

ADDIS ABABA UNIVERSITY  
SCHOOL OF GRADUATE STUDIES

*THE EFFECTS OF CORPORATIVE LEARNING STRATEGIES ON SECONDARY  
SCHOOL STUDENTS' ATTITUDE AND ACHIEVEMENT IN ALGEBRA*

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*June 2015*  
*Addis Ababa, Ethiopia*

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*A research submitted to the school of graduate studies of Addis Ababa University in partial fulfillment of the requirements for the degree of masters of education in mathematics and behavioral studies.*

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ADDIS ABABA UNIVERSITY  
COLLEGE OF EDUCATION AND BEHAVIOURAL STUDIES  
DEPARTMENT OF MATHEMATICS EDUCATION

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## ABSTRACT

The major purpose of this study is to investigate the contribution of cooperative learning and other variables to students' Mathematics Achievement. The subjects were out of 12 sections of grade 10<sup>th</sup> in Dejezmach Balcha Abanefso secondary and preparatory school two sections from of (n=75). Each class students were assigned into experimental and control groups, and the former were taught with cooperative method of teaching and the latter learned with traditional way of teaching for one six weeks.

Achievement test and questionnaire were instruments for data collection. Initially, these instruments were administered on pilot sample and improved through item analysis. The data analysis was carried out using SPSS and t-test. Results indicate that there is significant difference in mathematics achievement between students in experimental and control groups within achievement levels of each group.

# CHAPTER ONE

## 2. INTRODUCTION

The introduction part of this paper includes the background of the study, statement of the problem, objectives of the study, the significances of the study, delimitation of the study, and definition of terms.

### 2.1. Background of the study

Education is viewed as development of life long process and universal practice of human learning resulting from man's interaction with his social and natural environment. In line with this , Tegene and Tsegaye (1999) discussed education as a process and practice engaged in by different societies at all stage of development and geared towards shaping an all rounded personality by a harmonious and integrated development of the mental, physical, social, moral spiritual, aesthetic etc. powers of human being.

In the same way ETP (1994) put education as a process by which human beings transmit their experiences, new findings, and values accumulated over the years, in their struggle for survival and development, through generation. From the discussions it can be seen that education is the process of human experiences by which knowledge is acquired, skills developed, attitude and values formed, that enables individuals and society to make all rounded participation in the development process.

In the rapidly changing world and in the development of science and technology mathematics plays a vital role. In daily life and in most human activities the knowledge of mathematics is important. To understand the computerized world and match with the newly developing information technology the strong background in mathematics is critical. Emphasizing this Krutteskii (1976) as cited in Benbow and Arjmand (1990) said the development of sciences has been recently characterized by a tendency for them to become more mathematical....mathematical methods and mathematical styles are penetrating everywhere.

Most people associate problem solving with mathematics than other school subjects. Mathematics has a wide application in natural and social sciences. Adleke (1998) pointed out that mathematical techniques are consistently being developed to meet the changing requirements of physics, chemistry, biology and behavioral sciences, engineering and computer science. Similarly, Setrdisho (1961) as cited in Adeleke (1998) indicated that no other subject forms a strong binding force among other branches of sciences as mathematics. Historically, learning mathematics and teaching it to all students at the school stage has been motivated by the belief that a study of mathematics helps students to learn to reason and apply such reasoning to everyday problems. It is believed that learning mathematics leads to learners' cognitive development.

A learning environment that allows active participation of students in the learning process makes it possible for the students to have control over their learning and this leads to improvement in students' learning and retention as to both the developmental and cognitive theoretical bases (Johnson, Johnson, & Stane, 2000), thereby prevailing classroom climate of cooperation. Cooperative learning environment assumes that students seek information and understanding through active mental search with each group mirroring the make-up of the class in terms of ability, background and gender (Armstrong, 1998). Among all the instructional strategies for enhancing science achievement, emphasis is laid on the importance of group work.

## 2.2. Statement of the problem

Cooperative learning is measured in terms of different elements. From the word cooperative means to support one another in different ways in different academic levels. Therefore in our school there is no such connection among the students helping by cooperation, this is the reason why I am selecting this topic. Additionally in my study area the academic achievement of the students in mathematics is very low compared to the other subjects and also students are totally agree that mathematics is so difficult compared to the other subjects then to minimize such ambiguity idea I went to study the topic cooperative

learning strategies on secondary school students attitude and achievement in algebra.

Educators and researchers show enthusiasm regarding the application of the wide variety of approaches under the cooperative learning umbrella in schools; however, this support does not necessarily ensure that all of these methods are the most effective at improving students' cognitive abilities and social skills. As Sharan (1990) pointed out, "It is more than apparent to the research community that the 'face validity' and widespread appeal that cooperative learning holds for educators do not necessarily constitute confirmation that this approach actually results in the effects ascribed to it, appearances notwithstanding" (p. 288). Johnson, Johnson & Stanne (2000) argued that cooperative learning can significantly increase student achievement (compared with teacher centered methods) when properly implemented; however, this does not mean that all operationalizations of cooperative learning will be equally effective. They suggested that many of the studies conducted have methodological shortcomings and, therefore, any differences found could be the result of methodological flaws rather than the instructional approach itself. In the future, researchers should concentrate on conducting highly controlled studies that add to the confidence with which their conclusions will be received. Furthermore, the specific classroom contexts, procedures, and strategies involved in the cooperative approach need to be clearly defined and illustrated.

Researchers suggest that teachers should view the cooperative learning approach as being flexible and change teaching strategies depending on students' needs and interests. Matthews (as cited in Johnson and Johnson, 1993) stated, "Not all students like working with classmates, not all students want to be part of a learning community, and not everything that is called cooperative learning is in fact cooperative learning". The cooperative learning method can be difficult to implement effectively in the classroom. Adams and Hamm (1996) cautioned that the following elements must exist for cooperative learning methods to work effectively: positive interdependence, face-to-face interaction, individual accountability, and personal responsibility for reaching

group goals, frequent practice with small group interpersonal skills, and regular group processing and reflection. Another drawback is that cooperative learning approaches generally cost more money in comparison with teacher-centered approaches.

### 2.3. Objectives

The purpose of the study was to conduct research regarding the effect of cooperative learning environment to students' attitude and achievement in teaching algebra. The convenient sample consisted of tenth grade students.

#### 2.3.1. General objective:

- ✚ To assess the effect of using cooperative learning strategies on secondary school student's attitude and achievement in algebra in the case of Dejazmach Balcha Abanefso secondary and preparatory school of Lideta sub-city.

#### 2.3.2. Specific objective

The purpose of this study is to investigate the effects of using cooperative learning on secondary school students' attitude and achievement in algebra. The specific objectives of the study enable to: The study specifically aimed to:

- Compare the pre-test of the achievement scores of the students in algebra between the traditional and cooperative learning groups.
- Compare the posttest of the achievement scores of the students in algebra between the traditional and cooperative learning groups.
- Compare the mean gain scores of the achievement of the students in algebra of the traditional and cooperative learning groups.
- Compare the pretest and posttest of the mean score of the attitude of students in learning algebra using cooperative learning.
- Compare the gender difference between the mean scores of the attitude and achievement of the students in algebra of the traditional and cooperative learning groups.

## 2.4. Research Question

Based on the stated problem, the study has attempted to answer the following questions:

1. Is there a significant difference between the pre-test achievement score of students in algebra of the traditional and cooperative learning groups?
2. Is there a significant difference between the post-test achievement scores of the students in algebra of the traditional and cooperative learning groups?
3. Is there a significant difference between the mean gain scores of the achievement of the students in algebra of the traditional and cooperative learning groups?
4. Is there a significant difference between the pretest and posttest of the mean score of the attitude of students in learning algebra using cooperative learning?
5. Is there a significant gender difference between the mean scores of the attitude and achievement of students in algebra of the traditional and cooperative learning groups?

## 2.5. Significance of the study

This study was significant to identify in which method of teaching the students develop positive attitude toward mathematics. It is also important to explore in which type of teaching students achieve better results in mathematics. If there is any difference in the area of the achievement of the students to using cooperative learning strategies, the study indicates the concern bodies to make the necessary adjustment.

This study is particularly significant to school, teachers and students. From the findings of this study the school was understand the problem of their students, either in the areas of using cooperative learning. Then the school bodies were able to create conducive atmosphere for the student in developing positive attitude towards the effect as well as in acquiring better achievement in cooperative learning. This study was also help students to understand the level of their effect of problem solving as well as the use of cooperative learning

strategies in mathematics compared to other method of teaching so that they were able to seek solutions for the difference, if it exists.

Further, the findings of the study and their implications are expected to serve as a springboard for further study in any other subject areas. Therefore, the findings of the study may have the following significance:

- ✓ Show the main effects of using cooperative learning in Lideta secondary school.
- ✓ Create awareness for teachers, school directors and other educational personnel about the effects of using cooperative learning strategies on secondary school students' achievement in algebra in the case of Dejazmach Balcha Abanefso secondary and preparatory school of Lideta sub-city.
- ✓ Help the Lideta sub-city, the region benefit the finding of the study to improve and facilitate the quality of mathematics education.
- ✓ It was serve as a reference for further detailed study on the process of algebra teaching learning.

## 2.6. Delimitation of the study

The study have been of greater importance to get more comprehensive information which was cover a large part of Addis Ababa secondary and primary schools. However, due to constraints of time and other resources the study was confined to some selected governmental secondary school of Addis Ababa, specifically Lideta sub –city administrative.

## 2.7. Definitions of terms

- **Achievement**-Something accomplished successfully, especially by means of exertion, skill, practice, or perseverance.
- **Attitude**- A predisposition or a tendency to respond positively or negatively towards a certain idea, object, person, or situation.
- **Anxiety**- is a general term for several disorders that cause nervousness, fear, apprehension, and worrying.
- **Confidence** –is a feeling that you think you will do better after your efforts, a feeling that you can know more after your time, a feeling that you come from the environment so you can change yourself to adapt to the environment (is a feeling that you think you are capable of doing something).
- **Cooperative learning** – is the instructional use of small groups so that students work together to maximize their own and each others' learning.
- **Engagement**- as students' psychological investment in an effort directed toward learning, understanding, or mastering the knowledge, skills, or crafts that academic work is intended to promote.
- **Usefulness**- the quality of being of practical use.

## CHAPTER TWO

### 3. REVIEW OF RELATED LITERATURE

The study was designed to examine the effect of using corporative learning strategies on secondary school students' in mathematics attitude and achievement in Algebra. In the case of Dejazmach Balcha Abanefso secondary and preparatory school of Lideta Sub-City. In connection with this study, review of literature includes the following topics:-

- ❖ Cooperative Learning
- ❖ Achievement in Mathematics
- ❖ Attitude in Mathematics

#### 3.1. Cooperative Learning

##### 3.1.1. Definition of Cooperative Learning

*"Two are better than one, because they have a good reward for toil. For if they fall, one will lift up his fellow; but woe to him who is alone when he falls and has not another to lift him up...And though a man might prevail against one who is alone, two will withstand him. A threefold cord is not quickly broken."*

Cooperative learning, due to its ancient pedigree and positive outcomes, has been a focus of research in the past century. Different researches have defined cooperative learning in different ways.

According to Oxford American Dictionary, cooperative learning can be defined as a small group of students who are working together on a common learning task. Cooperative learning begins with the formation of groups into teams of students.

Roger (1992) proposed ,”cooperative learning is group learning activity organized in such a way that learning is based on the socially structured change of information between learners in groups in which each learner is held accountable for his or her own learning and is motivated to increase the learning of others”.

Parker (1994) defined the small group cooperative learning as classroom environment where students interact with one another in small groups while working together on academic task to attain the common goal. While, Davidson (1995) elaborated cooperative learning as a word as well as a term. Cooperative learning is a long standing concept in human affairs and indeed, is known to be essential to the functioning of human groups, organizations and societies. What does it mean to cooperate or to collaborate? Examining a Variety of dictionaries, it appears that 'to cooperate means to work or act together or jointly, and strive to produce an effect'. Cooperation involves joint operation or action and is also has social, economic and biological interpretation. For instance, the social meaning of cooperation is an activity shared for mutual benefits. The economic cooperation is a joint effort for the purpose of production, purchase and distribution. The biological / ecological meaning of cooperation is the conscious or unconscious behavior of organisms living together for survival. To collaborate means to work jointly with one or few others in a project such as composition or research.

While the expression "cooperation in education" may appear to be a twentieth century development, it has ancient roots in many societies...yet it is only in the twentieth century that we see systematic and wide ranging international research, development of the key concepts and methods related to cooperation in education. These methods, when applied in the classroom, are typically known as either cooperative learning or collaborative learning.

Johnson and Johnson (1998) provide a brief definition of cooperation and cooperative learning and differentiated it from competitive and individualistic learning as: cooperative means working together to accomplish shared goals. With cooperative situations, individuals seek out comes that are beneficial to all other group members. Cooperative learning is instructional use of small groups so that students work together to maximize their own and each other's learning. It may be contrasted with competitive (students work against each other to achieve an academic goal such as grade "A" that only one or a few students can attain) and individualistic (students work by themselves to

accomplish learning goals unrelated to those of other students) learning. In cooperative and individualistic learning, you evaluate student efforts on a criteria referenced basis while in competitive learning you grade students on a norm referenced basis. While there are limitations when and where you may use competitive and individualistic appropriately, you may structure any learning task in any subject area with any curriculum cooperatively. Artz and Newman (1990) define cooperative learning as “small groups of learners working together as a team to solve a problem, complete a task, or accomplish a common goal”.

### 2.1.2. Theoretical base of Cooperative Learning

The most of the development work on cooperative learning has been nurtured in the last three decades of 20<sup>th</sup> century when too much had been explored about the learning process. Therefore the roots of cooperative learning lie deep in learning theories. Study of related literature provides us a sound theoretical framework and conceptual base for cooperative learning. Most of the researchers (e.g. Slavin 1996a, Johnson and Johnson 1999) have described cooperative learning on four major theoretical perspectives.

- Motivational perspectives
- Social cohesion perspectives
- Cognitive perspectives
- Developmental perspectives
- Cognitive elaboration perspectives

#### 2.1.2.1. Motivational perspectives

Motivational perspectives on cooperative learning assume that cooperative efforts are based on group rewards or goal structures (Slavin, 1977). From motivational perspective (e.g. Slavin 1984) cooperative learning activities, when properly carried out, create a situation in which individual group members can achieve their goals if and only if each member is successful. Therefore the members of the group are motivated to help their classmates in order to meet their own goals. And even more importantly, they encourage their group mates to exert maximum efforts. This gives rise to interpersonal reward structure in which group members will hold social reinforces in response to group-mates’

task-related efforts (Slavin ,1983).thus , due to cooperative goal structures as identified by Deutsch(1949), cooperative learning encourages students to want their class-mates to succeed in contrast to competitive goal structures in competitive learning where individuals compete for grades and goals or individualistic goal structures in individualistic learning where individuals have no concern with the attainment of others.

Johnson and Johnson (1999) and Slavin (1987b) have adopted motivational concerns of cooperative learning from behavioral and humanistic learning theories. Two important behaviorist concepts are group contingencies by skinner and vicarious reinforcement or imitation by Bandura.

Slavin(1995) cites one intervention that uses operative goal structure is the group contingency, in which group rewards are given on the basis of group members' behavior. The theory underling group contingencies do not requires that group member be able to actually help one another or work together. The fact that their outcomes are dependent on one another's behavior is enough to motivate students to engage in behavior which helps the group to be rewarded, because the group incentive induces students to encourage goal-directed behaviors among their group mates.

The other behaviorist concept-individuals who observe someone else getting reinforced for a particular behavior tend to exhibit that behavior more frequently themselves-know as vicarious reinforcement (Bandura, 1965). This phenomenon induces that students learn not only by being reinforced themselves, but also by seeing other people receive rewards or punishment. Cooperative learning especially when students are heterogeneously grouped according to motivation and past achievement offers many opportunities for students to be motivated for hard work from models who are rewarded for their effort. However, Slavin (1987a) believes that extrinsic motivation is preferable over intrinsic motivation.

### 2.1.2.2. Social cohesion perspectives

Another theoretical perspective somewhat related to motivational view point holds that the effect of cooperative learning on achievement are strongly mediated by the cohesiveness of the group, in the essence that students will help one another because they care about one another and want one another to succeed. This perspective is similar to the motivational perspective in that it emphasizes primarily motivational rather than cogitative explanations for the instructional effectiveness of cooperative learning. However, motivational theorists hold that students help their group-mates learn at least in part because it is in their own interest to do so. Social theorist in contrast, emphasize the idea that students help their group-mates learn because they care about the group (Slavin,1996a).while Johnson and Johnson (1999) discuss this perspective with reference to social interdependence theory. The view that the way social interdependence is structured determines the way persons interact with each other. Moreover, outcomes are the consequences of persons' interaction. Therefore, one of the cooperative elements that have to be structured in the classroom is positive interdependence or cooperation. When this is done, cooperation results in primitive interaction as group members encourage and ease each other's efforts to learn. According to Slavin (1996a) a hallmark of the social cohesion perspectives is an emphasis on team building activities in preparation for cooperative learning, and processing or group self-evaluation during and after group activities. Social cohesion theorists tend to downplay or reject the group incentives and individual accountability held by motivation list researches to be essential. For instance, Cohen (1986) states "if the task is challenging and interesting, and if students sufficiently prepared for skills in group process, students will experience the process of group work it as highly rewarding...never grade or evaluate students on their individual contributions to the group product". In the area of cooperative learning, learning together by Johnson and Johnson (1999) are main techniques vividly based on social cohesion.

### 2.1.2.3. Cognitive perspectives

Cognitive psychology, in contrast to motivational and social views, focuses on how humans take in, store and process to learn. Cognitivists try to look inside the mind to explore how their thinking and leaning take place. According to Slavin (1996a) cognitive perspective holds that interaction among students will in themselves increase students' achievement for reasons which have to do with mental processing of information rather than with motivations. Cooperative methods developed by cognitive theorists involve neither the goals that are the corner-stone of the motivation list methods nor the emphasis on group cohesiveness, the characteristic of social cohesion methods.

### 2.1.3.4. Rationale for cooperative learning

Cooperative learning is strongly advocated in the classroom. Reports on studies comparing the achievement of high-middle and low achieving students in competitive, individualistic and cooperative learning situations show that cooperative learning experiences tend to produce higher results. This is true for "all ages, subject areas, and for tasks involving concept attainment , verbal problem solving , categorization, spatial problem solving retention and memory, motor performance, guessing, judging and predicting.

Slavin (1991a) points out that numerous research studies in K-12 classroom, in very diverse school settings and across a wide range of content areas, have revealed that students completing cooperative learning group tasks tend to have higher academic test scores, higher self-esteem, greater numbers of positive social skills, fewer stereo types of individuals of other races or ethnic groups, and greater comprehension of the content and skills they are studying. Cooperative efforts result in better preference in problem solving than competitive efforts do. This is true at all grade level, for both linguistic and non-linguistic problems, and regardless of whatever a problem has a clear or is ill defined (Qin, et al.1995).

Cooperative learning is seen as, a powerful tool to motivate learning and has a positive effect on the classroom climate which leads to encourage greater

achievement, to foster positive attitudes and higher self –esteem, to develop collaborative skills and to promote greater social support. (MOE, 1995)

Sadker and Sadker (1997) have focused on the benefits of cooperative learning. They say, research shows that both cognitive and affective growth results from cooperative learning with the following additional benefits:-

- ✓ Students taught within this structure make higher achievement gains; this is especially true for mathematics class.
- ✓ Students who participate in cooperative learning have higher levels of self-esteem and greater motivation to learn.
- ✓ Students have stronger sense that classmates have positive regard for one another.
- ✓ A particular important finding is that there is greater acceptance of students from different racial and ethnic background when a cooperative learning structure is implemented.

Johnson et al. (1998) state that the conviction to use cooperative learning flows from knowing the research. Since the first research study was published in 1898, there have been over 600 experimental and over 100 correlation studies conducted on cooperative, competitive, and individualistic efforts. The multiple outcomes studied can be classified into three major categories: effort to achieve, positive relationships, and psychological health. From the research, it is known that cooperation, compared with competitive and individualistic efforts results in:

- i. Greater efforts to achieve: this includes higher achievement and greater productivity by all students (high, medium, and low achievers), long term retention, intrinsic motivation, achievement motivation, time on task, higher level reasoning, and critical thinking.
- ii. More positive relationship among students: this includes sprit-de-corps, caring and committed relationships, personal and academic social support, valuing of diversity, and cohesion.
- iii. Greater psychological health: this includes general psychological adjustment, ego-strength, social development, social competencies, self esteem, self-identity to cope with adversity and stress.

The powerful effects of cooperation on so many important outcomes separate it from other instructional methods and make it one of the most important tools.

#### 2.1.4. Types of cooperative learning

Johnson et al. (1998) describe three types of cooperative learning.

##### 2.1.4.4. Formal cooperative learning

Formal cooperative learning lasts from one class period to several weeks. You may structure any academic assignment or course requirement for formal cooperative learning. Formal cooperative learning ensure that students are actively involved in the intellectual work of organizing material, explaining it , summarizing it, and integrating it into existing conceptual structures. They are the heart of using cooperative learning.

##### 2.1.4.5. Informal cooperative learning

Informal cooperative learning is ad-hoc groups that last from a few minutes to one class period. You use them during direct teaching (lectures, demonstrations, films, videos) to focus student attention on the material they are to learn, set a mood conducive to learning , help set expectations as to what class will cover, ensure that students cognitively process the material you are teaching ,and provide closure to an instructional session.

##### 2.1.4.6. Cooperative base learning

Cooperative base learning is long-term (lasting for at least a year), heterogeneous groups with stable membership whose primary purpose is for members to give each other the support, help, encouragement, and assistance each needs to progress academically. Base groups provide students with long-term, committed relationships.

### 2.1.5. Methods of Cooperative Learning

The application of cooperative learning in the class room has been focus of research since 1970s. Researchers all over the world have been studying practical applications of cooperative learning principles and as a result many cooperative learning methods are in practice today. Slavin(1995) has discussed some of the most researched and widely used cooperative learning methods. He divides these methods into the following categories.

#### 2.1.5.4. Student team learning methods

Students team learning methods are methods are cooperative learning techniques developed and researched at John Hopkins University. More than half of all studies of practical cooperative learning methods involve these methods.

All cooperative learning methods share the idea that students work together to learn and are responsible for their teammates' learning as well as their own. In addition the idea of cooperative work, student team learning methods emphasize the use team goals and goal success, which can be achieved only if all members of the team learn the objectives being taught. That is, in student team learning the students' tasks is not to do something as a team but to learn something as a team.

Three concepts are central to all students team learning methods-team rewards, individual accountability, and equal opportunities for success. Team may earn certificates or other team rewards if they achieve above a designated criterion. Teams do not complete to earn scarce rewards; all (or none) of the teams may achieve the criterion in a given week. Individual accountability means that the team's success depends on the individual learning of all team members. Accountability focuses the activity of the team members on helping one another learn and making sure that everyone on the team is read for a quiz or any other assessment that students take without teammate help. Equal opportunities for success mean that students contribute to their teams by improving on their own past performance. This ensures that high, average, and low achievers are equally challenged to do their best, and that the contributions of all team members are valued.

## 2.1.5.5. Other cooperative learning methods

### 2.1.5.5.1. Circles of Learning

In early publications of Roger Johnson referred to as “learning Together”. Later, they published a book entitled circles of learning (1984) which appears to provide a more recent title for this method. Students work in four or five member heterogeneous groups on a group assignment sheet. A single product is turned in, and the group receives rewards together. Emphasis on team-building activities and regular discussions within groups about how well they are working together (Johnson et al. 1984).

### 2.1.5.5.2. Jigsaw

The cooperative learning method was developed by Aronson (1975). (There are now two additional versions; Jigsaw II and Jigsaw III). In Aronson’s method, each student in a five-member group is given information that comprises only one part of the lesson. Each student in the group has a different piece of information. All students need to know all information to be successful. Students leave their original group and form an “expert group”, in which all persons with the same piece of information get together, study it, and decide how best to teach it to their peers in the original group. After this is accomplished, students return to their original groups, and each teacher his /her portion of the lesson to the others in group. Students work cooperatively in two different groups, their group and the expert group. Grades are based on individual examination performance. There is no specific reward for achievement or for the use of cooperative skills.

### 2.1.5.5.3. Jigsaw III

This method, developed by Kagan, is for use in bilingual classrooms. Cooperative groups consist of one English speaker, one non-English speaker, and one bilingual student. All materials are bilingual (Knight and Bohlmeier, 1990).

#### 2.1.5.5.4. Group investigation

This method, developed by Sharan and Sharan (1990), emphasize more student choice and control than do other cooperative methods. Students are involved in planning what to study and how to investigate.

Cooperative groups are formed on the basis of common interest in a particular aspect of a general topic. All group members help plan how they will research the topic and divide the work among themselves. Then each carries out his /her part of the investigation. The group synthesizes and summarizes the work and presents the findings to the class (Sharan and Sharan, 1990).

#### 2.1.5.5.5. Complex Instruction

Elizabeth Cohen and her colleagues at Stanford University have developed and researched approaches to cooperative learning that emphasize use of discovery-oriented projects, particularly in science, mathematics, and social studies. A major focus of complex instruction is on building respect for all of the abilities students have. Projects in complex instruction require a wide variety of roles and skills, and teachers points out how every student is good at something that helps the group succeed. Complex instruction has particularly been used in bilingual education and in heterogeneous classes congaing language minority students, where materials are often available in Spanish as well as English (Slavin, 1995).

#### 2.1.5.5.6. Team Accelerated Instruction (TAI)

In team accelerated instruction, four member mixed ability learning teams work together to complete their learning material and homework. This mode of cooperative learning is specifically designed to teach mathematics to students in grades 3-6. TAI, students enter an individualized sequence according to a placement test and then proceed at their own pace. Teammates check each other's work using answer sheets and help one another with any problems. Final unit tests are taken without teammate help and are scored by student monitors. Each week, teachers total the number of units completed by all team members and give certificates or other team rewards to teams that exceed in criterion score base based on the final test passed, with extra points for perfect papers and completed homework. As students are responsible for checking

each other's work and managing the flow of materials, the teacher can spend most of the class time presenting lessons to small groups of students drawn from various teams who are working at the same level in the mathematics sequences. Individual accountability, equal opportunities for success and motivational dynamics are the main features of this method (Slavn, 1995).

#### 2.1.5.5.7. Cooperative integrated reading and composition (CIRC)

Developed by Stavens et al. (1987), this method is designed to accommodate a wide range of student performance levels in one classroom using, both heterogeneous and homogenous with in class grouping. In most CIRC activities, students follow a sequence of teacher instruction, team practice, team pre-assessments, and quiz. Students do not take the quiz until their teammates have determined that they are ready. Team rewards and certificates are given to team, based on the average performance of all team members on all reading and writing activities. Because students work on materials appropriate to their reading levels, they have equal opportunities for success. Students' contributions to their team are based on their quiz scores and independently written compositions, which ensure individual accountability.

#### 2.1.5.5.8. Structured Dyadic Methods

While most cooperative learning methods involve groups of four members who have considerable freedom in deciding how they will work together, there is an increasing body of research on highly structured methods in which pairs of students teach each other. There is a long tradition of laboratory research showing how scripted pair learning, in which students take turns as teacher and learner to learn procedures or extract information from text, can be very effective in increasing student learning. Pair learning strategies have also been used over longer time periods in classrooms. One method, called Class wide peer tutoring (Green wood et al. 1989), has peer tutors follow a simple study procedure. Tutors present problems to their tutees. If they respond correctly the tutees earn points. If not, tutors provide the answer and the tutee must write the answer three times, reread a sentence correctly, or otherwise correct their error. Every ten minutes the tutors and tutees switch the roles. Dyads earning the most points are recognized in class each day. A similar method,

reciprocal peer tutoring also alternates tutor and tutee roles within dyads, but gives tutors specific prompts and alternative problems to use if tutees make errors. (Fantuzzo et al 1992)

#### 2.1.5.6. Informal methods

Many teachers weave cooperative activities into their otherwise traditional lessons or use them when presenting lessons in STAD, GT, or other cooperative techniques. A description of some of the most useful of these informal cooperative activities follows:

##### 2.1.5.6.1. Spontaneous Group Discussion

If students are sitting in teams, it is easy to ask them at various times during a lecture or presentation to discuss what sometimes means, why something works, or how a problem might best be solved. This simple cooperative learning structure complements a traditional lesson, and the group work can vary from a few minutes to a full class session (Slavin, 1995).

##### 2.1.5.6.2. Numbered Heads Together

Numbered Heads Together is basically a variant of group discussion; the twist is having only one student represent the group but not informing the group in advance whom its representative will be. That twist ensures total involvement of all the students. Russ Frank's method is an excellent way to add individual accountability to a group discussion (Slavin, 1995).

##### 2.1.5.6.3. Team Product

Have student teams make a learning center, write an essay, draw a mutual, work a worksheet, make a presentation to the class, design a better government, list possible solutions to a social problem, or analyze a poem. To maintain individual accountability, assign team members specific roles or individual areas of responsibility (Slavin, 1995).

##### 2.1.5.6.4. Cooperative Review

It is the day before the exam. Student groups make up review questions. They take turns asking the other groups the questions. The group asking the question gets a point for the question. The group initially called on, gets a point

for a correct answer. Then a second group can receive a point if it can add any important information to the answer.

In a variation on cooperative review, the teacher brings in the questions. Another variation combines numbered heads together with cooperative review. That is, when the teacher or students ask the review question, students first discuss their answers with their teammates. After this brief “heads together” time, a number is called 1, 2, 3, or 4. Students with the corresponding numbers have the opportunity to come up with the right answer. A second number is called after a correct answer is provided, and another student can earn a point for his or her team by adding information to the original correct answer. If the teacher feels there is still important information to be brought out, a third number may be called, and so on (Slavin, 1995).

#### 2.1.5.6.5. Think –pair-share

This is simple but very useful method was developed by Frank Lyman of the University of Maryland. When the teacher presents a lesson to the class, students sit in pairs within their teams. The teacher poses questions to the class. Students are instructed to think of an answer on their own, then to pair with their partners to reach consensus on an answer. Finally, the teacher asks students to share their agreed-upon answers with the rest of the class (Slavin, 1995).

#### 2.1.5.7. Group Discussion and Group Projects

Among the oldest and most widely used forms of cooperative learning are group discussion and group projects. For example, most science teachers use cooperative lab groups, and many social studies and English teachers use discussion or project groups (Slavin, 1995).

#### 2.1.6. Implementation of cooperative learning in the classroom

According to Slavin (1995), student teams-achievement division (STAD) has been used in every imaginable subject, from mathematics to language arts to social studies and science, and has been used from grade two through college. It is most appropriate for teaching well-defined objectives, such as mathematical computations and applications, language usage and mechanics,

geography and map skills, and science concepts. STAD is a general method of organizing the classroom rather than a comprehensive method of teaching any particular subject; teachers use their own lessons and other materials. STAD is one of the simplest of all cooperative learning methods, and is a good model to begin with for teachers who are new to the cooperative approach. Slavin (1995) described the implementation of STAD in the following steps:

#### 2.1.6.4. Overview

STAD consists of five major components – class presentations, teams, quizzes, individual improvement scores, and team recognition.

##### 2.1.6.4.1. Class presentations

Material in STAD is initially introduced in a class presentation. This is most often direct instruction or a lecture-discussion conducted by the teacher, but could include audiovisual presentations. Class presentations in STAD differ from usual teaching only in that they must be clearly focused on the STAD unit. In this way, students realize they must pay careful attention during the class presentation, because doing so will help them do well on the quizzes, and their quiz scores determine their team scores.

##### 2.1.6.4.2. Teams

Teams are composed of four or five students who represent a cross-section of the class in terms of academic performance, sex, and race or ethnicity. The major function of the team is to make sure that all team members are learning, and more specifically, to prepare its members to do well on the quizzes. After the teacher presents the material, the team meets to study worksheets or other material. Most often, the study involves students discussing problems together, comparing answers, and correcting any misconceptions if teammates make mistakes.

The team is the most important feature of STAD. At every point, emphasis is placed on team members doing their best for the team, and on the team doing its best to help its members. The team provides the peer support for academic performance that is important for such outcomes as inter group relations, self-esteem, and acceptance of mainstreamed students.

#### 2.1.6.4.3. Quizzes

After approximately one to two periods of teacher's presentation and one to two periods of team practice, the students take individual quizzes. Students are not permitted to help one another during the quizzes. Thus, every student is individually responsible for knowing the materials.

#### 2.1.6.4.4. Individual Improvement Scores

The idea behind the individual improvement scores is to give each student a performance goal that can be attained if he or she works harder and performs better than in the past. Any student can contribute maximum points to his or her best work. Each student is given a "base" score, derived from the student's average past performance on similar quizzes. Students then earn points for their teams based on the degree to which their quiz scores exceed their base scores.

#### 2.1.6.4.5. Team Recognition

Teams may earn certificates or other rewards if their average scores exceed a certain criterion. Students' team scores may also be used to determine up to 20 percent of their grades.

#### 2.1.6.5. Preparation

##### 2.1.6.5.1. Materials

STAD can be used with curriculum materials specifically designed for student team learning and distributed by the Johns Hopkins team learning project or it can be used with materials adapted from textbooks or other published sources or with teacher-made materials.

However, it is quite easy to make your own materials. Simply make a worksheet, a worksheet answer sheet, and a quiz for each unit you plan to teach. Each unit should occupy three to five days of instruction.

##### 2.1.6.5.2. Assigning Students To Team

As we have seen, STAD teams represent a cross-section of the class. A four-person team in a class that is half male, half female, would also have a high performer, a low performer, and two average performers. Of course, high performer is a relative team: it means high for the class, not necessarily high compared with national norms.

### 2.1.7. Mathematics and cooperative learning

Today, knowledge of mathematics is one of the components that separate people who have choice from people without choices. The computer revolution has made mathematics a more integral part of the insurance industry, medical research, government, transportation, manufacturing, and construction. Computer programs are used in the clothing industry for creating different sized patterns. Mathematical models of traffic patterns are used to plan road construction. Mathematical illiteracy leads to muddled personal decisions and misinformed governmental policies. Without an understanding of mathematics concepts, news about billion dollar deficits or discussions about the probability of contracting a disease is meaningless. Children born today will enter a work force where knowledge of mathematics is crucial to their career opportunities, their participation in society, and the conduct of their private lives. Any person who does not have a broad understanding of mathematics will have limited career opportunities (Johnson, 1991).

Thus, mathematics has been part and parcel of curriculum upon secondary level. Johnson and Johnson (1991) revealed that the goal of mathematics education is to ensure that all students possess a suitable and sufficient mathematics background to become productive citizens in a society that is characterized by complex information and technology. Students must understand mathematics well enough, for example, defense spending, medical advances, space exploration, and taxation. They must understand mathematics well enough to have the knowledge and skills required to work in modern production facilities. And they must understand mathematics well enough to solve problems within a variety of career, social, and personal contexts.

They query “how this goal can be well accomplished?” has been the focus of researchers for centuries. In USA and some other advanced countries, cooperative learning is well researched instructional strategy to promote learning in any subject area.

According to Johnson and Johnson (1991), there is considerable evidence indicating that the goals of mathematics instruction will be better achieved when cooperative learning procedures and strategies are employed. The use of cooperative learning will result in students being more cognitively active, more

successful in problem solving, more confident in their mathematics abilities, less anxious about learning mathematics, more motivated to take further mathematics courses, and better able to transfer what they know about mathematics to career situations.

Researchers, in their research findings of cooperative learning about mathematics achievement, have discussed why students using cooperative learning improve their learning situations. According to Slavin (1983) all forms of cooperative learning focus on involving students work together to help others in order to complete their goals.

Native (1994) pointed out students' helping behaviors are strongly related to their academic achievement. Cooperative learning establishes a community in which students can get help and support from other group members immediately in a non-competition learning environment, not just raising their hands and waiting the right answers. In contrast, giving or receiving answers only without help from others is not positive for students' achievement. Whicker et.al (1997) and Leikin and Zaslavsky(1997) found that most students like receiving help from others or like working in groups.

In addition to promoting mathematics achievement, there were other findings from the analysis of cooperative learning in mathematics instruction, such as increasing social communication, changing learning behaviors (i.e. passivity becoming activity), and increasing self-esteem because of getting help from others. First, teachers and students were in favor of cooperative learning being used in mathematics instruction (Jacobs et al.1997).

Roberston et al. (1999) presented a rationale I.e. why does cooperative learning deserve a central place in mathematics instruction? The study of mathematics is often viewed as an isolated, individualistic, or competitive matter. One works alone and struggles to understand the material or solve the assigned problems. Perhaps it is not surprising that many students and adult are afraid of mathematics and develop mathematics avoidance or mathematics anxiety. They often believe that only a few talented individual can function successfully in the mathematical ream. Small-group cooperative learning addresses these problems in several ways.

## 2.2. ACHIEVEMENT IN MATHEMATICS

### 2.3.1. Definition of Achievement

The quality of teaching and learning mathematics has been one of the major challenges and concerns of educators. Instructional design is an effective way to alleviate problems related to the quality of teaching and learning mathematics. Knowing the factors affecting mathematics achievement is particularly important for making the best design decisions.

As is the case in the past, most people today still believe that mathematics is all about computation. However, computation, for mathematicians, is merely a tool for comprehending structures, relationships and patterns of mathematical concepts, and therefore producing solutions for complex real life problems. This perspective of mathematicians has gained more attention and importance with rapid advancements in information and communication technologies. It has become necessity for people of all ages to reach, analyze, and apply the mathematical knowledge effectively and efficiently to be successful citizens in our information age. In particular, students need to be well-equipped with higher-order mathematical knowledge.

The quality of teaching and learning in mathematics is a major challenge and for educators. General concern about mathematics achievement has been evident for the last 20 years. The current debate among scholars is what students should learn to be successful in mathematics. The discussion emphasizes new instructional design techniques to produce individuals who can understand and apply fundamental mathematic concepts. A central and persisting issue is how to provide instructional environments, conditions, methods, and solutions that achieve learning goals for students with different skill and ability levels. Innovative instructional approaches and techniques should be developed to ensure that students become successful learners.

It is important for educators to adopt instructional design techniques to attain higher achievement rates in mathematics (Rasmussen and Marrongelle, 2006). Considering students' needs and comprehension of higher-order mathematical

knowledge, instructional design provides a systematic process and a framework for analytically planning, developing, and adapting mathematics instruction (Saritas, 2004). “Instructional design is an effective way to alleviate many pressing problems in education. Instructional design is a linking science, a body of knowledge that prescribes actions to optimize desired instructional outcomes, such as achievement and effect” (Reigeluth, 1983, p.5).

Instructional design alone cannot produce better learning and achievement. The instructional designer must know crucial factors that affect student learning and build a bridge between goals and student performance. Identifying these factors will help to utilize limited resources including financial resources and time more effectively (Libiensi and Gutierrez, 2008).

In an effort to understand the factors associated with mathematics achievement, researchers have focused on many factors (Beaton and Dwyer, 2002; Kellaghan and Madaus, 2002; Kifer, 2002). The impact of various demographic, social, economical and educational factors on students’ mathematics achievement continues to be of great interest to the educators and researchers. For instance, Israel et al. (2001) concluded that parents’ socioeconomic status is correlated with a child’s educational achievement. Another study by Jensen and Seltzer (2000) showed that factors such as individual study, parents’ role, and social environment had a significant influence on “further education” decisions and achievements of young students’. In another study, Meece, Wigfield and Eccles (1990) investigated cognitive motivational variables that influence high school students’ decisions to enroll in advanced mathematics courses. Their findings revealed that mathematics ability perceptions affect students’ valuing of mathematics and their expectations for achievement.

A growing body of research provides additional factors which could have an impact on students’ achievement such as gender, family structure, parents’ educational level, socio-economic status, parent and student attitudes toward school, and parent involvement (Campbell et al. 2000; Epstein, 1991; Fennema and 1986; Fluty, 1997). Three factors or predictors in mathematics

achievement, are divided into sub factors: Demographic Factors (gender, socio-economic status, parent's educational level), Instructional Factors (teacher competency, instructional strategies and techniques, curriculum, school context and facilities), and Individual Factors (self-directed learning, arithmetic ability, motivation). These are examined in the literature review below.

### 2.3.2. Factors Affecting the Mathematics Achievement

A growing body of research findings indicates that demographic, individual and instructional factors have an impact on the mathematical achievement of students. Identifying factors that affect mathematics achievement is particularly important to effectively educate new generations in, what is for many, a difficult subject. It also provides instructional designers better inputs for their design decisions.

#### 2.3.2.1. Demographic factors

Various demographic factors are known to be related to mathematics achievement. Gender, socio-economic status, and parents' educational level are factors that have been analyzed in this study as predictors of mathematics achievement.

##### 2.3.2.1.1. Gender

Many variables have long been studied as predictors of mathematics achievement. However, gender issues on mathematics achievement are studied most frequently by researchers. For instance, a study through a meta-analysis reveals that males tend to do better on mathematics tests that involve problem-solving (Hyde and Fennema). Females tend to do better in computation, and there is no significant gender difference in understanding mathematics concepts. Another study shows that females tend to earn better grades than males in mathematics (Kimball, 1989).

Some recent studies have revealed that gender differences in mathematics education seem to be narrowing in many countries. However, studies indicate that as students reach higher grades, gender differences favor increase in mathematics achievement by males (Campbell, 1995; Gray, 1996; Mullis,

Martin, Fierros, Goldberg, and Stemler, 2000). For instance, the results from the Third International Mathematics and Science Study showed that mathematics achievement scores of each gender group were close to each other at the primary and middle school years (Beaton et al., 1996; Mullis et al., 1997). However, in the final year of secondary school, evidence was found for gender differences in mathematics achievement. Another study, which was conducted to analyze factors that affect mathematics achievement of 11<sup>th</sup> - graders in mathematics classes with an identified gender gap, also showed that males scored higher than females on 11<sup>th</sup> grade mathematics achievement test, but this difference decreased from 10<sup>th</sup> grade (Campbell and Beaudry, 1998).

In addition, gender differences in attitudes and perceptions of the usefulness of mathematics for middle school students were found statistically important (Lockheed, Thorpe, Brooks-Gunn, Casserly, and McAloon 1985; Oakes 1990). For example, female students show less interest in mathematics and have negative attitude toward mathematics. It is also reported that girls tend to learn mathematical concepts by means of rules or cooperative activities, while boys have a tendency to be in a competition to master mathematical concepts (Fennema and Peterson, 1985; Hopkins, McGillicuddy-De Lisi, and De Lisi, 1997).

The literature on gender differences provides evidences that gender issues impact achievement in mathematics. Hence, it is crucial for educators and researchers to pay attention to gender differences in the design of mathematics instruction.

#### 2.3.2.1.2. Socio-economic status

Socio-economic status is determined to be a predictor of mathematics achievement. Studies repeatedly discovered that the parents' annual level of income is correlated with students' mathematics achievement scores (Jeynes, 2002). Socio-economic status was found significant in primary mathematics and science achievement scores (Ma and Klinger, 2000). Another study found poor academic achievement of Canadian students to be attributable to their low socio-economic status (Hull, 1990). Socio-economic status was examined and found to be one of the four most important predictors of discrepancy in

academic achievement of Canadian students (aged 15) in reading, mathematics, and science by the Program for International Student Assessment (Human Resources Development Canada, Statistics Canada, and Council of Ministers of Education Canada, 2001).

A number of studies showed that parents with higher socio-economic status are more involved in their children's education than parents of lower socio-economic status. This greater involvement results in development of positive attitudes of children toward school, classes, and enhancement of academic achievement (Epstein, 1987; Lareau, 1987; Stevenson and Baker, 1987). It is believed that low socio-economic status negatively influences academic achievement, in part, because it prevents students from accessing various educational materials and resources, and creates a distressing atmosphere at home (possible disruptions in parenting or an increased likelihood family conflicts) (Majoribank, 1996; Jeynes, 2002). For these reasons, socio-economic status of a student is a common factor that determines academic achievement.

#### 2.3.2.1.3. Parents' educational level

Parents' educational level has been shown to be a factor in academic achievement. Parents serve as a role model and a guide in encouraging their children to pursue high educational goals and desires by establishing the educational resources on hand in the home and holding particular attitudes and values towards their children's learning. In this case, the educational attainment of parents serve as an indicator of attitudes and values which parents use to create a home environment that can affect children's learning and achievement.

A number of studies indicated that student achievement is correlated highly with the educational attainment of parents (Coleman, 1966). For instance, students whose parents had less than high school education obtained lower grades in mathematics than those whose parents had higher levels of education (Campbell, Hombo, and Mazzeo, 2000). Research has shown that parents' educational level not only impact student attitudes toward learning but also impact their mathematics achievement scores.

## 2.3.2.2. Instructional factors

### 2.3.2.2.1. Curriculum

Many concerns have been emphasized in the literature about the existing mathematics curricula that emphasize not so much a form of thinking as a substitute for thinking. The process of calculation or computation only involves the deployment of a set routine with no room for ingenuity or flair, no place for guess work or surprise, no chance for discovery, no need for the human being, in fact (Scheffler, 1975, p.184).

The concerns here are not that students should never learn to compute, but that students must learn how to critically analyze mathematical problems and produce effective solutions. This requires them to learn, how to make sense of complex mathematics concepts and how to think mathematically (Cobb et al., 1992). Many mathematics curricula overemphasize memorization of facts and underemphasize understanding and application of these facts to discover, make connections, and test mathematics concepts. Memorization must be raised to conceptualization, application and problem-solving for students to successfully apply what they learn. An impressive body of research suggests that curriculum that considers students to be incapable of metacognitive actions (e.g., complex reasoning) should be replaced with the one that sees students who are capable of higher-order thinking and reasoning when supported with necessary and relevant knowledge and activities (Schauble et al., 1995; Warren & Rosebery, 1996). Research has also revealed evidence that curricula in which students' knowledge and skills grow is significantly connected to their learning, and therefore their achievement (Brown and Campione, 1994; Lehrer and Chazan, 1998).

### 2.3.2.2.2. Instructional strategies and methods

Being successful in mathematics involves the ability to understanding one's current state of knowledge, build on it, improve it, and make changes or decisions in the face of conflicts. To do this requires problem solving, abstracting, inventing, and proving (Romberg, 1983). These are fundamental cognitive operations that students need to develop and use it in mathematics

classes. Therefore, instructional strategies and methods that provide students with learning situations where they can develop and apply higher-order operations are critical for mathematics achievement.

In the literature, it is pointed out that for students to accomplish learning, teachers should provide meaningful and authentic learning activities to enable students to construct their understanding and knowledge of this subject domain (Wilson, 1996). In addition, it is emphasized that instructional strategies where students actively participate in their own learning is critical for success (Bloom, B. 1976). Instructional strategies shape the progress of students' learning and accomplishment.

#### 2.3.2.2.3. Teacher competency in mathematics education

Many studies report that what teachers know and believe about mathematics is directly connected to their instructional choices and procedures (Brophy, 1990; Brown, 1985; National Council of Teachers of Mathematics, 1989; Wilson, 1990a, b), also reported that "in mathematics education research, it seems to be undisputed that the teacher's philosophy of mathematics has a significant influence on the structure of mathematics classes" (p. 24). Teachers need to have skills and knowledge to apply their philosophy of teaching and instructional decisions.

In the 21<sup>st</sup> century, one shifting paradigm in education is about teachers' roles and competencies. Findings from research on teacher competency point out that if teachers are to prepare an ever more diverse group of students for much more challenging work--for framing problems; finding, integrating and synthesizing information; creating new solutions; learning on their own; and working cooperatively--they will need substantially more knowledge and radically different skills than most now have and most schools of education now develop (Darling-Hammond, 1997, p. 154).

Teachers not only need knowledge of a particular subject matter but also need to have pedagogical knowledge and knowledge of their students (Bransford et al., 2000). Teacher competency in these areas is closely linked to student thinking, understanding and learning in math education. There is no doubt

that student achievement in math education requires teachers to have a firm understanding of the subject domain and the epistemology that guides math education (Ball, 1993; Grossman et al., 1989; Rosebery et al., 1992) as well as an equally meticulous understanding of different kinds of instructional activities that promote student achievement. Competent math teachers provide a roadmap to guide students to an organized understanding of mathematical concepts, to reflective learning, to critical thinking, and ultimately to mathematical achievement.

#### 2.3.2.2.4. School context and facilities

School context and its facilities could be an important factor in student achievement. In fact, identifying factors related to the school environment has become a research focus among educational practitioners. For instance, research suggests that student achievement is associated with a safe and orderly school climate (Reynolds et al., 1996). Researchers also found a negative impact on student achievement where deficiencies of school features or components such as temperature, lighting, and age exist. In a study by Harner (1974), temperatures above 23° C (74° F) adversely affected mathematics skills. In terms of the condition of school building, Cash (1993) found student achievement scores in standard buildings to be lower than the scores of students in above standard buildings. In addition, Rivera-Batiz and Marti (1995) conducted multiple regression statistical analysis to examine the relationship between overcrowded school buildings and student achievement. The findings indicated that a high population of students had a negative effect on student achievement.

#### 2.3.2.3. Individual factors

##### 2.3.2.3.1. Self-directed learning

Self-directed learning could be a factor in students' math achievement. Mathematics learning requires a deep understanding of mathematical concepts, the ability to make connections between them, and produce effective solutions to ill-structured domains. There is no perfect, well-structured, planned or prescribed system that lets students think and act mathematically. This can be done if, and only if, students play their assigned roles in their

learning progress. Self-directed learning has an important place in successful math learning. Self-directed students can take the initiative in their learning by diagnosing their needs, formulating goals, identifying resources for learning, and evaluating or monitoring learning outcomes (Knowles 1975). The teacher's role is to engage students by helping to organize and assist them as they take the initiative in their own self-directed explorations, instead of directing their learning autocratically (Strommen and Lincoln, 1992).

#### 2.3.2.3.2. Arithmetic ability

Arithmetic ability could also be another predictor of math achievement. Arithmetic ability includes the skills such as manipulating mathematical knowledge and concepts in ways that transform their meaning and implications. It allows students to interpret, analyze, synthesize, generalize, or hypothesize the facts and ideas of mathematics. Students with high arithmetic ability or mathematical reasoning can engage in tasks such as solving complex problems, discovering new meanings and understanding, and arriving at logical conclusions.

Arithmetic ability was determined by various studies as a critical factor on students' math achievement. For instance, in a study by Kaeley (1993), arithmetic ability gave the highest correlation coefficient with mathematics achievement. Similarly, student achievement scores were found to be most strongly predicted by level of ability (Schiefele and Csikszentmihalyi, 1995). Some other researchers have also investigated the relationship of gender issues and arithmetic ability on math achievement. For instance, Mills (1997) conducted a study to investigate longitudinal data gathered over 10 years with an aim at asking whether personality traits were related to gender differences in long-term achievement in mathematics and the sciences. The study revealed that math ability was the most significant predictor of long-term achievement in math for young women. However, the level of math ability did not seem to be a factor of long-term math achievement for young men.

### 2.3.2.3.3. Motivation or concentration

Mathematics education requires highly motivated students because it requires reasoning, making interpretations, and solving problems, mathematical issues, and concepts. The challenge of mathematics learning for today's education is that it requires disciplined study, concentration and motivation. To meet these challenges, learners must be focused and motivated to progress. Broussard and Garrison (2004) examined the relationship between classroom motivation and academic achievement in elementary-school-aged children (122-first grade and 129-third grade participants). Consistent with previous studies, they found that for a higher level of mastery, motivation was related to higher math grades.

The teacher's role in students' motivation to learn should not be underestimated. In helping students become motivated learners and producers of mathematical knowledge successfully, the teacher's main instructional task is to create a learning environment where students can engage in mathematical thinking activities and see mathematics as something requiring "exploration, conjecture, representation, generalization, verification, and reflection" (Carr, 1996, p.58).

### 2.2.3. The Effect of Cooperative Learning on Mathematics

#### Achievement

Cooperation is working together to accomplish shared goals (Johnson & Johnson, 1989). Within cooperative activities individuals seek outcomes that are beneficial to themselves and beneficial to all other group members. Cooperative learning is the instructional use of small groups so that students work together to maximize their own and each other's learning (Johnson, Johnson, & Holubec, 1993). Within cooperative learning groups students are given two responsibilities: To learn the assigned material and make sure that all other members of their group do likewise. In cooperative learning situations, students perceive that they can reach their learning goals only if the other students in the learning group also do so. The values inherent in cooperative efforts are:

1. Commitment to the common good. In cooperative situations, individuals work contributes not only to their own well-being, but also to the well being of all other collaborators. There is a built-in concern for the common good and the success of others, as the efforts of others also contribute to one's own wellbeing.
2. Success depends on the joint efforts of everyone to achieve mutual goals. Since cooperators "sink or swim together," an "all for one and one for all" mentality is appropriate. What is valued is teamwork and civic responsibility. Succeeding depends on everyone doing his or her part. Cooperation teaches the value of working together to achieve mutual goals.
3. Facilitating, promoting, and encouraging the success of others is a natural way of life. Succeeding depends on everyone doing well. There are two ways to succeed contributing all one can to the joint effort and promoting other cooperators' efforts to contribute. A smart cooperator will always find ways to promote, facilitate, and encourage the efforts of others.
4. The pleasure of succeeding is associated with others' happiness in their success. Cooperators feel great about succeeding and they automatically feel great about other people succeeding. When someone succeeds, it is a source of pleasure and happiness because it means that one's help and assistance has paid off.
5. Other people are potential contributors to one's success. Because smart cooperators will promote and facilitate the work of others, cooperators are to be trusted because their efforts to succeed will promote one's own success. Cooperation casts schoolmates as allies, colleagues, and friends who will contribute to one's success.
6. Other people's worth is unconditional. Because there are so many diverse ways that a person may contribute to a joint effort, everyone has value all the time. This inherent value is reaffirmed by working for the success of all. Cooperation places value on a wide range of diverse qualities that facilitate joint success. Thus, everyone has value.

7. Self-worth is unconditional. Cooperation teaches that self-worth results from contributing whatever resources one has to the joint effort and common good. A person never loses value. Cooperative experiences result in individuals believing in themselves and their worth.
8. Cooperators value intrinsic motivation based on striving to learn, grow, develop, and succeed. Learning is the goal, not winning. The inducement of trying to contribute to the common good, like other intrinsic motivators, increases students' interest in the task itself.
9. People who are different from oneself are to be valued. Other people are perceived to be potential resources for and contributors to one's success. If they are different that means more diverse resources are available for the joint effort and, therefore, the difference is valued. The diverse contributions of members results in the realization that, in the long run, everyone is of equal value and equally deserving, regardless of their gender, ethnic membership, culture, social class, or ability.

Working together to achieve a common goal produces higher achievement and greater productivity than does working alone. This is so well confirmed by so much research that it stands as one of the strongest principles of social and organizational psychology. Cooperative learning, furthermore, resulted in more higher-level reasoning, more frequent generation of new ideas and solutions (i.e., process gain), and greater transfer of what is learned within one situation to another (i.e., group to individual transfer) than did competitive or individualistic learning. The more conceptual the task, the more problem solving required, the more desirable higher-level reasoning and critical thinking, the more creativity required, and the greater the application required of what is being learned to the real world, the greater the superiority of cooperative over competitive and individualistic efforts.

## 2.3. Attitude in Mathematics

### 2.3.4. Definition of Attitude

Most people have heard the age-old saying, “attitude is the key to success”. Various quotes can be retrieved that subscribe to this philosophy. In education, research suggests that student attitudes toward a subject lead to academic success (Popham, 2005; Royster, Harris, & Schoeps, 1999). Generally speaking, mathematics is a subject that is often disliked, begging researchers to investigate how mathematics attitude affects mathematics learning.

Furthermore, I wanted to know how much students enjoyed math class and how hard they were willing to work to learn math concepts. The students in this class had very positive attitudes regarding math. Most students liked math and saw mathematics as more than the memorization of facts and rules. Students were willing to share and discuss their solutions with their classmates, but there was conflicting evidence of their willingness to persevere through challenging problems. While it was not the original intent of my inquiry, I was surprised to find that gender differences existed in most areas of attitude toward mathematics.

A student’s attitude toward mathematics may be formed from a number of sources. One powerful influence on student attitudes is the classroom teacher. In a study of fourth, seventh, and ninth graders from both rural and urban schools, Haladyna, Shaughnessy, and Shaughnessy (1996) identified a strong relationship between teacher quality (enthusiasm, respect, willingness to help, fairness, etc.) and positive attitudes toward mathematics.

Student attitudes were also found to be shaped by a student’s level of success. In a study of college-aged men and women, Ross and Broah (2000) investigated factors that influence achievement. Specifically, they looked at self-esteem and personal control (attribution of success and failure). The more success a student had in mathematics, the more positive their attitude toward it (Stodolsky, Salk, and Glaessner, 1991).

### 2.3.2. Factor affecting the attitude of Mathematics

The complexity of factors that can influence mathematics performance is demonstrated by Singh, Granville, and Dika when they show that high achievement in mathematics is a function of many interrelated variables related to students, families, and schools. Among student variables, attitudes are regarded by several researchers, as an important/key factor to be taken into account when attempting to understand and explain variability in student performance in mathematics.

Mobilizing a set of different definitions concerning attitudes presented since 1935, Eshun defines an attitude towards mathematics as “a disposition towards an aspect of mathematics that has been acquired by an individual through his or her beliefs and experiences but which could be changed.” When emphasizing the importance of individual experiences, the contexts where students interact with others and with mathematics become important focal points. Fraser and Kahle have also highlighted this aspect in research which shows that learning environments at home, at school, and within the peer group accounted for a significant amount of variance in student attitudes and, furthermore, that class ethos had a significant impact on the scores achieved by students for these attitudes.

In addition, Mohamed and Waheed when reviewing literature aimed at understanding attitudes and the influences on their development in relation to differences between students, identified three groups of factors that play a vital role in influencing student attitudes: factors associated with the students themselves (e.g., mathematical achievement, anxiety, self-efficacy and self-concept, motivation, and experiences at school); factors associated with the school, teacher, and teaching (e.g., teaching materials, classroom management, teacher knowledge, attitudes towards mathematics, guidance, beliefs); finally factors from the home environment and society (e.g., educational background, parental expectations).

Attitudes can be seen as more or less positive. A positive attitude towards mathematics reflects a positive emotional disposition in relation to the subject and, in a similar way, a negative attitude towards mathematics relates to a negative emotional disposition. These emotional dispositions have an impact on an individual's behavior, as one is likely to achieve better in a subject that one enjoys, has confidence in or finds useful. For this reason positive attitudes towards mathematics are desirable since they may influence one's willingness to learn and also the benefits one can derive from mathematics instruction.

#### 2.3.2.1. Attitudes and School Grades

Nicolaidou and Philippou showed that negative attitudes are the result of frequent and repeated failures or problems when dealing with mathematical tasks and these negative attitudes may become relatively permanent. According to these authors when children first go to school they usually have positive attitudes towards mathematics. However, as they progress their attitudes become less positive and frequently become negative at high school. Köğçe et al. found significant differences between younger and older students' attitudes towards mathematics with 8<sup>th</sup> graders having lower attitudes than 6<sup>th</sup> graders. There are a number of factors which can explain why attitudes towards mathematics become more negative with the school grade, such as the pressure to perform well, over demanding tasks, uninteresting lessons and less than positive attitudes on the part of teachers.

#### 2.3.2.2. Gender and Attitudes towards Mathematics

Gender differences are a recurrent theme throughout the literature in academic studies in general and in math studies in particular. Math is often considered to be a domain in which boys are higher achievers, both in terms of attitudes and self-concept. Contrary to this, findings show that math school achievement and grades do not differ significantly between boys and girls. This similarity in performance between males and females is clear in the meta-analysis conducted by Lindberg et al. With data from 242 studies representing

1.286.350 people, indicating no gender differences and nearly equal male and female variances.

There are, however, noticeable differences in the beliefs held by boys and girls. Research has consistently shown that girls have lower mathematics self-concept than boys. Results concerning gender differences in attitudes are less consistent than those in self-concept. Some studies have reported significant differences when we compare girls and boys attitudes towards mathematics, nevertheless there are a number of studies where these differences are not identified. A meta-analysis conducted by Etsey and Snetzler taking into consideration 96 studies concluded that gender differences in student attitudes toward mathematics do exist but are small. The results indicate that males show more positive attitude. Also Hyde et al. In their meta-analysis confirm small gender effects, which increase among older students (high school and college), with females holding more negative attitudes. Although these meta-analyses were developed in the 1990s, there is recent research which confirms these results and attempts to provide a justification for it. Asante states that, when compared with boys, “girls lacked confidence, had debilitating causal attribution patterns, perceived mathematics as a male domain, and were anxious about mathematics”. The research carried out by this author in Ghana, showed that boys had more positive attitudes towards mathematics than girls. Also Sanchez et al. In a study with North American students found significant gender differences in eighth grade students’ attitudes towards mathematics. American boys showed more interest in mathematics than girls, but girls perceived mathematics as more important than boys. Girls also presented higher scores on items with regard to difficulties with mathematics. According to Asante’s school environment, developmental changes in gender identity, and teacher and parent attitudes and beliefs towards mathematics are factors that may contribute to the differences identified between boys and girls in their attitudes towards mathematics.

Nonetheless there is research which concludes that gender does not affect attitudes towards mathematics. The meta-analysis conducted by Ma and Kishor which looks at 113 studies, when studying the effects of gender,

concludes that this variable did not have a significant effect on the relationships between attitudes and performance in mathematics because separate analysis by gender demonstrated similar significant effect sizes. Georgiou et al. showed that there was no difference either in mathematics achievement or in mathematics attitudes between boys and girls. However, high achieving boys and girls, despite both considering mathematics as an attractive subject, differed in the explanations they gave for their performance. Since the ability attributions of boys were higher, they believed that their grades were due to their intelligence more consistently than girls did.

### 2.3.2.3. Achievement in Mathematics and Attitudes

Several studies have been undertaken to try to reach an understanding of the relationship between student attitudes towards mathematics and academic achievement. In Ma and Kishor meta-analysis only weak correlations between these variables were identified and these relationships were dependent on several variables (e.g., grade, sample size, ethnic background). With regard to grade, these associations become stronger among older students (7<sup>th</sup> to 12<sup>th</sup> grade).

However, more recent studies point to a positive correlation between student attitudes towards mathematics and student academic achievement. Along these lines are the results obtained by Nicolaidou and Philippou which reveal significant correlations between attitudes and performance. Students having positive attitudes achieved better. Mato and De La Torre in a study with secondary school students also showed that those with better academic performance have more positive attitudes regarding mathematics than those with poorer academic performance. These results were confirmed in wider research, concerning mathematics study attitudes among the secondary school students of nine countries, developed by Sanchez et al.

Lipnevich et al. in a study developed with USA and Bielo Russian middle school students highlighted the importance of attitudes in predicting academic achievement, when it showed that mathematics attitudes explained a variance

of 25% to 32% in mathematics achievement, with much of the explained variance independent of ability in mathematics.

Nevertheless, Georgiou et al. showed that high achievement could serve to predict a positive attitude towards mathematics, but such an attitude could not predict stronger achievement. However, these authors emphasize the role of teachers and schools in changing attitudes stating that, math achievement could be improved by, for example, better teaching methods, more motivated teachers or better course books, which has as its corollary the improvement of attitudes towards mathematics.

#### 2.3.2.4. Mathematics Learning Environments and Attitudes

Akey's work showed that several aspects of school context (e.g., teacher support, student-to-student interaction, and the academic and behavior expectations of the teacher) were significantly related to student attitudes and behaviors. Akey concluded that the class environment where teachers who students see as supportive promote student feelings of control and confidence in their ability to succeed. The way students perceive teacher characteristics will affect their attitudes towards mathematics. Maat and Zakaria and Vaughan identified a significant relationship between learning environment and attitude towards mathematics. Students with a higher perception of the learning environment and a more positive perception of their teachers have more positive attitudes towards mathematics. Rawnsley and Fisher also found that students had more positive attitudes toward mathematics when their teacher was perceived to be highly supportive.

#### 2.3.2.5. Motivation and Attitudes

A number of authors have shown that the relationship between aspects of the social environment and student emotional aspects may be mediated by other variables such as control-related appraisals and values-related appraisals. Therefore, competence support, autonomy support, expectations, and feedback that students receive from others have an impact on their cognitive appraisals

and these are the main sources of their emotional dispositions. When studying attitudes, it is important to take into consideration the role of these mediated variables where we can include the motivation features of each student. In this sense, Wigfield, in reading specific domain, maintains that attitudes, realized as the individual's feelings towards reading, could be related to the motivation of the individual concerned because they influence how much individuals involve themselves in reading activities. Attitudes are affective responses that accompany a behavior initiated by a motivational state. Attitudes can therefore be linked directly to motivation and provide key information to a better understanding of attitudinal and motivational processes. In the domain of mathematics there is little research that studies the relationships between motivation and attitudes. However, a number of studies have highlighted some specific associations. Singh et al. used two sets of items to tap motivation, one related to attendance of school and classes and another to participation and preparedness for mathematic classes. The authors concluded that mathematics attitude was affected by motivational factors. Students who displayed school behavior associated with low motivation (e.g., coming late to school, skip classes, coming unprepared without books and homework) had a more negative attitude toward mathematics. Other authors have taken into consideration Effort as an indicator of motivation. Reynolds and Walberg using structural equation modeling to analyze diverse factors effects on mathematics performance and attitudes with 11<sup>th</sup> grade students, identify a significant effect on motivation in mathematics attitudes. Hemmings and Kay in a study with 10<sup>th</sup> grade students also verified that Effort was positively and significantly related to math attitudes.

### 2.3.3. The effect of cooperative learning on mathematics attitude.

The use of cooperative learning groups and whether working in groups changed students' individual achievement and students' attitudes toward mathematics. In the public school setting, many classrooms have students with a wide range of abilities, but all are working toward the same goal. Students learn and understand mathematical concepts in a variety of different ways. Teachers

have the sometimes-difficult task of trying to identify which strategy works best for each individual student. I believe that in many instances, students can learn better from other students. Working cooperatively is an important life skill that students can use outside the classroom to help work effectively with others to solve any problem or task. This issue of group learning follows closely with the National Council of Teachers of Mathematics' (NCTM) process standard of communication. Students can communicate ideas with their peers about ways to solve particular problems. A student who understands a concept can share his or her ideas and strategies with other students. Sometimes it may be a situation where students are brainstorming ideas with one another until a decision is reached as to which may be the best method or approach. This work also would follow the NCTM's principle of equity. There would be high expectations for students to be able to work cooperatively and support one another as they work together. I would love to create an ideal classroom where all of my students felt comfortable sharing their ideas and strategies with one another. The interaction within cooperative groups helps students feel confident in their own abilities. The cooperative communication between students also can be very beneficial in other curriculum areas where the discussion of ideas is prevalent. Teachers are trying to prepare students for what happens after schooling is done. A person who can work with others cooperatively and willingly share his or her ideas can be a productive member of today's society. During the past several years, many studies have been done focusing on topics similar to the early days of teaching and using cooperative learning. According to Oxford American Dictionary, cooperative learning can be defined as a small group of students who are working together on a common learning task. Each student plays an important role of helping one another achieve this common goal. Cooperative learning begins with the formation of groups into teams of students.

Attitude is defined as a way of thinking or feeling about something. When working with students, their attitude can play an important role in the learning process. If a student feels that he or she can do well and be successful, then he or she usually is successful. However, if a student feels that he or she cannot

do the required work, then he or she may not be willing to put forth the effort needed to be successful. Cooperative learning can be a useful tool to help develop a positive attitude toward learning. In the study by Bernero (2000), those students who struggled with math continued to struggle and became frustrated with individual work, but improved both academically and in self-confidence (thus leading to social improvement), when it came to group work. Students working cooperatively often enjoy the experience and believe that their classmates like them. This belief that they are accepted by others also allows the students to believe that they are more successful academically.

## CHAPTER THREE

### 3. RESEARCH DESIGN AND METHODOLOGY

A research methodology is usually a guideline or a system for solving a research problem. The main objectives of this chapter was describes the method. It includes research design, population and design, sample techniques, instrument of the data collection, method of data collection, method of data analysis, validity and reliability.

#### 3.1. Research design

The research design is a quazi-experimental design and the purpose of this study was to examine the effects of using cooperative learning on mathematics attitude and achievement of secondary school students in algebra. This study is based on both experimental and descriptive research methods concerning the contribution of cooperative learning and other variables on mathematics achievement in Dejazmach Balcha Abanefso Secondary and preparatory school. There are three Governmental secondary school found in Lideta Sub-city. Dejazmach Balcha Abanefso Seondary and preparatory School, which is the oldest and containing the greatest sections of grade 10<sup>th</sup> than the other two secondary schools. This school had 12 sections of 10<sup>th</sup> grade in 2007 E.C. academic year.

First in the beginning of academic year, the academic vice director of the school announce me to teach three class of 10<sup>th</sup> grade. Then of the three class two class of the students have almost equal base in mathematics feedback. From the two class the majority of the student in a class (n=40) is as experimental group and the other class (n=35) was the comparison group. Therefore, the total number of the subjects of the study was 75 students of 10<sup>th</sup> grade. Pre-test and post-test were administered in algebra achievement. So, in order to see the significance differences between pre-test and post-test and to achieve the intended objective; the researcher selected quantitative methods since the goal

of quantitative methods is to determine whether the predictive generalization of a theory hold true.

### 3.2. Source of data

The purpose of this study was to examine the effects of using cooperative learning on mathematics attitude and achievement of secondary school students in algebra. Therefore, the target population for this particular research is Dejazmach Balcha Abanefso secondary and preparatory school of Lideta Sub-city. From this school the study was conducted on grade ten students. The researchers select two intact classes.

### 3.3. Sampling procedures

A formal letter from AAU department of mathematics education and permission was obtained from Dejazmach Balcha Abanefso Secondary and preparatory school of Lideta Sub-city.

The research use purposive sampling because it is the most basic among the sampling techniques involves assembling a sample in such a way that each independent sample size subset with in a population is given an equal chance of becoming a subject. In spite of its advantage, researchers limit the use of purposive sampling, especially when it comes to population based surveys because which allow to give equal chance to select the number of sample in all of the targeted population. It is an idea of statistical application it gives each of the targeted population has an equal chance of being chosen. Other sampling methods require much in-depth and advance knowledge of a population prior to the selection of the subjects. In purposive sampling, only the complete listing of the elements in a population (known as the sampling frame) is needed. A purposive sample, being highly representative of the population, also simplifies data interpretation and analysis of results.

The aim of this study was to investigate the relative effectiveness of using cooperative learning on mathematics attitude and achievement of secondary school students in algebra. Students were selected according to criteria sated.

### 3.4. Data collection instruments

In order to equate the comparison and the experiment groups, a teacher/researcher made pretest were administered before the allocation of students to the experimental and the comparison groups. Immediately after the treatment was over, a teacher/researcher made posttest was administered to subjects of both the experimental and the comparison groups. The purpose of this test was to measure the attitude and achievement of the students constituting the sample. These both tests, the pretest and the posttest were constructing by the researcher.

The main instrument used to collect for this study will be:

3.4.1. Questioners

3.4.2. Test

#### 3.4.1. Questioners

The main data gathering instrument were Questioners. The reason why questionnaire is to secure relevant information on opinions and attitudes in a structured framework from respondents. The questionnaire was developed to gather information about the students' cooperative learning in mathematics attitude in algebra. Then it was pilot tested with 40 samples of students before the actual data collection began. The rating of the pilot attitudes scale toward cooperative learning had the Crombach Alpha 0.63.

Finally the questionnaire for the main study contained a total of 24 questions were 6 of the questionnaire were confidence, 6 of the questionnaire were anxiety, 6 of the questionnaire were usefulness and 6 of the questionnaire were engagement of the students towards mathematics. Then 24 questionnaires on attitudes toward cooperative asked the subjects of the study about their belief and affective reactions to mathematics in algebra.

### 3.4.2. Test

The other instrument used to gather data is a test. First of all table of specification was prepared and objectives were formulated after a thought analysis of the mathematics content covered in the first semester of 10<sup>th</sup> mathematics classes. Accordingly, pretest (Appendix) items were constructed to determine the subjects of the study as indicated above. The test were administered to 40 pilot samples students and indices of item difficulty and discrimination as well as the relative worth of each destructors were analyzed on the upper 25% and lower 25% scores. As cited Assefa Enno, 2004 (Ebel, 1979; Mehrens and Lehmann, 1984).

The post test was constructed from the new contents taught to the subject of the study for both groups. Contain validity an important quality that achievement tests should posses, was taken care of by making use of tables of specification, and the test were administered to pilot samples and item analysis was also carried out in the same way as pre-test. Finally, the pretest and post tests for the main study contained 20 items each and the pretest and the post test scores of the students from the experimental had reliability Crombach Alpha 0.71 and 0.632 respectively.

### 3.5. Validity and Reliability

Validity concerns the assessment procedures used in psychological and educational testing. Validity refers to the degree to which evidence and theory support the interpretations of the scores entailed by proposed uses of test. Validity is generally considered the most important issue in psychological and educational testing because it concerns the meaning placed on results. The data were collected using standardized questionnaire from the students. The questionnaire were distributed and collected by the researcher himself from all the respondents on the given period of time. Reliability analysis allows you to study the properties of measurement scale and the items that make them up. The reliability analysis procedure calculates a number of commonly used measures of scale reliability and also provides information about the relationships between the students and cooperative methods of learning.

The researcher during collecting the questionnaire, tried to mention this research useful for only the academic master thesis purpose and feel free during the questionnaire was filled. In addition to this, make sure that it was the respondent who had completed the whole question properly. To assure the reliability of instrument, the most commonly used methods for consistency analysis for likert type questionnaire was used.

Table 1 Reliability statistics of questionnaire

Total respondent	N	%	Cronbach's Alpha	No of Items
valid	40	100	.63	24

As we shown the above table, the reliability statistics of final output of valid cooperative learning items measured by the Cranbach's alpha is 0.63, this figure is very near to one point and indicated that the measurement scale of questionnaires in the overall cooperative was standardized, strong and reliable.

### 3.6. Data collection procedure

As expressed earlier, the subject of the study were 75 10<sup>th</sup> grade students, who were enrolled in Dejazmach Balcha Abanefso Secondary and Preparatory school in 2007 E.C. the selected students or section were assigned as experimental group (cooperative learning applied) and the comparison group (without cooperative learning). Both sections of the group were taught for 6 weeks (all school days except holiday). The experimental group students were given practice and extension assignment related to their respective mathematics contents on Monday through Thursday during 6 weeks of teaching sessions and they facilitate and encourage independent learning. In assigning homework to students, the guide line which could be completed approximately within 20 minutes.

The students were monitored for doing for their different activities and were provide feedback by the teachers in the experimental group.

Finally, both sections ( the experimental and the comparison groups) were administered their respective mathematics post-test which had been prepared from the contents covered during the process of teaching with cooperative learning for the experimental group and without cooperative learning for the comparison group during 6weeks sessions. The subjects of the study were also given a questionnaire to gather information about the effect of using cooperative learning on mathematics attitude and achievement in algebra.

### 3.7. Data analysis

Raw scores obtained from pretest and posttest was presented in tabular form for the purpose of interpretation. For the manipulation of data, the means, standard deviation and difference of means were being computed for each group. The data was entered into EPI-INFO version exported to SPSS then the data were cleaned and analyzed by using Statistical Package for Social Science (SPSS) version. Significance of difference between the mean score of both the experimental and the comparison group on the variables of the pretest scores and posttest scores was tested at 0.05 levels by applying t-test.

### 3.8. Ethical consideration

Ethical clearance was secured from the AAU College of education, department of Mathematics. A respondent was informed about the purpose of the study then information was collected after obtaining verbal consent from each participant. Verbal consent will be sought from all the informed respondents before the start of each questioner. A respondent was allowed to refuse or discontinue participation at any time they went.

## CHAPTER FOUR

### 4.1. PRESENTATION OF DATA ANALYSIS AND INTERPRETATION

The results of the main study are presented in the following sequences: the effect of using cooperative learning on mathematics attitude and achievement in algebra in secondary school.

Analysis of data is a process of inspecting, cleaning, transforming and modeling data with the goal of useful information, suggesting conclusions and supporting decision making. Data analysis has multiple facts and approaches, encompassing diverse techniques under different organizations. The main purpose of this study was to present the data gathered from secondary school of students. The specific purpose of the research was to answer the following research problems:

1. Is there a significant difference between the pre-test achievement score of students in algebra of the traditional and cooperative learning groups?
2. Is there a significant difference between the post-test achievement scores of the students in algebra of the traditional and cooperative learning groups?
3. Is there a significant difference between the mean gain scores of the achievement of the students in algebra of the traditional and cooperative learning groups?
4. Is there a significant difference between the pretest and posttest of the mean score of the attitude of students in learning algebra using cooperative learning?
5. Is there a significant gender difference between the mean scores of the attitude and achievement of students in algebra of the traditional and cooperative learning groups?

The following result of the data analysis and interpretations was reported as follows. The data presentation in the analysis of the descriptive statistics on the variable under condition. The researcher used the statistical procedure for social science (SPSS) version 19 for analyzing and calculating all the research data. The result of the descriptive frequency and descriptive analysis independent sample t-test, ANOVA are included here in this chapter.

The result of the main study is presented in the following sequence: the attitude and achievement of experimental group and control group of students in Algebra on mathematics test, and their attitudes toward mathematics learning.

## 4.2. Descriptive statistics

Descriptive statistics is the discipline of quantitatively describing the main feature of the collection of data or descriptive statistics aims to summarize a sample, rather than use data to learn about the population. The main purpose of the descriptive statistics was to show the mean and standard deviation of the respondent what they feel about providing teaching and learning on the cooperative learning in secondary school. The overall 75 target population responded was calculated in the following table.

### 4.3. Demography of the respondent.

Table 2. Frequency distribution of the respondent by sex.

Group	Gender	Frequency	percent
Experimental	Female	18	45.0
	Male	22	55.0
	Total	40	100.0
Comparison	Female	16	45.7
	Male	19	54.3
	Total	35	100.0

The above table indicated that the gender of the respondent from the total targeted population of the research was conducted. As we can see from the above table, in both group the majority of the sample was male. From the experimental group (n=22) of which 55.0% were male the remaining (n=18) or 45.0% were female respondents. Additionally, in the comparison group of

(n=19) or 54.3% were male and the remaining (n=16) or 45.7% were female respondents.

#### 4.4. Effect of Cooperative Learning on Mathematics Achievement

The findings of the study appear to support the view of the advocates of cooperative learning on mathematics achievement of secondary school students in algebra.

The research questions handled in this section dealt with the significant difference between the pre-test achievement score of students in algebra of the traditional and cooperative learning (research question 1), the significant difference between the post-test achievement score of students in algebra of the traditional and cooperative learning (research question 2), difference in mathematics achievement between the experimental and the comparison group and a significant difference between the mean gain scores of the achievement of students in algebra of traditional and cooperative learning group (research question 3).

A research was conducted to examine the effect of cooperative learning on attitudes and academic achievement of secondary school students in Mathematics especially on Algebra. Two classes of a total of 75 students of 10<sup>th</sup> class of Governmental High School were divided into two groups having equal base in the subject of Mathematics. This division was made on the basis of teacher made pre-test. Some lesson plans and worksheets were used along with direct teaching strategy for both the groups. One of the groups were provided with cooperative learning methods as treatment and other group was kept under comparison condition by providing traditional competitive learning situation. After provision of instruction and practice on 18 lesson plans and worksheet covering four chapters, the academic achievement of the comparison group and the experimental group was examined through a teacher made post test. A gap of five weeks was given to both the groups after first evaluation and they continued working on the next chapters. After this gap same posttest was

administered to test the retention of the students of both groups. Obtained results are presented in the following pages.

Table 3: significant difference between the pre-test achievement score of students in algebra of the traditional and cooperative learning groups

Variable	Group	M	N	SD	SE	df	t	P
Pre-test achievement	Experimental	17.0857	35	6.31115	1.06678	34	.493	.625
	Comparison	16.9286	35	6.50468	1.09949			

As we can see from table 3, the descriptive statistics showed that the overall mean score of the respondents in experimental group was 17.0857(SD=6.3) and for the comparison group the mean score was 16.93(SD=6.5). Therefore the overall mean score of the experimental group in the pre-test was greater than the control group. Referring to the independent sample t-test table again as we can see the result of t-test from the table, the t-value is .625 which is greater than .05, therefore there is no statically significant difference between the experimental and the comparison group in the pre-test.

Table 4: a significant difference between the post-test achievement scores of the students in algebra of the traditional and cooperative learning groups

Variable	Group	M	N	SD	SE	df	t	p
Post-test achievement	Comparison	51.1143	35	22.97284	3.88312	34	5.605	.00
	Experimental	61.8000	35	20.13163	3.40287			

The above table shows the t-test on experimental and comparison group on the post-test. Then the mean score of experimental group was 61.8 with (SD=20.13) and for comparison group the mean score was 51.11(SD=22.97). Therefore the mean score of experimental group exceed than the comparison group and it indicates that the experimental group was helpful for the students teaching cooperative learning than traditional teaching. And also as we have seen again from the above table 4, the p-value is .00 which is less than .05 therefore there is statistically significant difference in the experimental and the control groups.

Sherman and Thomas (1966) conducted research to compare the effectiveness of cooperative learning and individualistic instruction in high school classroom. At posttest, the cooperatively goal-structured class demonstrated significantly higher achievement than the individualistic group. Whicker et al. (1997) investigated the effects of cooperative learning on students' achievement and attitude in a secondary mathematics classroom. Students in the cooperative learning group had significantly higher test scores than the students in the comparison group.

Table 5: A significant difference between the mean gain scores of the achievement of the students in algebra of the traditional and cooperative learning groups

Variable	Group	M	N	SD	SE	t	df	p
Mean deviation achievement	Comparison	34.1857	35	17.52019	2.96145	-5.649	34	.000
	Experimental	44.7714	35	14.66355	2.47859			

From the above table 5, the descriptive statistics showed that the mean deviation achievement test score of the comparison group from the post-test to pre-test read as 34.1857 and the SD is 17.52019 whereas the mean deviation achievement test score of the experimental group from the post-test to pre-test is 44.7714 and the SD is 14.66355, from these we can say that the mean deviation achievement test score of the experimental group is greater than that of the comparison group. Additionally as we have seen from the above table the sample t-test the p-value read as  $.000 < .05$  then there is statistically significant difference in the groups.

#### 4.5. Effect of Cooperative Learning on Mathematics Attitude

The research question guiding the analyses of this section was the difference in attitude towards cooperative and traditional way of teaching in secondary school. The number of observations, the mean and the standard deviations are presented in the following table.

Table 6: A significant difference between the pretest and posttest of the mean score of the attitude of students in learning algebra using cooperative learning

Variable	Type	N	M	SD	t	df	p
Attitude	Pre-attitude	40	3.5141	.39010	-2.670	39	.011
	Post-attitude	40	3.7272	.35400			
Confidence	Pre-confidence	40	3.1792	.60198	-1.062	39	.295
	Post-confidence	40	3.3036	.42327			
Anxiety	Pre-anxiety	40	3.5375	.70760	-1.09	39	.301
	Post-anxiety	40	3.7208	.80010			
Usefulness	Pre-usefulness	40	3.9708	.70498	-2.078	39	.044
	Post-usefulness	40	4.2542	.52568			
Engagement	Pre-engagement	40	3.3708	.49136	-2.365	39	.023
	Post-engagement	40	3.6292	.49998			

As the above tables 6 indicate that the mean attitude of the respondents in the experimental group on pre-test and post test are 3.5141 and 3.7272 respectively and their SD read also .39010 and .35400 respectively but the independent sample t-test indicated that there is statistically significant difference between the pre-test and the post test of the group ( $t = -2.670$ ,  $df = 39$ ,  $p = 0.01 < 0.05$ ). The confidence of the students toward cooperative learning on the post test and pre-test respectively was 3.3036 and 3.1792 with the SD is 0.42327 where as that of the pretest was 3.1792 with the SD of 0.6018. This indicates that the confidence of the responses was higher in the posttest than that of the pretest, but the independent sample t-test indicated that students

have similar confidence on cooperative learning towards algebra was ( $t = -1.062$ ,  $df = 39$  and  $p > 0.05$ ). And again the table indicates that the mean rating of the student's toward anxiety of the respondent on the pretest was 3.5375 and that of the posttest was 3.7208 showing that the posttest on anxiety of the student's toward cooperative learning on algebra was somewhat greater than that of the pretest towards the attitude of cooperative learning on algebra.

Again from table 6 it shows that the means of the rating of the usefulness of the respondent on posttest and pretest on cooperative learning. Then the result shows that the mean on the posttest was 4.2542 where as the mean on the pretest was 3.9708, this indicates that attitudes towards cooperative learning were useful for the students than that of attitude towards the traditional learning.

The above table 6 indicates that the mean of the respondents toward the of engagement of cooperative learning on the posttest was 3.6292 where as the of the students towards the engagement of cooperative learning on pretest was 3.3708.

#### 4.6. Gender difference on the effect of cooperative learning of Mathematics attitude and Achievement

Table 7: A significant gender difference between the mean scores of the achievement of students in algebra of the traditional and cooperative learning groups

Variable	Group	Gender	N	M	SD	t	df	p
Achievement (Mean deviation)	Control	Female	16	32.7188	14.32535	-.484	33	.631
		Male	19	35.1184	14.82054			
	Experimental	Female	18	37.2500	12.74668	-.119	38	.906
		Male	22	37.7500	13.53809			

From table 7 the descriptive statistics showed that the mean deviation of the female achievement on the control group was 32.7188 with SD 14.32535. Whereas the mean deviation of the male on the posttest to pretest in the control group was 35.1184 with the SD 14.82054. Additionally (because of  $t = -.484$ ,  $df=33$ ,  $p$  value  $0.631 > 0.05$ ) the independent sample t-test indicated that there is no statistically significant difference between the female and the male group on the control group.

The mean deviation of the female responses of the experimental group from the post test to pretest was 37.2500 with the SD 12.74668 whereas the mean deviation of the male responses of the experimental group from the posttest to pretest was 37.7500 with SD 13.53809. Table 7, as independent sample t-test indicated, t-value was greater than 0.05 then there is no statistically significant difference in the group between the male and the female group in the experimental group ( $t = -.119$ ,  $df = 38$ ,  $p = .906 > 0.05$ ).

Table 8: A significant difference between the mean scores of male control group with male experimental group achievement of male students in algebra of the traditional and cooperative learning groups

Variable	Group	N	M	SD	t	df	p
Male Achievement	Control	19	36.0790	15.81606	-.096	39	.064
	Experimental	22	43.6363	13.09667			
Female Achievement	Control	16	44.2778	31.93750	-.470	32	.226
	Experimental	18	43.6363	44.2778			

From table 8, the descriptive statistics showed that the mean achievement scores of male control group was 36.08 with SD 15.81 whereas the mean achievement scores of male experimental group was 43.63 with SD 13.097. Then the mean achievement score of male responses on the experimental group

was similar to that of the men achievement of the male responses on the control group, that is ( $t=0.096$ ,  $df= 39$ ,  $p=0.064 > 0.05$ ). Again From table 8 also the mean achievement scores of the female students in the control group was 44.3 with SD 31.94 whereas the mean achievement scores of female students on the experimental group was 43.64 with SD 44.28. From these, the mean achievement of female students on the control group was similar to that of the mean achievement scores of the female students on the experimental group that is ( $t= 0.470$ ,  $df =32$ ,  $p =0.226 > 0.05$ ).

Table 9: A significant gender difference between the mean scores of the attitude and achievement of students in algebra of the traditional and cooperative learning groups

Variable	sex	N	M	SD	t	df	p
Attitude	Male	22	3.625	.2892	.72	38	.943
	Female	18	3.6186	.26342			
Confidence	Male	22	3.2291	.31837	-.237	38	.814
	Female	18	3.2599	.42439			
Anxiety	Male	22	3.6886	.50017	.813	38	.421
	Female	18	3.5550	.53797			
Usefulness	Male	22	4.0607	.53474	-.413	38	.682
	Female	18	4.1197	.31268			
Engagement	Male	22	3.5157	.39218	.297	38	.768
	Female	18	3.4817	.31637			

From table 9 the significant between the mean attitudes of the students on the confidence of male students was 3.2291 with SD .31837 and that of the female students was 3.2599 with SD .42439. As independent sample t-test indicated from the above table ( $t = -.237$ ,  $df = 38$ ,  $p = .814 > 0.05$ ) the confidence of the students was not statistically significant between male and female in the case of confidence in the pretest and posttest. Also the mean

attitude of the students on an anxiety of male students was 3.6886 with SD .50017 and that of the female students was 3.5550 with SD .53797. Independent sample t-test indicated from the above table ( $t = .813$ ,  $df = 38$ ,  $p = .421 > 0.05$ ) then the anxiety of the students was not statistically significant between male and female in the case of anxiety in the pretest and posttest. The mean attitude of the students on the usefulness attitudes toward cooperative learning on algebra of male students was 4.0607 with SD .53474 and that of the female students was 4.1197 with SD .31268. As independent sample t-test indicated from the above table also ( $t = -.413$ ,  $df = 38$ ,  $p = .682 > 0.05$ ) then the usefulness of the attitudes towards cooperative of the students was not statistically significant between male and female in the case of usefulness in the pretest and posttest. Similarly the mean attitude of the students on the engagement of male students was 3.5157 with SD .39218 and that of the female students was 3.4817 with SD .31637. As independent sample t-test indicated from the above table ( $t = .297$ ,  $df = 38$ ,  $p = .768 > 0.05$ ) the engagement of the students was not statistically significant between male and female in the case of engagement in the pretest and posttest.

## CHAPTER FIVE

### SUMMARY, CONCLUSION AND RECOMMENDATIONS

The primary purpose of this research was to examine the effect of cooperative of using cooperative learning on mathematics attitude and achievement of secondary school students in algebra. Specifically this study was conducted to find out answer to question raised in chapter one. Therefore, this chapter consists of three sections: the summary, conclusion and the recommendation.

#### 5.1. Summary

Cooperative is an essential component of the total educational program for students in Ethiopian school system. However, this degree of the effect of cooperative learning up on academic achievement of the students may not evident in the country. The objectives of the present study were to investigate the extent of the contribution of cooperative learning and other variables to students' mathematics achievement on algebra in Addis Ababa.

Accordingly, the specific research questions formulated for investigation were:-

- Is there a significant difference between the pre-test achievement score of students in algebra of the traditional and cooperative learning groups?
- Is there a significant difference between the post-test achievement scores of the students in algebra of the traditional and cooperative learning groups?
- Is there a significant difference between the mean gain scores of the achievement of the students in algebra of the traditional and cooperative learning groups?
- Is there a significant difference between the pretest and posttest of the mean score of the attitude of students in learning algebra using cooperative learning?
- Is there a significant gender difference between the mean scores of the attitude and achievement of students in algebra of the traditional and cooperative learning groups?

The study was confined to Dejazmach Balcha Abanefso Secondary School. The subjects of the study were two classes of 10<sup>th</sup> grade (75) students from the

school of in 2007 E.C. The class selected from the school was the one I teach students of three classes and two class of averagely equal in mathematics performance.

Two instruments (namely achievement test and questionnaire) were employed for data collection of the study. Initially these instruments were administered on a pilot sample. The instrument used in this study was all determined to be reliable and valid through various mechanisms. The descriptive statistics for all variables indicated in chapter four, the overall mean achievement score of the respondents on both experimental and control group on pretest were 17.0857 and 16.9286 respectively. Whereas the posttest of the experimental and control group were 61.8000 and 51.1143 respectively. The figure indicated that the effect of using cooperative learning were helpful.

The findings of the study are summarized as follows:-

- A significant difference is found between the pre-test achievement score of students in algebra of the traditional and cooperative learning groups. That is the mean score of the control group was 16.9286 and the mean score of the experimental group was 15.775 then the control group was better scores in mathematics test than that of the experimental group.
- A significant difference is found between the post-test achievement scores of the students in algebra of the traditional and cooperative learning groups. That is, the mean score of the experimental group was 59.7 and the mean score of the control group was 51.1143 in the posttest.
- There is a significant difference between the mean gain scores of the achievement of the students in algebra of the traditional and cooperative learning groups.
- A significant difference is found between the pretest and posttest of the mean score of the attitude of students in learning algebra using cooperative learning.
- A significant gender is found difference between the mean scores of the attitude and achievement of students in algebra of the traditional and cooperative learning groups.

Though, cooperative learning appears to have positive effect upon cooperative learning on mathematics attitude and achievement in algebra, its degree differs

within the attitude and achievement levels of the students. The results of the study also indicate that cooperative learning has positive effect on students' mathematics achievement in algebra. But there is a slight difference in its degree of effect. These findings imply that the students' level of achievement is the basic factor in their mathematics achievement even though a regularly assigned cooperative learning and prompt feedback improves students' learning and academic achievement. In general the subjects of the study have positive attitude toward cooperative learning group rather than traditional way of learning in algebra.

## 5.2. Conclusion

In the preceding section, the main findings of the study have been summarized in line with its objectives. On the basis of the main findings the following conclusion can be drawn. The importance of creating awareness, close relationship and common understanding between the students and the teachers on the effect of cooperative learning on mathematics attitude and achievement in algebra. In the school there exist poor relationship between the students and the teachers.

## 5.3. Recommendation

Based on the findings of this study, the following recommendations may be forwarded to enhance the students' mathematics achievement.

- Students have to view cooperative learning as instructional strategy that improves their learning and academic achievement and attempt to do and apply successfully.
- Teachers are expected to review the cooperative learning and assure whether students have the necessary knowledge to do cooperatively.
- Teachers are required to monitor students for doing cooperatively and give a prompt feedback.

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Appendix A

PRETEST

MATHEMATICS

GRADE 10<sup>TH</sup>

Students Name \_\_\_\_\_ Roll No \_\_\_\_\_ Section \_\_\_\_\_.

Time allowed 2hours

Total weight 100

Direction: this test contains 20 multiple choice items. Each item is followed by four possible answers. There is only one best answer for each item. Choose the best answer and write the letter that corresponds to your choice on the space provided.

1. If  $x < y$  and  $z < 0$ , then  
A.  $xz < yz$     B.  $xz \geq yz$     C.  $xz \leq yz$     D.  $xz > yz$
2. The equation similar to  $\log_b y$  is \_\_\_\_\_.  
A.  $y = b^x$     B.  $y = x^b$     C.  $b = y^x$     D.  $b = x^y$
3.  $\log 6 + \log 7 - \log 3$  is equal to \_\_\_\_\_  
A.  $\log 39$     B.  $\log 11$     C.  $\log \frac{13}{3}$     D.  $\log 10$
4. The simplest form of  $\frac{27m^2n}{9mn}$  is  
A.  $\frac{1}{3m}$     B.  $3m$     C.  $3n$     D.  $3nm$
5. If  $|x + 3| = 8$ , then find the value of x.  
A. -5 or 11    B. 5 or -11    C. 5 or 11    D. -5 or -11
6. The simplified form of  $(\frac{2}{1.5})^2$  is \_\_\_\_\_  
A.  $\frac{4}{3}$     B.  $\frac{16}{9}$     C.  $\frac{4}{9}$     D.  $\frac{3}{4}$
7.  $\text{Log}_3^{18} - \log_3^2 =$  \_\_\_\_\_  
A. 11    B. 2    C. 3    D. -2
8. If  $8^x = 256$ , then  $x =$  \_\_\_\_\_  
A. 2    B.  $\frac{3}{8}$     C.  $\frac{7}{3}$     D.  $\frac{8}{3}$
9. For  $x < 0$ ,  $1 < a < b$  and  $x, a, b \in Z$ , then which one is true?  
A.  $(1/a)^x > (1/b)^x$   
B.  $a^x < b^x$   
C.  $a^x > b^x$   
D.  $(1/a)^x < b^x$

10. If  $f(x) = x^3 - 1$  and  $g(x) = x + 1$ , then which one is not true?
- $\frac{f}{g}$  is a polynomial
  - $\frac{g}{f}$  is a polynomial
  - $(f + g)$  has degree 3
  - The constant term of  $(f \cdot g)$  is -1
11. If  $x^3 + 3x^2 - 3x + c$  will be divided by  $x + 3$  exactly, then  $c =$  \_\_\_\_\_
- 0
  - 9
  - 9
  - 27
12. The solution set of  $|x - 6| = -3$  is
- {3}
  - {3, 9}
  - {-9, -3}
  - $\emptyset$
13. Let  $g(x) = 2^{-x}$ , then which one is not true about  $g(x)$ ?
- It is a decreasing function
  - Its y-intercept is at (1, 0)
  - x-axis is an asymptote to its graph from the right
  - $0 < g(x) < 1$  for  $x > 0$
14. Which of the following is not true about  $f(x) = x^3 - 3x^2 + 3x - 1$ ?
- $f(x)$  has three zeros
  - 1 is the only zero of  $f(x)$
  - 1 is the multiplicity of 3 of  $f(x)$
  - $(x - 1)$  is the factor of  $f(x)$
15. The logarithm form of  $a^k = d$  is \_\_\_\_\_
- $\log_a k = d$
  - $\log_a k = a$
  - $\log_k a = d$
  - $\log_a d = k$
16. Given  $\log_a \bar{5}$  and  $\log_a 3 = y$ , then  $\log_a 135$  is \_\_\_\_\_
- $2x + 3y$
  - $2x + y$
  - $x + 3y$
  - $\frac{1}{2}x + 3y$
17. The midpoint of the line segment with end points (-3, 6) and (7, 0) is
- (3, 2)
  - (-5, 3)
  - (2, 3)
  - (2, 5)
18. What is the point of the intersection of the line  $y = 1$  and  $y = x^2 + 5x + 3$ ?
- $(-\frac{1}{2}, 0)$  and (2, 0)
  - $(-\frac{1}{2}, 1)$  and (-2, 1)
  - (-1, 0) and  $(-\frac{3}{2}, 0)$
  - (-1, 1) and  $(\frac{3}{2}, 1)$
19. For what factor number "k" is  $(x + 1)$  a factor of  $f(x) = 2x^6 - kx^3 + 5x - 1$ ?
- 6
  - 4
  - 4
  - 6
20. If  $f(x) = \log_3 x$  and  $g(x) = 3^x$ , then which of the following is equal to  $f(g(x))$ ?
- 3
  - 0
  - 3
  - 1

Appendix B  
POSTTEST  
MATHEMATICS  
GRADE 10<sup>th</sup>

Students Name \_\_\_\_\_ Roll No \_\_\_\_\_ Section \_\_\_\_\_.

Time allowed 2hours

Total weight 100

Direction: this test contains 20 multiple choice items. Each item is followed by four possible answers. There is only one best answer for each item. Choose the best answer and write the letter that corresponds to your choice on the space provided.

1. If  $-1 < x < 0 < y < 1$ , then which of the following is not necessarily true?  
A.  $-\frac{1}{x} > 0$     B.  $-1 < xy < 0$     C.  $\frac{1}{xy} < -1$     D.  $-1 < \frac{x}{y} < 0$
2. Which of the following is the inverse of the function  $f(x) = (\frac{1}{3})^x$ ?  
A.  $g(x) = \log_3 x$     B.  $g(x) = \log_3(-x)$     C.  $-g(x) = \log_3 x$     D.  $g(x) = (\log_3 x)^{-1}$
3. the solution set of  $\log_2 x + \log_4 x^2 = 2$  is  
A. {4}    B. {-2,2}    C. {2}    D. {-2}
4. The equation similar to  $\log_b y$  is \_\_\_\_\_.  
A.  $y = b^x$     B.  $y = x^b$     C.  $b = y^x$     D.  $b = x^y$
5. Which of the following is the solution set of the equation  $|3-2x| = |x-6|$ ?  
A. {-3,3}    B. {-3,1}    C. {4,3}    D. {4,-3}
6. The simplest form of  $\frac{27m^2n}{9mn}$  is  
A.  $\frac{1}{3m}$     B.  $3m$     C.  $3n$     D.  $3nm$
7. If  $|x+3|=8$ , then find the value of x.  
A. -5 or 11    B. 5 or -11    C. 5 or 11    D. -5 or -11
8. The simplified form of  $(\frac{2}{1.5})^2$  is \_\_\_\_\_  
A.  $\frac{4}{3}$     B.  $\frac{16}{9}$     C.  $\frac{4}{9}$     D.  $\frac{3}{4}$
9.  $\log_3^{18} - \log_3^2 =$  \_\_\_\_\_  
A. 11    B. 2    C. 3    D. -2
10. If  $8^x = 256$ , then  $x =$  \_\_\_\_\_  
A. 2    B.  $\frac{3}{8}$     C.  $\frac{7}{3}$     D.  $\frac{8}{3}$
11. For  $x < 0$ ,  $1 < a < b$  and  $x, a, b \in Z$ , then which one is true?  
A.  $(1/a)^x > (1/b)^x$     C.  $a^x > b^x$   
B.  $a^x < b^x$     D.  $(1/a)^x < b^x$

12. If  $f(x) = x^3 - 1$  and  $g(x) = x + 1$ , then which one is not true?
- a.  $\frac{f}{g}$  is a polynomial  
 b.  $\frac{g}{f}$  is a polynomial  
 c.  $(f + g)$  has degree 3  
 d. The constant term of  $(f \cdot g)$  is -1
13. If  $x^3 + 3x^2 - 3x + c$  will be divided by  $x + 3$  exactly, then  $c =$  \_\_\_\_
- A. 0                      B. 9                      C. -9                      D. -27
14. The solution set of  $|x - 6| = -3$  is
- A. {3}                      B. {3, 9}                      C. {-9, -3}                      D.  $\emptyset$
15. Let  $g(x) = 2^{-x}$ , then which one is not true about  $g(x)$ ?
- E. It is a decreasing function  
 F. Its y-intercept is at (1, 0)  
 G. x-axis is an asymptote to its graph from the right  
 H.  $0 < g(x) < 1$  for  $x > 0$
16. Which of the following is not true about  $f(x) = x^3 - 3x^2 + 3x - 1$ ?
- E.  $f(x)$  has three zeros  
 F. 1 is the only zero of  $f(x)$   
 G. 1 is the multiplicity of 3 of  $f(x)$   
 H.  $(x - 1)$  is the factor of  $f(x)$
17. The logarithm form of  $a^k = d$  is \_\_\_\_\_
- A.  $\log_a k = d$       B.  $\log_d k = a$       C.  $\log_k a = d$       D.  $\log_a d = k$
18. Given  $\log_a \sqrt{5}$  and  $\log_a 3 = y$ , then  $\log_a 135$  is \_\_\_\_
- A.  $2x + 3y$       B.  $2x + y$       C.  $x + 3y$       D.  $\frac{1}{2}x + 3y$
19. The midpoint of the line segment with end points (-3, 6) and (7, 0) is
- A. (3, 2)      B. (-5, 3)      C. (2, 3)      D. (2, 5)
20. What is the point of the intersection of the line  $y = 1$  and  $y = x^2 + 5x + 3$ ?
- E.  $(-\frac{1}{2}, 0)$  and (2, 0)  
 F.  $(-\frac{1}{2}, 1)$  and (-2, 1)  
 G. (-1, 0) and  $(-\frac{3}{2}, 0)$   
 H. (-1, 1) and  $(\frac{3}{2}, 1)$

21. For what factor number “k” is  $(x+1)$  a factor of  $f(x) = 2x^6 - kx^3 + 5x - 1$ ?  
B. 6    B. 4    C. -4    D. -6
22. If  $f(x) = \log_3 x$  and  $g(x) = 3^x$ , then which of the following is equal to  $f(g(x))$ ?  
B. -3    B. 0    C. 3    D. 1

## Appendix B

### Statistical data /Test Scores/

Experimental Group					Control Group				
Pupils	Sex	Pretest scores	Posttest scores	Average	Pupils	Sex	Pretest scores	Posttest scores	Average
1	M	29	95		1	M	27	85	
2	M	29	93		2	M	26	85	
3	F	27	93		3	M	26	83	
4	M	27	93		4	M	25.5	83	
5	F	26	92		5	F	25.5	82	
6	M	25	92		6	M	25	87	
7	M	25	91		7	F	24	86	
8	F	25	90		8	M	23.5	78	
9	F	23	81		9	M	23	82	
10	F	20	78		10	F	23	74	
11	M	20	75		11	M	21	60	
12	M	18.5	46		12	F	21	40	
13	M	18	60		13	F	19	47	
14	F	18	60		14	M	18	25	
15	M	18	41		15	F	18	69	
16	F	17	65		16	F	18	61	
17	M	16.5	58		17	F	17.5	52	
18	M	16.5	71		18	F	17	51	
19	F	16	45		19	F	16.5	37	
20	M	14	53		20	F	16	44	
21	M	14	46		21	M	15.5	50	
22	M	14	44		22	M	15	33	
23	F	13	50		23	F	14	31	
24	F	13	53		24	M	14	30	
25	M	12	43		25	M	13	33	
26	F	11.5	64		26	F	12	30	
27	F	11.5	43		27	F	12	34	
28	F	11	40		28	F	11.5	30	
29	F	11	37		29	F	11	27	
30	F	10	41		30	F	10	47	
31	F	10	51		31	F	10	28	
32	M	10	44		32	F	09	33	
33	M	10	43		33	M	08	20	
34	M	9.5	43		34	F	04	27	
35	M	9	49		35	F	03	25	
36	M	9	48		36				
37	M	08	40		37				
38	F	08	45		38				
39	F	05	45		39				
40	M	03	47		40				

## Appendix C

ADDIS ABABA UNIVERSITY  
COLLEGE OF EDUCATION AND BEHAVIOURAL STUDIES  
DEPARTMENT OF MATHEMATICS EDUCATION

### A QUESTIONNAIRE TO BE FILLED BY STUDENTS

Dear students,

The purpose of this questionnaire is to collect first hand information for the study about the effects of word problem solving using cooperative learning strategies on secondary school students' achievement in algebra, in the case of Dejazmach Balcha Abanefso Secondary and preparatory school of Lideta sub-city. This study is to be conducted in partial fulfillment of the requirements for the Degree of Master of Education in Mathematics. In order for this study to turn out well your sincere and genuine response to each question is required. You are therefore, kindly requested to complete the questionnaire honestly and responsibly.

#### **General Directions:**

- ✓ You are not required to write your name
- ✓ Follow instructions provided for each section of the questionnaire.

***Thank you in advance for your time and effort!***

All responses will be held confidential.

#### **Part one: personal characteristic**

Instruction

Sex    Male                       Female

Age below 14     14-20     21-25     Above 25

Grade level: Grade 9     Grade 10     Grade 11     Grade 12

**Part two: student's attitude scale questionnaire**

Respond to the following items by drawing by making “√” under the response that most closely represents your opinions right now: strongly agree (SA), agree (A), undecided (U), disagree (D) or strongly disagree (SD).

No	Post-attitude scale of students on the effects of word problem solving using cooperative learning strategies on secondary school students' achievement in algebra.	SA	A	U	D	SD
1	I cannot get a good result in Mathematics solving Algebra.					
2	I know I can handle difficulties in Mathematics on solving Algebra.					
3	I am not confident in Mathematics on solving Algebra.					
4	I have less trouble learning in Mathematics solving Algebra than other subjects.					
5	For some reason even though I study, mathematics solving Algebra seems usually hard for me.					
6	I am sure that I can learn Mathematics on solving Algebra.					
7	Mathematics on solving Algebra makes me feel uneasy and confused.					
8	I enjoy going beyond the assigned work and trying to solve new on Mathematics Algebra.					
9	I am not interested and not willing work to use Mathematics on solving Algebra outside the school and on the job.					
10	I would like to develop my Mathematics on solving Algebra skills and study this subject more.					
11	Mathematics solving Algebra is dull and boring because it leaves no room for personal opinions.					
12	Mathematics solving Algebra is very interesting and I have usually enjoyed courses in this subjects.					
13	Mathematics on solving Algebra is not important for the advance of civilization and society.					
14	Mathematics on solving Algebra has a contributed greatly to science and other fields of knowledge.					
15	Mathematics solving Algebra is not important in everyday life.					
16	Mathematic on solving Algebra is a very worthwhile and necessary subject.					
17	There is nothing creative about Mathematics solving Algebra; it's just memorizing formulas and things.					
18	Mathematics on Algebra helps develop a person's mind and teaches him to think.					
19	I didn't try always doing additional Mathematical exercise on Algebra.					
20	I really make an effort in my Mathematics solving Algebra lesson.					
21	In Mathematics solving Algebra I didn't try to link new ideas to knowledge I already have.					
22	I didn't make an effort in my Mathematics on Algebra lesson.					
23	If I make mistakes, I didn't work until I have correcting them.					
24	I test my understanding by doing exercise on Algebra.					

