class, and students choose an interest group. The problem posed here is particularly important, as a variety of reactions from students is necessary for appropriate group formation. Teachers should avoid giving their own ideas or rejecting ideas from students. Second, groups plan their investigation the procedures, tasks and goals consistent with the chosen subtopic. Third, groups carry out the investigation as planned in the above step. The teacher's role at this step is to follow the investigative process, offering help when required: suggesting resources, ensuring a variety of skills is being used. Fourth, groups plan their presentation. They evaluate what they have learned, and synthesize it into a form that can be understood by the class. Fifth, groups conduct the presentation. Finally, the teacher and students evaluate the investigation and resulting presentations. Throughout the process, group representatives often make reports to the class, helping group members appreciate that they are part of a larger social unit.

Constructive Controversy: This cooperative approach was introduced by Johnson.D & Johnson.R in 1994. It has been researched and validated, and it's recognized as a leading model for developing robust and creative solutions to problems. Constructive Controversy is not about simply arguing and creating conflict for its own sake it follows a formal procedure to manage controversy in a positive way using the following steps: First, each team presents its case to the wider group. The objective is to help the group understand the particular choice, and convince people of its validity. Second, the other teams then have the opportunity to argue

against the position. This is an open discussion the presenting team listens to the counter-arguments, tries to disprove them, and defends its original position as best as it can. Third, the emphasis is on logic and critical thinking. Remind the teams that the overall objective is to gain a better understanding of all options in order to make the best decision possible. Encourage them to ask for solid data, and push the team to defend its conclusions. The next team presents its case, and discussion follows. This continues until all teams have presented their positions. Lastly, it's the time to drop the advocacy roles, and bring the group together to make a final decision.

Student Teams-Achievement Divisions (STAD): In Student Team Achievement Division (STAD) (Slavin, 1994) students are assigned 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 members have mastered the lesson. This current study problem solving approach of Cooperative learning integrated cooperative STAD to encourage and help each other in mastering the lessons and raising awareness of the importance, the meaningfulness, and the excitement of learning (Slavin, 2010).In the teaching of STAD, heterogeneous groups were formed after explaining the materials. The students were then expected to help each other in understanding the materials through discussion among the group members (Slavin, 1995).

The main idea of STAD was to motivate students in order to support and help each other in mastering the lessons. In the case that the students wanted their teams to get reward, they had to support each other and learn the materials very well. They supported their team mates in doing their best (Slavin, 1995). However, they worked together and made sure themselves in understanding the lessons or teaching materials. Intensive interaction and positive interpersonal relationship among students during the learning process were able to increase motivation and provide stimulus for thinking. It surely was beneficial for the long term education, especially in achieving maximum learning outcomes. According to Slavin (2010), high motivation, self-confidence relating to self-thinking ability and inquiry ability give positive influence in enhancing students' learning achievements.

STAD also affects students' thinking skills. According to Johnson (2017), cooperative learning environment involves students' sense of responsibility, job division, students' interaction and communication, and mutual connection which are beneficial for each team member. Communication and interaction provide the possibility for exchanging information which helps students enhance their thinking skills and create new ideas. Therefore, for the purpose of achieving successful learning process, students are indirectly required to have the willingness and skills to work together, as well as thinking skills.

It is based on challenging questions or problems. It involves students in designing, solving problem, making decision, or investigating activities.

The implementation of problem solving approach in corporation with cooperative learning a class increases the learning interest and develops thinking skills (Johnson, 2017). According to Slavin (2010), Student Team Achievement Division (STAD) are possible to achieve because CLA offers some advantages, namely (1) authentic context (goal-directed activities) which strengthens the relationship between activity and conceptual knowledge, (2) promoting learning autonomy (self-regulation) which develops thinking skills, (3) collaborative learning which enhances the understanding of conceptual and technical skills through the opportunities of mutual learning, (4) realistic active-oriented learning in solving real problems which contributes to the development of problem solving skills, and (5) providing internal feedback which sharpens thinking skills.

Cooperative Integrated Reading and Composition (CIRC): According to Slavin, this is a comprehensive program for teaching reading and writing in the upper elementary grades. Students work in four-member cooperative learning teams. They engage in a series of activities with one another, including reading to one another, making predictions about how narrative stories will come out, summarizing stories to one another, writing responses to stories, and practicing spelling, decoding, and vocabulary. They also work together to master main ideas and other comprehension skills. During language arts periods, students engage in writing drafts, revising and editing one another's work, and preparing for publication of team books. Three studies of the CIRC program have found positive effects on students reading skills, including improved scores on standardized reading and language tests.

Learning Together and Alone: This is also a model of cooperative learning developed by Johnson & Johnson in 1994. It involves students working in four or five member s of heterogeneous groups on assignments. When completed a single assignment, the group receive praise and rewards based on the group performance. This method emphasizes team-building activities before students begin working together and regular discussions within groups about how well they are working together. Students find this model helpful to get together with classmates to discuss material they have read or heard in class. A formalization of this age-old practice has been researched by Slavin in 1995 and his colleagues. In it, students work in pairs and take turns summarizing sections of the material for one another. While one student summarizes, the other listens and corrects any errors or omissions. Then the two students switch roles, continuing in this manner until they have covered all the material to be learned.

A series of studies of this cooperative scripting method has consistently found that students who study this way learn and retain far more than students who summarize on their own or who simply read the material (Cohen *et al*., 2004). It is interesting that while both participants in the cooperative pairs gain from the activity, the larger gains are seen in the sections that students teach to their partners rather than in those for which they serve as listeners (Slavin, 2010).

2.5. Cooperative learning for Mathematics achievement

In cooperative learning students work in group to gain from each others' efforts; they share a common necessity, work in cooperation and feel proud for group success (Kiran *et al.,* 2012). When striving students to create, monitor, and evaluate the equity in their cooperative group, teachers teach them how to begin to create a just society. Cooperation thus is humanity's strongest asset and hope. It is a great tool that can be used to improve student achievement in any classroom (Cohen *et al.,* 2004). It also fosters tolerance and acceptance in the community, which improves students' achievement. Studies done by Hulya & Kamile (2007) on a group of ninth grades on mathematics achievement showed that cooperative and individual concept mapping conditions promoted the use of effective learning strategies more than traditional teaching.

In addition Vasay (2010) held a study to find out the effect of cooperative learning strategy on the students' performance in mathematics. The study consisted of two parts: Phase 1 and Phase2. In the first phase, the researcher aimed to investigate the effect of cooperative learning in developing the foundation of students in number, integers, decimals, and fractions. While in Phase 2 he measured the performance of students in algebra. The study used pretest-posttest Control-Experimental group design. The data obtained by posttest was analyzed by t-test. The results showed that the experimental group was significantly better in their performance. On the other hand, Yamarik (2007) studied a total of 116 students enrolled in mathematics classes in the spring of 2002 and the fall of 2004. Using multivariate regression analysis, he found that students taught by cooperative learning achieved greater mathematics performance in the form of higher exam scores.

Cooperative groups were established with three or four students that were heterogeneous in aptitude based on a 10-question test to measure mathematics achievement. The size of the group varied depending on the level of the students, the older the students and the larger the size of the groups. Each of the studies showed an average of four students per group and mixed the groups according to the abilities of the students. The distribution of the ability levels in the groups included a high-ability learner, a low ability learner, and two medium-ability learners.

Some researchers believe that cooperative learning is suitable for more complicated or higher level epistemic targets and also suitable for learning tasks involving emotions, attitudes, and values (Wang, 2002). However, in our context, a more specific statement is needed to offer a better guideline for mathematics teaching practice in our middle schools.

According to (Wang, 2002) cooperative learning in mathematics is suitable for topics involving large-scale conceptualization, and multi-tiered reasoning. With more scale or with more tiers more advantage will be gained from cooperative learning. For examples, "study conditions for Congruent triangles" (Shi, 2009), which requires one to investigate which condition regarding relations among three angles and three lines, need to be satisfied. Students need to first carefully classify the situations into nine types that respectively include cases with one line, one angle, two lines, two angles, and one line plus one angle. In this example,

students learn by team vs. team discussions and students are able to manipulate the learning target by trying to give peer/opposite examples, visualizing concepts and doing experimental research. This allows research to be conducted in depth. Cooperative learning in this example shows clearly its advantage for topics involving large-scale conceptualization, and multi-tiered reasoning where the learning process can be made more vividly with colorful spotlights.

Capability of solving problems independently should be encouraged in mathematics cooperative learning. When students solve problem independently, they tend to over whelming rely on their own biased personal experience in order to find the solution while missing or rarely using a different perspective on the same issue. It is often seen that even when alternative solutions come across their minds they tend to be overlooked due to the existence of the first solution already in mind. However, in cooperative learning, a team composed of subjects with different mathematics knowledge experience, background and thinking patterns will help each other take advantage of the complimentary views of others in the epistemic process, benefiting from multichannel communication and further polishing their capability in problem solving.

According to Slavin (2010) under the circumstances of cooperative learning, thinking independently and cooperative communication combine and nurture each other. It is especially important to see the independency of thoughts in the processes of students' representing, listening and discussing. In fact, mentors tend to reserve a certain amount of time for students to be able to think independently prior to communication; however they often overlook students' independency during discussion. For example, it is often seen that average students take advantage of achievements made by merit students and they tend to follow them. Merit students usually are those who first propose solutions and therefore the chance of independent thinking for the average students becomes automatically blocked. This compromises the teaching quality largely due to the varying possible gains obtained by these two different types of students. Many reasons account for this:

i) It can be due to the contents of overcomplicated problems used in cooperative leaning. When the subject is complicated and very abstract, students can be bored, and when tasks

involved have a less clear structure, average students are likely to be very anxious about the situation's uncertainty;

ii) Skill levels of different students can be heterogeneous and differentiation in terms of students' knowledge structure and varying tiers in absorbing knowledge will damage the synchronization between different students in terms of the maturity or correctness level of their logical reasoning prior to cooperative discussion. A variety of factors account for weakened independent thinking. Whether or not students are able to keep their thinking independent determines, to a large extent, whether cooperative learning is able to achieve its desired quality. However, it is a challenge to assure that all students, in the same class, with varying skill levels, are able to think independently to meet our satisfaction.

The methodology of the research of each of the cases looked at a comparison between two groups of students. One group of students was being taught by using cooperative learning whereas the other group was using the usual traditional lecture classroom setting. He found out that students who taught by using cooperative learning strategy perform better than those who taught by traditional lecture classroom setting.

2.6. Four in one cooperative learning

One of the mechanisms implemented in school is organizing students in a group of four. This organization is believed to help students improve their understanding level & score better grades. Low achieving students can learn more from high achieving students by discussing in group after the teacher has done his best in class.

According to the teacher assigned to facilitate the organization of cooperative learning groups in the School, the grouping of students is done by dividing students in the three categories: high achievers, medium achievers, & low achievers, these students will be distributed in to different groups in a proportion of 1:2:1. This means one high achievers, two medium achievers & one low achiever will form one group, & the team is led by low achieving students.

Additionally, research studies showed an average of four students per group and mixed the groups according to the abilities of students. Because cooperation is humanities strong asset and hope (Cohen *et al*., 2004).Four in one cooperative learning is a great tool that can be used to improve students' achievement in any classroom.

The activities in teaching and learning process which used to practice four in one group work small group in problem solving approach cooperative learning. These are grouping students in class room to exist cooperative learning climate, arranging classroom seats to make strategies cooperation effective more than individual learning condition.

2.7. Conventional teaching methods

Conventional teaching or the traditional teaching methods are the ordinary teaching methods used by teachers to deliver the contents of the syllabus to the learners (Macharia *et al*., 2009). Most conventional methods of teaching mathematics are teacher-centered. The teacher demonstrates and summarizes the main points and there is surface learning of concepts, principles and skills. These methods are highly dependent on the skills of the teacher and not useful in enhancing learners interpersonal and communication skills. Teachers need to help students develop the skills they will use every day to solve mathematical and non-mathematical problems which include the ability to reason, explain and justify ideas. The teacher should also help students to use resources to find needed information to work with other people on a problem and to generalize to different situations as well as the traditional ability to carry out computations. Daniels & Hycles (2005) describe the mathematic teachers‟ goal as helping all students to feel that mathematics is personally helpful and meaningful and to feel confident that he or she can understand and apply mathematics in life.

Traditional teacher-centered teaching like drilling, individual worksheet practice, lecturing and flashcards are considered effective depending on traditional definition of mathematics as merely collection of formulae, rules and procedures that must be memorized and mastered. However the current definition emphasizes that mathematics integrated as a whole, is the study of structures and the relationships between things and a way to study and understand the

world around us (Dean, 2001). Conventional teaching methods used in teaching mathematics increases students‟ anxiety and negative attitude towards the subject.

2.8. Cooperative problem solving approach

Cooperative problem solving approach is a strategy of instruction whereby students work together in groups of varying composition to achieve common objective (Esan, 1999). According to Esan, for this strategy to be successful, students should share ideas rather than working alone and assist one another in order to maximize mutual benefits. This approach is different from the conventional or traditional lecture methods where learners work individually or competitively in its use of cooperative group. Several studies indicated that CPSA has greater effect on learners' achievement in different subjects than traditional lecture method.

There are a number of methods used in CPSA strategies categorized on the basis of groups' composition, organization and direction of study (Akala, 2000). However, the CPSA used students' teams comprising of four to six students working on a task given to each group. According to Akala, the teacher presented the lesson first, and then students' teams used a variety of methods to master the material, such as quizzing each other, discussing and using worksheets. The teacher just acted as a facilitator. To recognize team members' output, performance scores were computed on the basis of team members improvement scores, after which certificates and school bulletin boards were used to recognize high scoring teams.

2.9. Cooperative learning approach for mathematics achievement

Cooperative learning approach used in mathematics lesson is based on the work Polya‟s problem solving model that involves four stages: understand the problem, devise a plan for solving the problem, carry out your plan, and look back (Bay, 2000). In this teaching approach, learners are expected to learn to apply and adapt a variety of appropriate strategies to solve a mathematical problem. These strategies include using diagram looking for patterns, listing all possibilities, trying special values or cases working backward, guessing and checking, creating an equivalent problem, and creating a simpler problem. Problem solving is

crucial in mathematics education because it transcends mathematics. By developing problem solving skills, learner learns not only how to tackle mathematics problem, but also how to logically work our way through problems we may face. The memorizer can only solve problems that he or she has encountered already, but the problem solver can solve problems that he or she has never been encountered before.

In summary, cooperative learning approaches take advantage of heterogeneity in classes by encouraging learners to learn from one another and from more and less knowledgeable peers. Cooperation thus develops among learners which can lead to increase understanding and acceptance of all members. Hence, the benefit of cooperative learning approach that expands beyond the walls of the classroom itself. It was proved to be very effective in increasing problem solving skills, enhancing social maturity, and improving affective growth. Furthermore, several research studies have proved that problem solving approach of cooperative learning creates a positive learning environment for students and has positive effects on student achievement; it can help students develop skills in communication and improve their motivation to learn, increases student relationships, develops cognitive abilities, improves creativity and increases self-value D'Ambrosio (2003). According to D'Ambrosio, proponents of teaching mathematics through problem solving approach based their pedagogy on the notion that learners who encounter problematic situation use their existing knowledge to solve problems, and in the process of solving problem, they construct new knowledge and new understanding.

2.10. Role of teachers and students in CLA

When we are conducting this approach, we follow a line of investigations that are clearly identified the responsibility of teacher and the character of students. The teacher's role in CLA is fundamentally different from that in a more traditional representation. It is vital that the teacher first provides the supportive classroom culture to promote cooperative learning and opportunities for set building (Whicker *et al*., 2010).

When we come to the role of students in CLA, we use inclusion of cooperative student-to-student interaction over subject matter as an integral part of the learning process. In contrast,

the traditional classroom consists primarily of teacher-fronted lessons, independent work and competition (Spencer, 2009). Often, student interaction is discouraged: “Keep your eyes on your own paper.” “No talking.” In addition, there is often a competitive component to the traditional classroom as when students vie for the teacher’s attention by answering teacher review questions.

CLA is a character by frequent student cooperation in which students attempt to find solution on the basis of certain known data and condition (Spencer, 2009). Many studies have shown that students’ academic achievement was better for students who were involved in a problem solving approach of cooperative learning environment, and the effects of problem solving approach of cooperative learning on student achievement can be impressive. For example, the cooperative learning students in (Whicker *et al*., 2010) had increasingly higher test scores than the students in the comparison group and significantly outscored the assessment group on the other test. Students working together toward a common goal enjoy the feeling of helping one another to be successful and the longer the groups worked together, the more beneficial this group works seemingly.

The use of groups divided according to their abilities was beneficial to all students. Students can learn best from one another when they are required to provide reasoning for their answers or explain how they arrived at the answers (Walmsley, 2003). In favor of mainstreamed and slower students, problem solving approach of cooperative learning seemed to help bring them up to speed, possibly because it allow discussion among group members and a willingness on the team members’ parts to help. According to Walmsley, firstly, problem solving approach of cooperative learning raised student-instructor interaction and develops cognitive abilities, emphasizes the application of mathematical knowledge, proves creativity. Students felt more comfortable asking questions as a group than individually. Secondly, cooperative learning increased group studying for the exams. Third, the novelty of working in small groups sparked greater interest in the material.

Apiece of the research study in the past mentioned found that there was an increase in student achievement when using problem solving approach of cooperative learning. When students strategize together and discover various ways to solve a problem, they developed a better

understanding of the concept. Both Whicker *et al*. and Walmsley researched high school students in a mathematics classroom. Each study used a reward system to help promote the use of cooperative learning so that all students would have the opportunity to be successful. Both studies found that it took team for groups to association with one another and work together effectively. A major contrast between the two was how the studies performed. Whicker *et al*. (2010) used a quasi-experimental design and compared two different class groups using different teaching strategies, and Walmsley (2003) used a single classroom setting and looked at how these students performed based on previous knowledge about the class's performance.

It is important to create an atmosphere in the classroom where students feel comfortable to share their ideas. This may take time for the group members to become aware of the strengths that each member can bring to the entire group. Structure of the groups is important. In the research done by Gillies (2004) and Yamarik (2007), children in the structured groups demonstrated less non-cooperative behaviors and less off-task behaviors than their peers in unstructured groups. They were more willing to work with others on the task, listen to what they had to say, and share ideas and information (Gillies, 2004). The novelty of working in small groups sparked a superior interest in the material (Yamarik, 2007).

Understanding what happens as students work cooperatively together in particular, how they interact to facilitate learning and how they perceive these experiences is critical to understanding how this approach to learning could be used more effectively in classrooms to achieve academic and social goals (Geilsli, 2004). Helping students to achieve at the highest academic level possible is important to the study. Cooperative learning has been shown with the reviewed literature to be a useful method at achieving this goal.

Problem solving is the highest form of learning since the individual defines new ideas based on this process. Likewise, it is well known that when faced with problem one needs knowledge of rules, on the one hand and the capacity to use them, on the other, thus achieving transfers of learning. Being able to solve problems then enables persons to their environment and to modify it in part (Vila *et al*., 2003).

2.11. Benefits of implementing CLA

From the ideas presented in the definition and concept of problem solving approach of cooperative learning section we can understand to what extent problem solving approach cooperative Learning is a multi-dimensional learning strategy. Problem solving approach of cooperative learning method has some merits when it is implemented in classrooms lesson. The following are some benefits of using problem solving approach of cooperative learning.

Academic benefit

When the classroom is structured in a way that allows students to work cooperatively on learning tasks, students benefit academically. Learners in Problem solving approach of Cooperative learning groups can discuss debate and clarify their understanding of the concepts and materials being considered during the class and can help one another master the basic facts necessary for computational procedures. Lavin & Cooper (2006) suggested that, the intent of cooperative work is to enhance the academic achievement of students by providing them with increased opportunity for discussion, for learning from each other, and for encouraging each other on applying mathematical knowledge.

Enhance creativity

Johnson & Johnson (2009) stated that problem solving approach of cooperative learning promotes creative thinking by increasing the number of ideas, quality of ideas, feelings of stimulation and enjoyment, and originality of expression in creative problem solving. It is not surprising that students are "triggered" by the ideas of others and that different perspectives cause group members to consider a larger number of alternatives.

Psychological benefits

Studies of Problem solving approach of cooperative learning experiences of consistently indicate numerous positive cognitive and affective outcomes. These include enhanced academic learning, improve self-esteem and frequent social interaction among majority members outside of the learning group, enhanced feeling of trust and acceptance by peers

and teachers, expression of more altruistic feelings and increased acts of cooperative behavior in other setting. Moreover, Problem solving approach of cooperative learning gives the opportunity to develop interpersonal relationships among learners, creates a safe and nurturing environment because solutions come from the group rather than from the individual and errors are corrected in the group before they are presented to the class (Isaacs, 2008). Overall, psychological benefits of Problem solving approach of Cooperative learning pertinent for minority student learning include the lowering of anxiety and strengthening of motivation, self-esteem and empowerment.

Social benefit

One of the most valuable uses of Problem solving approach of cooperative learning is to teach social and interpersonal skills. Problem solving approach of cooperative learning teams provide a safe, intimate atmosphere where social skills are modeled by other group members. Problem solving approach of cooperative learning method increases student motivation and effort by allowing student to work together on common development to attain a shared goal; it result in student feeling greater mutual concern for each other and an overall greater liking of school, it also improves race relation (Slavin *et al*., 2010). Learners in Problem solving approach of cooperative learning tend to become tolerant of diverse viewpoints, to consider others' thoughts and feelings in depth, and seek more support and clarification of others' positions (Stahl, 2011).

2.12. Research findings on cooperative learning

The idea of CL is practiced in different structures of education in Ethiopia. An attempt has been made to implement CL since 1994. In 1994, a new Education and Training Policy were designed, which introduced a lot of changes in the implementation of educational activities. Realizing the importance of secondary school education in empowering the quality of Ethiopian human power, the government of Ethiopia has decided, CL as a very effective means in secondary school education settings, providing mature students an opportunity to share their experiences and be more involved in their education (ETP, 1994).

Research on CL conducted at all educational levels indicated that benefits are universal, regardless of the age of the student. Cognitive-academic and social-emotional benefits were evident at all educational levels and in all types of cultural ethnic environments. There are research studies validating the effectiveness of CL over competitive and individualistic efforts.

Haberyan (2007) reported that team based learning is motivating, interesting and enjoyable, and has been utilize in science, education, business and medical disciplines with positive results. Although the teaching strategy of CL help teachers to create a student center environment where the students reach the achievement of academic, affective and social interpersonal development (Slavin, 1995; Johnson and Johnson, 2009).

Most institutions of higher learning and quality assurance agencies have not ignored the quality of teaching and learning occurring in classrooms, the concern remains that they have not seen it as crucial in their efforts to promote quality learning (Spencer *et al*., 2009). The widespread use of CL is due to multiple factors. Three of the most important are that CL is clearly based on theory, validated by research, and operational zed into clear procedures educators can use (Johnson & Johnson, 2002). In the Ethiopian higher education system, most teaching is characterized by a high degree of instructor control, student passivity and powerlessness (Zerihun *et al*., 2012).

The findings of the teaching process in CL showed there were several shortcomings and difficulties, such as free-rider effect, the unified course schedule, and the difficulties of designing meaningful activities, managing noisy and chaotic classroom, grouping the students, facing attendance rate or distracted students and evaluate a vast of students' test grades. On the other hand, the difficulties of the teaching process in teacher-centered had also struggles such as teaching-led style, too much teaching, explaining and drill activities, little stress on language product, lack of creativity and interaction (Johnson & Johnson, 2009).

Gara and Asrat (2009) conducted a research to find out the attitude of teachers towards the use of active learning method and they concluded that the study has demonstrated positive outcomes. A study by Bethel (2011) investigated practice and attitude of Bulbula school community towards the implementation of active learning in Bulbula high school. The result

showed that active learning tasks they used were fewer in number and lacked variety, misperception of teachers towards active learning, lack of pre service training in active learning, large students' number in their classes, and lack of essential resources were some of the constraints the researcher identified. Enhancing teacher's awareness of active learning method and providing resource book involving active learning tasks were among the remedies suggested.

According to Wossen (2011) a study on the assessment of teachers' and students' perception and classroom practice of CL in English as Foreign Language classes. The finding shows that the majority of the students and all teachers had positive and high level of perception for most of CL tenets. However, Wossen states that teachers are not giving due attention for CL activities. This indicates that the awareness of teachers towards instructional activities in implementing CL was medium.

According to Muhammed (2012) a study on CL practices in college of education and behavioral sciences in Haramaya University, CL practices are not effective in the study area. Lack of awareness, lack of motivation, shortage of instructional materials, resistant and lack of clear guidelines are some of the major challenges hampered CL practices. It was recommended that the College should have to provide continuous and relevant trainings for instructors and students, department and other stakeholder should have to fulfill necessary inputs and provide proper follow-up and support to effectively practice CL.

Atalay (2015) revealed a study on challenges, opportunities and implementations of building effective education critical mass organization for CL ,the main challenges for organizing and implementing effective education critical mass were negative attitude of instructors and students towards the program, student's belief of the task is belonging to only instructors, no guide line for the implementation, class size and lack of time. Different stakeholders who are directly or indirectly participate in the program were taken lion share recommendations.

Aschalew (2012) conducted a research on teachers' perceptions and practices of active learning in that the respondents have perceived active learning positively. In spite of their good perceptions, their practices of active learning were low. Among the major

factors affecting the effective implementation of active learning were instructors' tendency toward the traditional/lecture method, lack of students' interest, shortage of time, lack of instructional material and large class size. Moreover, benefits noted by cooperative students include improved people skills, increased understanding of lessons and concepts learned in class, the opportunity to apply theory in trouble-shooting and problem solving, and maturity and independence. Cooperatives also enable employers to make more informed hiring decisions, often to the benefit of someone who has had a cooperative experience with their company or another (Mariani, 2009).

From the review of related literature, we can see that implementation of CL in mathematics class have effect on students achievement in secondary school. Cooperation on problem solving thus develops among learners which can lead to increased understanding and acceptance of all members of society. By developing CLA skills, we learn not only how to truckle mathematics problems, but also how to logically work our way through problem we may face.

Furthermore, several research studies have proved that CLA creates a positive learning environment for students and has positive effects on student achievement; it can help students develop skills in self discovery of knowledge and improve their motivation to learn, increases student relationships and increases self-esteem.

CL and Academic Achievement Findings of various researches support the benefits of CL in the area of academic success and social skills (Slavin, 2010). These findings motivate teachers to use CL in their classrooms. Recently, in a meta-analytical study reviewing same reviews of similar studies and analyzing.

According to (Bay, 2000) synthesis of the meta-analyses found that "cooperation has relatively consistent positive effects on achievement, attitudes and other variables".
Cooperative learning has been reported to produce better achievement than competitive learning environments (effect size = 0.67) or individualistic learning (effect size = 0.64) (Johnson & Johnson, 2005) cited in Ramon (2012).

Using effect size as the measure of CL effects on achievement, as it was cited in Ramon (2012), Slavin (1990) analyzed 68 studies and found that forty-eight of the sixty-eight experimental and control comparisons supported CL groups (72%); and only eight (12%) supported control groups.

Slavin (1996), (cited in Ramon, 2012), reviewed an additional 99 studies and reported that sixty three (63%) of the ninety-nine comparisons supported the treatment groups' impact on achievement and only five (5%) identified the control groups as superior. Similarly, using voting, effect-size, and z-score for meta-analyses, Johnson & Johnson (1999), (cited in Ramon, 2012), reviewed 122 studies and yielded 286 empirical findings, which showed students with CL, on average, achieved academically at the 80^{th} percentile of students experiencing competitive or individualistic learning.

These findings validate the extensive review of 323 studies yielding 1,691 findings conducted by Johnson & Johnson(2002), which reported that students in cooperative situations academically outperformed students in individualistic settings (effect-size = 0.75).

Similar findings have also been noted in recent studies as Ramon (2012) cited (Yamarik, 2007; Kilic, 2008; Doymus, 2008a&b; Adeyemi, 2008; Sahin, 2010; Doymus et al., 2010; Bertucci et al., 2010; Slavin, 2011) which reported that students in CL groups have higher adjusted post-test mean scores than those in conventional lecture groups. The findings of the above research studies have led to strong influence by various authors that CL is an effective teaching pedagogy for schools (Ramon, 2012).

Ramon (2012) studied the Effects of Cooperative Learning on 80 final-year students comprising 32 females and 48 males, from two mathematics classes in the Faculty of Education at An Giang University in Vietnam. He found out that the results of the ANOVA show no statistically significant difference in MAE (Managing Administration and Education) pre-test scores ($F(1, 78) = 0.556$; $p > 0.05$) of the experimental group ($M = 6.61$, $SD = 0.88$, $N = 40$) and the control group ($M = 6.76$, $SD = 0\ .91$, $N = 40$). The results show that students in both groups had similar academic knowledge on the MAE before the experiment commenced.

Multiple researches have shown that cooperative learning strategies can be utilized to promote deeper understanding. Educators can use various strategies of cooperative learning along with their instructional techniques to enhance learning in a classroom.

For example according to Johnson & Johnson, (2008), the jigsaw group students had higher achievement than those in the control group because they had more opportunities for mutual help, exchange of needed resources, effective communication, and mutual influence.

The two groups were pre-tested prior the implementation of CL. At the end of the study, post test was given, while daily quiz was used as a tool for formative testing. Teaching and learning process was carried out for two weeks. Data were analyzed using the t-test to determine performance by comparing the mean of the post-test for treatment and control group. The results of the study showed that CL methods improve students' achievement in mathematics and attitude towards mathematics.

According to Johnson & Johnson (2017) in their studies using questionnaire ascertaining the perceptions of students regarding improvement in their generic skills that were taught by CL method found that student perceived and reported cooperative learning was effective method in improving their generic skills.

NCTM (2013) in study comparing the effectiveness of lecture method and CL-on students' achievement in mathematics subject showed a significant academic achievement and social skills. Similar findings according to Reza (2013) were also reported in another study indicating that CL showed a significant effect on students` academic achievement and SS on students in experimental group. Mohammed (2014) in an experimental research study doing a comparative analysis of the effectiveness of three teaching methods of traditional instruction, loosely structured CL and Students Team Achievement Division models of CL on students' academic achievement concluded that CL (STAD) model enhanced experimental group students' academic achievement as well as facilitated to enrich and make the learning experience more enjoyable for them as compared to students in control group. According to Mohammed (2014) Experimental group performed better (average score= 13.90) than control group (average score= 10.76) on posttest achievement

According to Bramlet.D & Herron.S (2009) conducted an experimental study to assess the impact of CL on student' academic success overall average performance of Control group (average score=7.00) while the overall performance of Treatment group is (average score= 11). In order to determine whether there is statistically any significant difference between the two groups. Experimental group was treated with Learning Together model of CL in the subject of mathematics..

Studies done by Hulya and Kamile (2007) on a group of ninth graders on mathematics achievement showed that cooperative and individual concept mapping conditions promoted the use of effective learning strategies more than traditional teaching. The type of group formation can have an impact on the motivation of students and how well they work together.
Vasay (2010) held a study to find out the effect of cooperative learning strategy on the student's performance in mathematics. The study consisted of two parts: Phase 1 and Phase 2. In the first phase, the researcher aimed to investigate the effect of cooperative learning in developing the foundation of students in number, integers, decimals, and fractions. While in Phase 2 he measured the performance of students in college algebra.

The study used pretest-posttest Control-Experimental group design. The data obtained by posttest was analyzed by t-test. The results showed that the experimental group was significantly better in their performance.
Yamarik (2007) studied a total of 116 students enrolled in mathematics classes in the spring of 2002 and the fall of 2004. Using multivariate regression analysis, he found that students taught by cooperative learning achieved greater mathematics performance in the form of higher exam scores. Cooperative groups were established with three or four students that were heterogeneous in aptitude based on a 10-question test to measure mathematic achievement. The size of the group varied depending on the level of the students, the older the students and the larger the size of the groups.

Each of the studies showed an average of four students per group and mixed the groups according to the abilities of the students. The distribution of the ability levels in the groups included a high-ability learner, a low ability learner, and two medium-ability learners. The

methodology of the research of each of the cases looked at a comparison between two groups of students. One group of students was being taught by using cooperative learning whereas the other group was using the usual traditional lecture classroom setting. Yamarik (2007) found out that students who taught by using cooperative learning strategy perform better than those who taught by traditional lecture classroom setting. Cooperative learning is a great tool that can be used to improve students achievement in any classroom and it also faster tolerance and acceptance in the community, which improves students achievement (Cohen et al.,2004).Cooperative learning has been reported to produce better achievement than competitive learning environment (effect size=0.67) or individualistic learning(effect size=0.64) (Johnson &Johnson,2005) cited in Ramon(2012).

Many studies have shown that students' mathematics achievement was better for students who were concerned in the problem solving approach of cooperative learning situation, and the property of CLA on student achievement can be remarkable. For example, Smialek and Boburka (2006) investigated the effectiveness of cooperative learning on secondary school students' mathematics achievement and found that cooperative interventions proved to be more effective than traditional lectures or occasional group work. From the literature, we can see that motivational strategies on one hand and cooperative learning strategies on the other hand can play a positive role for students' mathematics achievement.

3. RESEARCH METHODOLOGY

This chapter dealt with a description of the study area, research design & procedure, source of data, data collection instruments, target population, sample size and sampling techniques, method of data analysis and ethical.

3.1. Description of the study area

The study area of this research was Boroda secondary school which is located in Boroda town, Gorogutu woreda in Eastern Hararghe zone of Oromia region, Ethiopia. This school is located 114km from Harar and 411km to the east from Addis Ababa city on the main high way. In addition, there is only one secondary school in Boroda town.

3.2. Research design and procedure

3.2.1. Research design

The research used both survey and control-experimental group design. A survey design was used because the study utilized survey questionnaire in order to determine students perception on cooperative learning approach and a control-experimental group design involving two equal groups called control group (CG) and experimental group (EG) was used in order to determine whether there was any statistically significant difference between the two groups in mathematics achievements using pre-test and post-test. Hence, descriptive survey and a control-experimental group designs were used jointly.

3.2.2. Research procedure

The procedure of this study was consisted three steps. The first step was pre-study stage. During this step, a sample of 64 students out of the total 192 grade 9 students were selected purposively according to their ability level based on their first semester ranks and previous mathematics achievement from school documents such as roster and mark list. The purposive selection was conducted since this kind of selection is believed to be desirable for the selection of higher, medium and lower achievers. Accordingly, 16 higher achievers, 32 lower achievers and 16 medium achievers, in total 64 students were selected. Each this of ability level was

further equally divided in to two groups so that 8 higher, 8 medium and 16 lower achievers were randomly selected and grouped under the experimental group (EG). Similarly, 8 higher, 8 medium and 16 lower achievers were grouped under the control group (CG). Pre-test for both groups and questionnaire for EG were given in this stage. Further, students in EG formed small group so that each of this group consists four members in such a way that one higher achiever, two lower achievers and one medium achiever.

The second step was the study stage. In this stage, the experimental group (EG) was exposed to CLA. Students Teams Achievement Division (STAD) technique was used as strategy of intervention on EG since this technique of CL includes heterogeneous grouping method as well as all cooperative learning elements such as: positive interdependence, individual accountability, face to face promotive interaction, social skills and group processing. However, during this step, the CG was taught in traditional lecture method. It was the researcher who carried out the lesson for both groups throughout the study periods. The lesson was prepared from grade 9 mathematics textbook, Unit 5 under the unit title “Geometry and measurement” for both groups in separate schedule. The number of periods allotted to complete the lesson was 35 periods and as a result, the study took seven weeks in total.

The third step was a post-study stage, in this stage, the second survey was conducted on students belonging to the experimental group (EG) and post-test was given for both groups in order to determine whether there is any statistically significant difference in students’ mathematics achievement between the two groups.

3.3. Sources of data

The researcher was used both primary and secondary sources of data.

3.3.1. Primary sources of data

Primary sources of data were obtained through questionnaire, pre-test and pot-test.

3.3.2. Secondary source of data

Secondary sources of data were obtained from school documents such as roster and mark lists.

3.4. Population, sample size and sampling techniques

3.4.1. Population

The target population of this study was grade 9 students in Boroda secondary school. The target populations under consideration were 64 students out the total populations of 192.

3.4.2. Sample and sampling techniques

Boroda secondary school was selected purposively as area of the study. Out of the 192 students, 64 students consisting of 16 higher achievers, 16 lower achievers and 32 medium achievers were selected purposively according to ability level based on first semester ranks and mathematics scores. This means 33.3% of students were selected for the sample of the study. A sample of this amount can be considered sufficient to choose for the study. Moreover, purposive selection was believed to be suitable for the selection of students when the selection involved based on students ability level. Each of this level further, randomly divided in to two equal groups under two study groups namely CG & EG.

The following table shows both experimental and control groups.

Table 3.1: Population and sample size

Subject of study	**CG**			**EG**		
	M	F	Total	M	F	Total
Boroda Grade 9 Students	23	9	32	23	9	32

3.5. Instruments of data collection

Survey questionnaire, pre-test, post-test and school documents were used to collect both primary and secondary data.

3.5.1. Questionnaire

Questionnaire was developed for students based on research questions, research objectives and the literature. The questions item were prepared in English and developed using Likert-type five point rating scales. The five points weighed according to the degree of agreements: Very high (5), High (4), Undecided (3), Low (2), and Very low (1). Hence, the questionnaire contained 8 items related to students' perception about CLA (See appendix A).

3.5.2. Document analysis

Document of secondary data from roster and mark list of mathematics achievement results were analyzed for typical case for selected 64 students to provide information on their previous mathematics achievement. Hence, students' previous class ranks and their scores on mathematics were obtained from school documents.

3.5.3. Pre-test and post-test

Each group (Control and experimental) took a pre- test before the treatment was administered to the sample students and post test after the completion of the treatment. The pre-test was used to validate the equivalence of the mathematics ability of the groups before the treatment and was also used as a covariate to allow an estimate of the raise in achievement after the treatments. Both pre and post tests contain equal number and identical items. The questions were prepared from Unit 5 of grade 9 students' mathematics textbook in coordination with five mathematics teachers. The test consisted 20 multiple choose items (See appendix B).

3.6. Validity and reliability of instruments

3.6.1. Validity and reliability of questionnaire

To validate the questionnaires, face validity was obtained. The questionnaire was shown to the researcher's advisor and co-advisor and then modifications were made based on their recommendations. Their recommendation included rearranging statements. The reliability of the questionnaire was also calculated using SPSS and its reliability was found to be Cronbach's alpha $\alpha = 0.89$.

3.6.2. Validity and reliability of the test

The test was obtained from well known resources. Nevertheless, the test was validated before being administered. Two kinds of validation, content and face validity were obtained. Moreover, the reliability of the test was also assured through test retest and its reliability coefficient using SPSS was found to be Cronbach's alpha $\alpha = 0.81$.

3.7. Methods of data analysis

Both descriptive statistics such as mean to measure the overall trends in the data, standard deviation to measure variability or provide an understanding of how varied the Scores might be, and percentage as well as an inferential statistics were used in the analyses of quantitative data. Descriptive and Independent sample t-test was used for the analyses of data obtained through questionnaire and tests using SPSS 23.

3.8. Ethical considerations

The researcher was conscious about all the ethical considerations to be made when conducting the study. According to the research code of ethics, this study was intended for the purpose of master of education in mathematics. Hence the researcher was governed by maintaining privacy and/or other related values of research. The researcher promised to the participants of the study that the information which was collected from the respondents would not be transferred for other than the purpose of the research study. On the other hand, appropriate measures were taken to assure confidentiality of the information both during and after data collection.

4. RESULTS AND DISCUSSIONS

This chapter presented analysis of the data obtained through questionnaire and achievement test before and after the treatment, and discussions of the results obtained from the analyses of the data. The data was analyzed quantitatively and SPSS 23 was used for the analyses. Both descriptive and inferential statistics were used for the analyses using descriptive and an independent sample t-test in order to answer the two research questions.

Moreover, to answer the first research question, the following null hypotheses were tested based on the analyses of the result both before the treatment and after the treatment.

HO_1: There is no statistically any significant difference between the experimental group (EG) and control group (CG) before the treatment.

HO_2: There is no statistically any significant difference between the experimental group (EG) and control group (CG) after the treatment.

The treatment group (EG) under consideration was those students who were exposed to STAD techniques of CLA and the non-treatment group (CG) was those students who were taught using traditional lecture method.

4.1. Data obtained from pre and post tests before and after the treatment

This section dealt with analysis of data obtained from the pre-test and post-test. The analyses of the data were done using an independent sample t-test, and were discussed using mean, standard deviation and the P-value to determine whether there is any statistically significant difference between the two groups. Consequently, the analyses of the data and discussions of the results were presented as follows.

4.1.1. Analysis of students achievements on pretest score before the treatment

In order to test the first hypothesis, the two groups' scores on pre-test were analyzed using independent-sample t-test to determine whether there is statistically any significant difference between the groups. The pre-test consisting of 20 questions on geometry and measurement

was given to students of the two groups and the analysis of the result presented as in the tables below.

Table 4.1: CG and EG group statistics on pre-test achievement score

Group Statistics					
	Group	N	Mean	Std. Deviation	Std. Error Mean
Pretest	CG	32	6.94	2.614	.462
	EG	32	6.88	2.992	.529

The result shows that the average performance of CG (M = 6.94, SD = 2.614) and that of EG (M = 6.88, SD = 2.992). These results asserted that students' performance on pre-test was poor before the treatment. In order to determine whether there is any statistically significant difference between the two groups' score, an independent sample t-test was conducted and the result was presented as follows.

Table 4.2: Independent-sample t-test of CG and EG on pre-test achievement score

Independent Samples Test						
		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	T	df	Sig. (2-tailed)
Pretest	Equal variances assumed	1.367	.247	.089	62	.929
	Equal variances not assumed			.089	60.905	.929

As it can be seen, from the Levine's test for equality of variance, the row with equal variances assumed was selected for discussion since the F's Sig.>0.05. The analysis indicated that df (62, 60.905), the t-score t(62) = 0.089 and the P-value [Sig. (2-tailed)] P = 0.929 > 0.05. Therefore, from the analysis, it can be concluded that there is no statistically any significant difference between the two groups on the pre-test achievement scores. Consequently, the first null hypothesis $\mathbf{HO_1}$ was not rejected.

4.1.2. Analysis of the data obtained from post-test achievement score

In order to test the second hypothesis, the data obtained from a post-test achievement score was analyzed using the independent-sample t-test to see whether there is any statistically significant difference between the two groups on pre-test as follows.

Table 4.3: CG and EG group statistics on post-test score

Group Statistics				
Group	N	Mean	Std. Deviation	Std. Error Mean
CG	32	8.56	2.409	.426
EG	32	16.66	3.096	.547

From the analysis, the overall average performance of CG was (M = 8.56, SD = 2.409) while the overall performance of EG was (M =16.66, SD = 3.096). In order to determine whether there is statistically any significant difference between the two groups, an independent sample t-test was used for computation and the result was presented as in Table below.

Table 4.4: Independent-sample t-test of CG and EG on post-test achievement score

Independent Samples Test						
		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	Df	Sig. (2-tailed)
Posttest	Equal variances assumed	2.391	.127	-11.671	62	.000
	Equal variances not assumed			-11.671	58.463	.000

From the Table, it can be seen that at $\alpha = 0.05$ significant level, df (62, 58.463), the t-score t(62) = -11.671 and P-value [Sig. (2-tailed)], P= 0.00 < 0.05. Hence, it can be concluded that there is a statistically significant difference between the two groups on post-test score. The analysis of result on the post-test revealed that there is statistically significant difference on post-test achievement scores between the control group (CG) and the experimental group (EG). The results further indicated that EG outperformed CG on post-test. Consequently, the second hypothesis $\mathbf{HO_2}$ was rejected.

From the analyses of the data on pre-test and post-test, it can be concluded that CLA using STAD as a method improves students mathematics achievement. The result revealed that there is statistically significant difference between CG and EG on mathematics achievement. Therefore, the study answered the first research question.

4.2. Data obtained through questionnaire before and after the treatments

The same questionnaire consisting of identical items was provided to the experimental group (EG) before and after the treatment to determine students' perception about CLA. The data was analyzed using descriptive analysis as indicated below and discussed using percentage & mean value.

4.2.1. Students responses on questionnaire before the treatment

The data obtained through the questionnaire from students in EG before the treatment was analyzed and discussed as follows. 1=Very low, 2=Low, 3=Neutral, 4=High and 5=Very high.

Table 4.5: The EG responses on statements related to perception before the treatment

Statement	Response					Mean
	1	2	3	4	5	
1. Your interest in CLA in mathematics class	18	5	7	1	1	1.81
	56.2%	15.6%	21.9%	3.1%	3.1%	
2. Your participation in CLA in mathematics classroom	19	7	5	1	0	1.63
	59.4%	21.9%	15.6%	3.1%	0.0%	
3. Your awareness of CLA practice in mathematics class	12	10	7	3	0	2.03
	37.5%	31.2%	21.9%	9.4%	0.0%	
4. The importance of CLA in mathematics class	11	8	10	3	0	2.16
	34.4%	25.0%	31.2%	9.4%	0.0%	
5. Your motivation to participate in CLA in mathematics class	17	7	6	0	2	1.84
	53.1%	21.9%	18.8%	0.0%	6.2%	
6. Role of CLA in improving mathematics performance	13	6	10	2	1	2.25
	40.6%	18.8%	31.2%	6.2%	3.1%	
7. Role of CLA in improving your interaction in math lesson	14	9	7	1	1	1.94
	43.8%	28.1%	21.9%	3.1%	3.1%	
8. CLA creates common understanding among students	9	17	4	2	0	1.97
	28.1%	53.1%	12.5%	6.2%	0.0%	

As illustrated above, the analyses show that students responses on statements related to their perception about cooperative learning approach (that is, there interest, participation, awareness and understanding of the role of CLA). As a result, the mean value 1.81 on the first statement indicated that students belonging to EG responded that their interest in cooperative learning approach in mathematics classroom is low. Moreover, 56.2% of them responded very low before the treatment. Similarly, the mean value 1.63 on statement number 2 also indicated that majority of students belonging to this group responded they have low participation in cooperative learning approach in mathematics classroom as responded by students. In addition, the mean value 2.03 on statement number 3 indicated that majority of students in the treatment group have little awareness on cooperative learning practice in mathematics classroom at their grade level while only 9.3% of students in EG responded that they have high awareness on the given statement.

In the same manner, the mean values on statement number 4, 5, 6, 7 and 8 indicated that majority of students responded their knowledge about the importance; their awareness and understanding of the role of cooperative learning approach in mathematics classroom were low as asserted by students. Only 9.4% of students in EG responded that they have high knowledge of the importance of CLA in mathematics lesson while only 6.2% of students indicated they have very high motivation as responded by them on the statements.

In general, the result of the analyses before the treatment indicated that majority of students belonging to EG have low perception about CLA.

4.2.2. Students responses on questionnaire after the treatment

To determine whether there were changes in students' perceptions about CLA in mathematics classroom, the data obtained through questionnaire from students belonging to the experimental group (EG) was analyzed and presented as in table below.

Table 4.6: The EG responses on statements related to perception after the treatment

Statement	Response					M
	1	2	3	4	5	
1. Your interest in CLA in mathematics class	0	1	4	17	10	4.13
	0.0%	3.1%	12.5%	53.1%	31.2%	
2. Your participation in CLA in mathematics classroom	0	0	1	13	18	4.53
	0.0%	0.0%	3.1%	40.6%	56.2%	
3. Your awareness of CLA practice in mathematics class	0	0	2	2	28	4.81
	0.0%	0.0%	6.2%	6.2%	87.5%	
4. The importance of CLA in mathematics class	0	0	0	4	28	4.88
	0.0%	0.0%	0.0%	12.5%	87.5%	
5. Your motivation to participate in CLA in mathematics class	0	0	0	1	31	4.97
	0.0%	0.0%	0.0%	3.1%	96.9%	
6. Role of CLA in improving mathematics performance	0	0	0	0	32	5
	0.0%	0.0%	0.0%	0.0%	100.0%	
7. Role of CLA in improving your interaction in math lesson	0	0	0	2	30	4.94
	0.0%	0.0%	0.0%	6.2%	93.8%	
8. CLA creates common understanding among students	0	0	0	0	32	5
	0.0%	0.0%	0.0%	0.0%	100.0%	

From the analysis of the data obtained through questionnaire, it can be seen that the mean value of EG on each statement became greater than 4 and it indicated that students responses regarding statements related to perception were changed after the treatment. That means, majority (more than 80%) of students from this group responded high or very high on each item.

The result obtained from the responses of students before and after the treatment indicated clearly shows that, although students perception regarding their interest in CLA, participation in CLA, awareness of CLA, believe of the importance of CLA and the way they see the role of CLA was low or negative as responded by them. However, after the treatment, their perception about CLA became changed from low to high. Consequently, the second research question was answered.

The result of this study was entirely attained due to the intervention and it was not due to external factors.

5. SUMMARY, CONCLUSION AND RECOMMENDATION

5.1. Summary

This section of the thesis summarized statements of the problem, the methodology and the results or the findings of the current study.

Summary of the problem:

Students' underachievement in mathematics has become a greater problem from time to time particularly in secondary school like Boroda. Even though, the Ethiopian federal government's ministry of education tried to implement the so-called one-to-five group organization form of cooperative learning to deal with the problem of students' poor performance, the method couldn't bring any satisfactory outcome as it was initially claimed and intended by the ministry of education. Hence, it was this problem which initiated the researcher to conduct this study. Consequently, the study answered two key research questions which were raised in chapter one with the general objective to improve students achievement in mathematics through problem solving approach of cooperative learning.

Summary of the design and procedure:

The design of the research was survey and control-experimental group design. The survey design was conducted using questionnaire consisting of 8 items that were related to students' perception about CLA while the control-experimental group design was conducted using pre and post tests. A sample of 64 grade 9 students from Boroda secondary school were selected purposively based on their ability level and divided equally in to two groups so that one as control group and the other as experimental group. Under the procedure, the entire process of the study was divided in three stages. The first stage was operational preparation for the environment in which the selection of the sample, collection of the data and forming groups were made. The second stage was the treatment stage in which EG exposed to STAD method of cooperative learning while CG was taught using traditional lecture method. The final stage

was the post study stage in which the collection and analysis of data were done. The duration the study had taken was 7 weeks.

Summary of the result:

The data was collected twice before and after the treatment through questionnaire and test in order to answer the research questions. The results of the analyses before the treatment revealed that the perception of majority of students in EG was low. Similarly, the results obtained from the pre-test score indicated that both groups poorly performed the pre-test and the analysis revealed that there is no statistically any significant difference between the two groups' performance. Consequently, the first null hypothesis was retained.

However, after the treatment the results of the analyses showed that the perception of majority of students belonging to the experimental group about CLA became positive. Moreover, the results of the post-test achievement score further revealed that students in EG outperformed on the post-test than students of CG. There is statistically significant difference between the two groups after the treatment on the post-test. Consequently, the second null hypothesis was rejected and the finding answered the two research questions.

5.2. Conclusion

This study applied Students Teams-Achievement Divisions (STAD) method of cooperative learning strategy as CLA in order to improve students' mathematics achievement. Two groups of students were formed for the study to determine the effect of this strategy. One group was exposed to STAD technique of cooperative learning approach while the other group was taught using traditional lecture method. The findings of the study revealed that students who were exposed to Students Teams-Achievement Divisions (STAD) method of cooperative learning approach outperformed students who were taught using traditional method on mathematics achievement test. The findings further revealed that the perception of students in the treatment group toward cooperative learning approach became positive although it was negative before the treatment. Therefore, the present study concluded that CL approach using Students Teams-Achievement Divisions (STAD) technique can greatly improve students' mathematics achievement than traditional lecture method. The CLA strategy that was applied

here improved not only students mathematics achievement but it also changed students perception toward CLA by creating common understanding among students, improved their interest in CLA, developed students self-confidence in solving challenging mathematical problems, sharing mathematical ideas and enhanced their participation in mathematics lesson.

5.3. Recommendations

Based on the findings of this study, the researcher would like to recommend the use of Students Teams-Achievement Divisions techniques of cooperative learning as CLA in mathematics classroom in order to improve students' mathematics achievement and develop positive perception toward CLA. Applying STAD method as CL approach may help students attain improved outcomes in mathematics performance. Mathematics teachers may consider using this approach in mathematics classroom to improve students' achievement particularly those students who are considered to be lower achievers in mathematics. If teachers implement this strategy, they may not only improve students mathematics achievement but they can also change students perception, develop students self-confidence in solving challenging mathematical problems, make students share mathematical ideas and enhanced their participation in mathematics lesson Teachers can use this strategy according to their classroom conditions but the strategy might be effective on small number of students (not more than 40). Moreover, this study recommends that any other researchers may conduct researches on whether this approach of CL can be effective on large class size and compare their outcome with these findings.

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7. APPENDICES

7.1. Appendix A

Students' Questionnaire

Dear students

This questionnaire is proposed to collect relevant information for research purpose about your perception on cooperative learning. Thus, your honest & genuine response to the items in the questionnaire helps to meet the objectives of the study. Be sure that the information you provide will be kept confidential & used only for the academic purpose.

Thank you very much In advance!

Direction: For each of the following statements, please √ the response on the sheet that best corresponds to your position, according to the following response scale bellow

Response Scale:

5. Very high 4. High 3. Undecided 2. Low 1. Very low

No	Questions	1	2	3	4	5
1	Your interest in Cooperative learning approach in mathematics classroom					
2	Your participation in Cooperative learning approach in mathematics classroom					
3	Your awareness of Cooperative learning approach practice in mathematics at your grade level					
4	The importance of CLA in mathematics class					
5	Your motivation to participate in CLA during mathematics class					
6	Role of Cooperative learning approach in improving mathematics achievement					
7	Role of problem solving approach of Cooperative learning in improving your interaction in mathematics lesson					
8	Problem solving approach of Cooperative learning creates common understanding among students in mathematics					

7.2. Appendix B

Mathematics achievement test for grade 9 students

Direction: Attempt the following questions properly and choice the correct answer from the given choice and write your answer on the space provided.

____1. Which one of the following is the measure of interior angle of a regular polygon with 5 sides? A) 108º B) 120 º C) 140 º D) 110 º

____ 2. Which one of the following is perimeter of regular hexagon inscribed in a circle of radius 6 cm? A) 60 cm B) 48 cm C) 36 cm D) 24 cm

_____3. Which one of the following is the length of an equilateral triangle if its radius is √12 cm ? A) 10cm B) 6cm C) 8cm D7cm

____4. In Δ ABC , if A B= 21 cm, B C = 14 cm and m ($\hat{}$B) =60^0, what is the length of AC? A) 7 cm B) 77 cm C) 7 cm D) none

_____5. Which of the following is the length of right angled triangle? A) 5, 8, 10 B) 4, 6, 10 C) 9, 12, 13 D) 5, 12, 13

____6. If the area of a certain isosceles triangle with base length 10 units is 96 unit square, what the altitude of this triangle in unit? A) 9.6 B) 12 C) 24.5 D)19.5

____7. A right circular cylinder with radius of the base 5 cm and height 8 cm is open from the top. What is the total surface area of this cylinder? A) 200Π cm^2 B) 105Π cm^2 C) 80Π cm^2 D)130Π cm^2

____8. The altitudes of a parallelogram are 2cm and 3cm. if the perimeter of the parallelogram is 20cm, what is the longest side of the parallelogram? A) 10cm B) 20cm C) 8cm D) 6cm

___9. The area of perimeter of hexagon whose radius is 5cm? A) 21 B)20 C) 30 D)28

__ 10. Which of the following is the area of a square inscribed in a circle of radius 2 cm? A) 16Πcm^2 B) 8Πcm^2 C) 4Πcm^2 D) 2Πcm^2

___11 Which of the following is equal to cos(1/2 Π)? A) -1 B) 1 C) 0 D) undefined

___12.If the ratio of perimeters of two regular polygons 2:3,what is the ratio the areas the polygons ? A) 4:9 B) 2:6 C) 1:3 D) 5:8

___13. A regular polygon which has eight lines of symmetry is called

A) Hexagon B) heptagon C)octagon D) pentagon

___14.If two triangles are similar. A side of one is 2 units long .The corresponding side of other is 5 unit long. which of the following is the ratio of their perimeters?

A)2/3 B) 2/5 C)4/25 D) ½

____15. Which one of the following is the exact value of cos Π/3

A)0 B)1 C) ½ D)2/3

___16. If A and B are complementary angles ,which one of the following not true ? A) sinA = cosB B) tanA= sinA/cos A C) cos A= tanA D) $\sin^2 A + \cos^2 A = 1$

___17.A segments of a circle of radius 12cmis cut of by a chord subtending an angle 60° at center of the circle, which one is the area of the segment?

A)12 Π CM^2 B)28 ΠCM^2 C)25 ΠCM^2 D)24 Π CM^2

___18. In Give triangle ABC. If AB=15 units ,BC=14 units ,and AC= 13 units, which one of the following is the area of the triangle ABC? A)84 Unit square B) 80 unit square C)85 unit square D) 87 unit square

____19.T he altitude of a rectangular prism is 4 units and width and length of its base 3 and 2 units respectively .Which one of the of the following is the total the total surface area of the prism? A)52 unit square B)50 unit square C)54 unit square D) 56 unit square

_____20.If the radius and height of right circular cone respectively 5cm and 8cm then ,which of the following is equal to volume the cone?

A) $\frac{212\,\Pi}{3}$ cm^3 B) $\frac{200\,\Pi}{3}$ cm^3 C) $\frac{214\,\Pi}{3}$$cm^3$ D) $\frac{231\,\Pi}{3}$ cm^3

The Results of experimental group and control group out of 20

N		Pretest		Posttest	
		CG	EG	CG	EG
1		8	9	9	19
2		7	3	8	17
3		9	4	7	18
4		12	4	11	15
5		11	2	13	14
6		5	6	7	11
7		3	7	5	19
8		6	8	9	17
9		7	11	7	20
10		8	13	8	19
11		14	5	15	20
12		12	9	12	20
13		5	13	6	19
14		7	11	8	19
15		3	12	11	17
16		7	7	7	18
17		8	6	10	14
18		4	5	7	10
19		4	8	8	16
20		5	3	9	16
21		6	4	7	9
22		5	5	8	14
23		6	6	8	14
24		4	9	7	17
25		5	8	9	12
26		6	9	4	18
27		7	5	5	19
28		9	6	12	20
29		8	4	11	20
30		7	7	10	15
31		6	8	8	20
32		8	3	8	17
Total	N	32	32	32	32