Factors Influencing Students' Learning of Mathematics: The case of First Cycle Secondary Schools in Hadiya Zone

Abayneh Ergogo

A Thesis Submitted to

The Institute of Educational Research

Presented in Partial Fulfillment of the Requirements for the Degree of Masters of Arts (Educational Research and Evaluation)

Addis Ababa University

Addis Ababa, Ethiopia

September 2012

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School of Graduate Studies

This is to certify that the thesis prepared by Abayneh Ergogo, entitled: *Factors Influencing First Cycle Secondary School students in Learning Mathematics: The case of Hadiya Zone* and submitted in Partial Fulfillment of the Requirements for the Degree of Masters of Arts (Educational Research and Evaluation) complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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ABSTRACT

This study was designed to find out the most determinant factors that influence the First Cycle Secondary School students in Learning Mathematics. The objective of the study is to explore to what extent the student- and school-level factors that influence the student' learning of mathematics. The participants of the study were students, teachers, the school principals as well as Woreda and Zone education experts selected by using purposive and stratified sampling techniques. The main data gathering instruments used were questionnaire, interview and focused group discussion. To this end, the study employed mostly quantitative method and also the qualitative one as an integrated part. Results revealed that teacher competency in mathematics education, school contexts and facilities, students' self directed learning and motivation influence students' mathematics learning significantly.

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CHAPTER ONE INTRODUCTION

1.1. Background of the Study

Education is an important instrument for promoting peace and prosperity in a given society. It is highly important to the scientific, industrial, technological and social progress of a society (Burton, 1979). In line with this Ratnaliker (2003) stresses the role of education as that it has become necessary for people of all ages to reach, analyze, and apply the knowledge effectively and efficiently to be successful citizens in this information age. Computer literacy, technological and mathematical competences are perceived as essential skills for the higher-order mathematical knowledge. In realization of these significant roles of mathematics fully, subject mastery and demonstrated achievement should be ensured. Identifying the problem and striving to the solution for it will help to utilize limited resources including financial and time more effectively (Libienski & Gutierrez, 2008).

Despite the aforementioned importance that mathematics education has, the quality of teaching and learning have been one of the major challenges and concerns of educators in different countries (*Shin et al., 2009*). According to Shin, a central and persisting issue here is how to provide instructional environments, conditions, methods, and solutions that can attain learning goals set for students with different skill and ability levels. All of them agree in that innovative

instructional approaches, designs and techniques should be developed to ensure that students become successful learners (Rasmussen & Marrongelle, 2006). Instructional design is an effective way to alleviate many pressing problems in education. It is a linking science – a body of knowledge that prescribes instructional actions to optimize desired instructional outcomes, such as achievement and effect (Reigeluth, 1983). This shows that in effective instructional design (and as it is the main input for effective design) the instructional designers and practitioners must know the factors that affect students' learning.

Researchers such as Campbell and others provides factors which could have an impact on students' mathematical learning 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 & Sherman, 1976, 1986; Fluty, 1997). These factors could be seen in categories: 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 (student related) Factors (self-directed learning, arithmetic ability, motivation).

In an effort to understand the school - level and student - level factors associated with students' learning mathematics, researchers revealed that instructional strategies and methods, teacher competency in

math education, and motivation or concentration and interest of the student are the influential factors that should be considered in the design decisions (Beaton & Dwyer, 2002; Kellaghan & Madaus, 2002; Kifer, 2002). According to Shin et al. (2009, 520) there is a relations between student- and school - level predictors and mathematics learning although they differ in pattern.

To this effect the present Government of Ethiopia has demonstrated its devoted interest on education and has taken series of measures to promote it in all levels. The development of New Education and Training Policy, which was ensured in 1994 by the Transitional Government of Ethiopia (TGE, 1994 E.C.), was one of the measures taken to this effect. The Government has also put in place an Education Sector Development Program (ESDP) in 1997, by means of which an ambitious plan with a target of achieving Universal Primary Education by the year 2015 has been stipulated. In addition, General Education Quality Improvement Program has been set and a lot of improvements have been done with this regard (MOE, 2001).

Although the Government has been making such a concerted efforts in opening access to education for a number of school-aged children and have started to show in some respects, relative change in quality in the past years, there are still low academic achievements among the First Cycle Secondary School students (MOE, 2001; UNESCO, 2004; Assefa, 1991; Bedru and Tilaye, 2001; MOE, 1999, 2001;

Genet, 1991). No doubt in that the source of this achievement is a poor learning.

Based on this it is necessary to shed light on factors that influence first cycle secondary students' mathematics learning in order to create awareness to the teachers, students and other stakeholders about the main roles that they would play. Therefore; this study focuses on revealing factors that influence students' mathematical learning with specific target on first cycle secondary school. A problem becomes critical due to lack of awareness of its existence (Anonymous, 2002).

1.2. Statement of the Problem

Many attempts have been made by various scholars to identify factors that affect students' learning in mathematics. An increased body of research findings indicates that demographic, individual and instructional factors have an impact on students' learning in mathematics (Campbell et al., 2000; Epstein, 1991; Fennema & Sherman, 1976, 1986; Fluty, 1997). For example, Israel and others concluded that parents' socioeconomic status is correlated with a child's educational achievement (Israel et al., 2001). Another study by Jonsen and Seltzer (2000) showed that factors such as individual study, parents' role, and social environment had a significant influence on students' further education decisions. Fehrman, Keith and Reimer (1987) also studied that the effects of parental involvement on secondary school students affect their learning.

Therefore, examining impact of factors that influence the students' learning of mathematics such as the school - and the student leveled ones is very important to the attainment of the expected outcomes. It gives direction in educating effectively the new generations and provides instructional designers better inputs for their design decisions.

As indicated above, the theoretical evidences support that school - and student leveled factors determine students' learning of mathematics. The present researcher, as an educational expert in the Zone, observed that the practical treatments of the respective factors in the society (of the Zone) are not yet fully understood and as a result, students' mathematical achievement of the Zone is very poor.

From the highlighted observation of the 2000-2003 E.C. national (grade 10) examinations of the students of the Zone, the average number of students who got at least a grade C is not more than 68%. And this shows that the academic achievement of the students in the Zone is very low. It seems that 68% is the average performance but it is including the low grade C. It is also worsened when it is observed across gender with the gap 8.2% that favors boys (see Appendix D).

Therefore, this study examines the impact of the student- and school-level factors on mathematics learning of students in the secondary schools of the Zone. Knowing such factors will be the initial reference for making the best decisions to alleviate the problems of academic achievement.

1.3. Basic Questions of the Study

Based on the above problem statement, the study is attempted to answer the following research questions:

1. To what extent do school level factors, including, teacher competency and school contexts as well as facilities influence students' learning in mathematics?
2. To what extent do student level factors, including, motivation and self-directed learning influence students' learning in mathematics?
3. Do school - level factors influence female students more than that of males?
4. Do student - level factors influence female students more than that of males?

Therefore, the study attempts to gain an understanding of the schools role of offering activities and the student's role of learning that play bridging, otherwise accelerating the gaps, on the academic achievement.

1.4. Objective of the Study

The general objective of the study is to investigate the extent to which school – and student - based variables influence students' Mathematics learning with special reference to first cycle secondary school students in Hadiya Zone.

The specific objectives are to:

1. identify to what extent school related factors such as teacher competency in mathematics and school context and facilities determine the mathematics learning of the students.
2. identify to what extent student related factors such as motivation and self-directed learning determine the mathematics learning of the students.
3. show whether school and student level factors of learning mathematics influence girls more than that of boys or not.
4. provide directions for the further study on the area.

1.5. Significance of the Study

The findings of this study are expected to have practical utility in the effective teaching and learning processes in the subject mathematics. It helps the academic and administrative staff in being aware of the variables (factors) which can have positive and negative effects on the Mathematics learning of the students. Educational experts, policy makers and other concerned stakeholders may use the results of this study in implementing educational policies, strategies and programs. It also informs organizations and others stakeholders to participate for the attainment of objective of the quality of general education in schools by realizing gender equity.

Thus, it is hoped to create a better strategy to improve students' mathematics achievement by focusing on students – and school – related factors. The outcomes of this research may also solve the dilemma of why students have low mathematics achievement.

1.6. Delimitation of the Study

The scope of this study covers students in First Cycle Secondary Schools of Hadiya Zone in SNNPR Ethiopia. Feingold (1988); Jakobson (1985), as cited in Silashi (1995) pointed out that students' early experience determine the later sex differences in mathematics learning. Accordingly, it is fundamental grade level for their next more complex application of mathematical understandings.

Considering the fact that the Zone has 25 First Cycle Secondary Schools in the 11 woredas including the Government and private schools, the study is limited to the 19 Government First Cycle Secondary Schools.

1.7. Limitation of the Study

One limitation of the current study is that the respondents were not given the standard response especially for the open ended questions of the survey instrument. The second one is shortage of money since I was not supported by finance.

1.8. Operational Definitions of Terms

According to their usage in this study the following terms are defined in the manner stated as follows.

- Mathematics learning: - Refers to students' acquiring knowledge in Mathematics from their schools.
- School level factors: Elements (such as Teacher's Competency in Math Education and School Context & Facilities), or circumstances of schools that influence the student's Mathematics learning.
- Student level factors: Elements (such as Self directed learning and Motivation) or circumstances of students that influence the student's Mathematics learning.
- Teacher Competencies: are the capacities of a teacher to demonstrate skills and abilities, which result in effective performance of teaching.

1.9. Organization of the Study

This study consists of five chapters. The first chapter deals with the introductory section. Under this section, the background of the study, statement of the problem, objectives of the study, significance of the study, delimitation of the study, limitation of the study, and operational definitions of terms are treated. The second chapter deals with the review of the related literature,

which provided detail information, related to factors that influence first cycle secondary school students' mathematics learning. The third chapter focuses on research design and methodology such as target population and sampling techniques, data gathering methods and instruments, procedure of data gathering and method of data analysis. The fourth chapter deals with the data presentation, analysis and interpretation. Finally, the last chapter presents summary, conclusion, and recommendations.

CHAPTER TWO REVIEW OF RELATED LITERATURES

2.1 Factors Influencing Students' Learning of Mathematics

A growing body of research provides factors which could have an impact on students' mathematics learning 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 & Sherman, 1976, 1986; Fluty, 1997). These factors or predictors in Mathematics learning, are categorized as: 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 (student related) Factors (self-directed learning, arithmetic ability, motivation).

In an effort to understand the school - and student - level factors associated with mathematics learning of students, researchers have focused on many factors. Beaton et al. revealed that instructional strategies and methods and teacher competency in mathematics, and motivation or concentration and interest of the student are the influential factors that should be considered in the design decisions (Beaton & Dwyer, 2002; Kellaghan & Madaus, 2002; Kifer, 2002). Shin et al. (2009, 520) also emphasized that although there is difference in pattern, there is a relations between student- and school

level predictors and mathematics learning achievements among countries.

2.2 School Related Factors that Influence Students' Learning of Mathematics

There are several school related factors that affect the smooth running of teaching and learning process in general and of mathematic in particular. However, for the sake of manageability, this study treats school context and facilities as well as teacher's competence in mathematics education.

2.2.1 School Context and Facilities

School context and facilities could be important factors in students' Mathematics learning. For instance, researchers suggest that students' learning is associated with a safe and orderly school climate (Reyonds et al., 1996). They have also found that a negative impact on student learning exist where deficiencies of school features or components such as temperature, lighting, and age exists. In developing countries including Ethiopia, school contexts and facilities such as adequate availability of school facilities, instructional materials and quality of teachers have more impact on students learning (Hile, 2002) with regards to significance of learning environment. Ministry of Education, MOE (2005) stated that learning environment is determining factors for students' achievement at any

given educational level. 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 students' learning.

It is characterized that a space or a place students and teachers interact with each other and use a Varity of tools and information resources pursue of teach (Wilson, 1996). This shows that the nature of the classroom environment and social interactions can make a difference in how students learn and achieve their goals. Other studies were also showed the level of importance of classroom environment in the teaching and learning process (Fraser and Fisher 1983). This study suggested that learning is improved by working in a preferred classroom environment. Physical, social and psychological dimensions how people relate to each other are the first stage to improve it.

As cited by Shin and others, student-teacher relationships and school climate are socio-psychological variables that increase or decrease individual differences in academic efforts and outcomes (Shin et al.

2009; Kim et al. 2004; Purkey and Smith, 1983). Teachers' educational and emotional supports leading to positive student-teacher relationships are critical factors that affect student's learning. Sometimes, teachers' support has a larger impact on student learning than that of parental support (Chen, 2005). Teachers' emotional support and positive relationships with students are also related to positive classroom cultures fostering higher academic performance (Grinsven and Tillema, 2006) and students' self-regulated learning behaviors (Eshel and Kohavi, 2003).

School climate is also related to students' attitude and academic behavior in the classroom. In schools where the disciplinary climate is strong, students tend to perform better both behaviorally and academically (Kim et al., 2004; OECD, 2004; Purkey and Smith, 1983). Related with this, Eklund et al. have also showed that classroom plays an important role in students' cognitive and affective development (Eklund 1995; Entwhile 1992). Lewin (1936), as quoted by David (2001) for example introduced the formula:

B= P.E, where human behavior (B) is a result of two independent influences the person (P) and the environment (E). Moos (1997), as quoted by Back (2002) argued similarly.

Some researchers have done on the relationship between the school variable and students' attitudes towards mathematic. They found a small but positive correlation between school factor and attitudes (Jacobs, 1974; Field, 1975; Evans, 1978). Mammalian (1992) also

provides evidence that aspects of the classrooms learning or climate are positively related to Mathematics attitude.

2.2.2 Instructional Materials and Classroom Facilities

Teachers use various materials to assist students in learning. These instructional materials guide the teacher as well as the students in the teaching and learning process. As Daly, (1990) posited, in some form, most of the teachers use course syllabic, textbooks and other printed materials provide opportunity to students learning outside of the class or as in the class of instructional media applications, enables students to process knowledge in additional visual and auditory models. In other words, the classroom facilities are important to employ appropriate method of teaching and in turn to reach good learning. This is because teaching facilities help to create conducive element in the classroom and to maintain active participation of students. If the classroom is facilitated, it obviously facilitates the teaching learning activities. Students, who learned in a facilitated environment, develop an increased ability to solve problems and evidence greater understanding of the material (Cooper, 1985).

2.2.3 Mathematics Classroom (Teaching - Learning) Context

Heartel (1981) revealed perception of classroom environment as critical factor in determining students' actions such as motivation, achievement and satisfaction. The issue of teaching mathematics within a good educational environment is deeply related with the idea

of being facilitator because students (especially females) need an appropriate environment where they can understand a mathematical knowledge in more active ways. Accordingly, teachers should promote the students (female students) to work with others toward common goals and to be actively involved in doing mathematics. It will be a good challenge for students to listen to the other and compare each one's solution process (Cohen, 1988).

This allows for better communication and interactive skills which are very useful for learners. When such conditions are created, learners can express their own idea and learn to brainstorm these with others. Hewson (1996) argues the same idea and he adds that students must respect the ideas of others and listen carefully to them even though they might not agree with them. To create effective mathematics classroom atmosphere, Telem (1998) also argues that schools should utilize ideas, animations, graphs, pictures or movies, to stimulate the students and making sure they pay attention. Such activities also have the advantage enabling students better understand and have deeper and lasting impressions of what was done in the classroom. The activities also have an inherent entertainment and enjoyment value.

2.2.4 Teacher Competency in Mathematics Education

As explained by Weddel (2006), competencies are the characteristics that lead to the demonstration of skills and abilities, which result in effective performance. Accordingly teacher's competence can be

examined in relationship to the students' learning including measurement of academic ability, year of teacher experience, measure of subject matter and methodology, certification status and teaching behavior in the learning context (Tilahun, 2007). To show the impact of qualified teachers, Zewdinesh(1987) states that, teachers with higher cognitive ability are more likely to be flexible, adaptive, creative and innovative. Gouald and Yoakan(1954) state also that a well qualified teaching staff will render a higher quality of instruction and poorly qualified staff will result in inferior teaching.

A number of studies have indicated that the personality and behavior of the teacher is very important in the formation of the students' attitudes, with one notable exception by Fennema (1976). Moor (1993) found in a national sample of high school students that impressions of the teachers are "like" or "smart" significantly predicted students' attitude. Anderson (1991) found that it is important for teacher to be enthusiastic and the use more indirect teaching behaviors. Fennema and Sherman (1995) found that students of teachers who were well organized, achievement oriented and enthusiastic tended positive Mathematics attitudes.

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; Thompson, 1992; Wilson, 1990a, b). Gellert (1999) 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.

Other findings from research on teacher competency also 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).

Teachers need to have skills and knowledge to apply their philosophy of teaching and instructional decisions. 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). The teacher has to master every method to use accordingly. The teacher need not stick to the same method always because even the best of methods will become monotonous with continuous use (Anderson, 1991). Accordingly, it is wrong to name a single method as the best method. A good mathematics teacher will so digest or absorb all the available methods that he evolves his own method comprising good points of all the methods. He will not permit any of the methods to become his master but will remain true master of all them.

Teacher competency in these areas is closely linked to student thinking, understanding and learning in mathematics education.

There is no doubt that student achievement in mathematics education requires teachers to have a firm understanding of the subject domain and the epistemology that guides the 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 learning. Competent mathematics 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.

The strength of an educational system often is determined by the quality of teacher assigned and the students' achievement and success is partly the reflection of the teachers in the school. With regard to quality of teachers, MOE (1995) explain that teachers to be effective in their profession they need to possess the professional skill, knowledge and attitude that enable them effective in their assignment. Much of the students' mathematics achievements also depend up on the teachers' beliefs, expectation and attitude about their students learning (Chaube 1996). Coombs also stress that the quality of education and learning achievement of students depend heavily on competence, personality and education of teachers (Coombs, 1985).

2.2.5. The Role of a Teacher

No doubt of the role teachers play in what happens in their class room. They provide a leadership or guidance role in teaching and learning context and therefore are highly influential. The goals and

objectives of educational system, change of behavior of students as a result of positive inclination towards learning can be greatly affected by the teachers. They in a sense determine the other ethnic of the classroom and set the standard to accomplish it. Generally how much well equipped and furnitured classroom and fully facilitated resourceful school we have it will not contribute more, even nothing unless the key person in the school or the teacher guide the instructional process effectively (Sidhu, 1995; Sills, 1981).

As cited by Kebede (2007), Michael (1968) states communications are effective and directed towards the intended goals of learning in instructional context if the learners understand their teachers. Therefore, unless students understand their teachers no learning in that particular context is happened.

Aiken (1970) has offered evidence that teacher attitude toward and effectiveness in teaching mathematics is important determinants of students' attitude and performance in the subject. A good teacher can attract the attention of his or her students employing different techniques. For this instance in group discussion method, a teacher has the role of supporting, evaluating, disciplining, facilitating, socializing agent and formal authority person. In line with these roles Daly (1990) has en-numbered the following teacher roles. Teachers as learning, evaluate teacher learning and guiding students equally. In addition to these teachers can create suitable condition in the

classroom. Because they are considered to be students needs, expert and flexible in the teaching process.

Similarly Borich (1981) also proposed the roles of teachers as orienting the students to the objective of the discussion, providing new or more accurate in foundation when it might be necessary and reviewing, summarizing, combining together opinions and facts in to a meaningful relationship. He/she alter the flow of information and ideas to that which will be most productive to the goals of the lesson in combining, promoting and compromising ideas to arrive at a final consensus. Drikx (1997) named teacher as collaborative. He noted that teachers must form a myriad of instructional strategies such as buzz groups, case study small group discussion and investigation, and peer teaching or teaching. All of these strategies emphasize different kinds of skills and use varying degree of structure with in the learning experience. For this reason, it is helpful to think of collaborative learning as representing a continuum of learning activities. These types of learning are a sharp departure from traditional way of structuring learning in education for pupils. Students are no longer passive recipients of information providing by an expert teacher or text. Rather they are viewed as active agents in constructing knowledge. Collaborative learning provides structured group activities for students and promotes the social skills they need in order to work together.

Drikx also proposed about collaborative learning as that learners are interdependent and they need to depend on one another to succeed in the learning tasks. Also, each member is held responsible and accountable for a particular part of the learning task. The teacher assesses learning and needs help in what area in doing so, groups of learners evaluate how well they are doing on the learning task, taking notes of what was done well and what could improved. Besides, learning requires students to use a variety of social skills, including leader ship, decision making, trust building, conflict management, conflict resolution, encouraging, listening and giving feedback then, learning takes place through face to face information as students verbally discuss various aspects of the learning task.

2.2.6. Specific roles of Mathematics Teachers

Teaching mathematics is a task which, if sincerely undertaken, will challenge the best efforts of the best teacher. No teacher can does a thoroughly good job of teaching mathematics unless he/she is willing to make a careful analysis of his/her job to be guided by that analysis. Sidhu suggests the role of mathematics teachers as he/she is Mathematics specialist, classroom director as employee and curriculum implanter.

Therefore a teacher has a role of coach, acting as a mentor, assistant and collaborator who with blend of empathy, guides and instructs. His role is essential link in the relationship between the teachers function

(diagnosis, mediating and facilitating) and his/her behavior and attitude. In general the role of a teacher will be that of facilitating and monitoring.

Mathematics is essentially a subject where doing is more prominent than reading. That is why it is felt by a majority of people that mathematics is a dry and difficult subject, full of abstract thinking (Sidhu, 1967, 2003). These result the students to take very little interest in it. Therefore, to create the necessary interest is a constant problem for the teacher. The teacher has to master every method to use accordingly. The teacher need not stick to the same method always because even the best of methods will become monotonous with continuous use (Anderson, 1991). Accordingly, it is wrong to name a single method as the best method. A good mathematics teacher will so digest or absorb all the available methods that he evolves his own method comprising good points of all the methods. He will not permit any of the methods to become his master but will remain true master of all them.

Smith and Shepard (1989) further pointed out that interventions like tutoring, summer school individualized instructions and encouraging involvement in the school through regular meeting are more effective and less costly than making children repeat the grade. They conclude a coordinated system of comprehensive support services aimed at addressing the academic, socio – emotional, behavioral and

psychological need of the child will help promote health adjustment and achievement among children at risks for low academic achievement. Accordingly, teachers should promote the students (female students) to work with others toward common goals and to be actively involved in doing mathematics. It will be a good challenge for students to listen to the other and compare each one's solution process (Cohen, 1988). This allows for better communication and interactive skills which are very useful for learners. When such conditions are created, learners can express their own idea and learn to brainstorm these with others. Hewson (1996) argues the same idea and he adds that students must respect the ideas of others and listen carefully to them even though they might not agree with them.

On the other hand, Yager and Penick (1984) reported that teachers were viewed by learners as that they were the ones who choose topics for students. This is not recommended as the solely option of teaching, because if changes are to occur attention must be focused on the students own views and perceptions of the learning environment and the effects on mathematics activities.

2.3 Student Related Factors

2.3.1. Students' Role in Teaching – Learning Process

Students have their own role on the activities of teaching learning processes. As noted by Arends (1998) students are expected to practice and display their thinking and all members of the class talk

are required. Similarly, Hansen (1994) suggested responsive in through and toward what each other says and the exchange of dialogue is talk centered. As they strive to attain a particular concept and critical thinking skills, subjects interact verbally, although the emphasis is often on student to student exchange their ideas in small groups. And students form and express independent through and opinion through dialogues about shared experience and argument about what these experiences means, ideas are refined or expanded and questions are raised for their future study (Arends, 1988).

In general, learning experiences and performance depends on both individual accountability and group interdependence (as a class); group members sink or swim together that is for anyone in the group to succeed everyone in the group must succeed (Thomas, 1995). Group need to know who needs more assistance in completing the assignment and members needs to know they cannot let others do all the work while they sit back. Ways to ensure that students are held accountable including giving spot quizzes to be completed individually and calling on individual students to present their group progress (Johnson, Johnson and smith 1991).

2.3.2. Students' Self-Directed Learning

As suggested by Tuncay and Omur, Mathematics learning requires a deep understanding of mathematical concepts, the ability to make connections between them, and produce effective solutions to ill-

structured domains. As they further suggested, there is no perfect, well-structured, planned or prescribed system that lets students think and act mathematically unless and otherwise, students play their assigned roles in their learning progress.

Knowles also concludes self-directed learning as it has an important place in successful mathematics learning in that 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). Strommen & Lincoln proposes that, teacher's role here 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 & Lincoln, 1992). Took & Lindstrom connect self – directed learning with attitude that the students have. Accordingly, students who have high level of positive attitude in mathematics will have high level of self directed attitude in life (Took & Lindstrom 1998).

Therefore, willingness towards Mathematics initiated by him/her self is believed to play a significant role in learning mathematics. A study conducted by Mahmud (2001) found that excellent students have high level of willingness to solve mathematics problems compared to average and weak students. His finding is also supported by Faridah (2004) that excellent students have high level of willingness towards problem solving. Andrew, Salamonson and Holcomb (2009:218) argue similarly. Bandura (1977) claims that an individuals' self-efficacy

expectation of their individual ability to successfully perform a given task is a reliable predictor of whether or not they will attempt the task, the amount of effort they will expend and their level of perseverance in the face of unanticipated difficulties.

2.3.3. Students' Motivation in Learning Mathematics

Cole and Chan (1994) explained motivation as the personal energy directed towards the achievements of particular goals. One can understand that students can be activated by both intrinsic and extrinsic motivations. Students need to be satisfied internally in what they do in the class, and they to be externally motivated to be successful in their mathematics learning.

Mathematics learning requires highly motivated students because it requires reasoning, making interpretations, and solving problems, mathematical issues, and concepts. The challenges of mathematics learning for today's education are 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). They added 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).

Ninth grade students' interest in Mathematics was found by Reed (1968) to increase with teachers who utilized students' intrinsic motivations. Research shows that competition for rewards can stimulate students to learn (Tauer and Harackiewicz, 1999; Tyler et al., 2006). According to the researchers Asian countries such as Korea, Japan and Hong Kong, which have shown high performance in international comparison studies, are characterized by a competitive academic atmosphere when compared with Western countries. In addition, instrumental motivation is a factor that positively affects academic achievement (Greene et al., 2004; Husman and Lens, 1999; Simons et al., 2003). It also functions positively in relation to students' course selections and career choices (Eccles, 1994). The PISA 2003 data also show that there is a positive relation between instrumental motivation and educational expectation in most countries (OECD, 2004).

In another study, Meece, Wigfield & Eccles (1990) investigated cognitive motivational variables that influence high school students' decisions to enroll in advanced math courses. Their findings revealed

that mathematical ability and perceptions affect students' valuing of mathematics and their expectations for learning.

2.4. Factors Influencing Female Students' Learning of Mathematics

It has been one of the most debated and lively topics in education if and what type of gender differences on mathematics learning and achievement exists. It seams to be the stereotyped belief that mathematics is a male dominated (Fennema & Sherman 1977, 1978). According to this study, nature tends to favor male dominance over the feminine gender. Environmental provision for male students makes them fit and able to cope with tasks requiring high intellectual challenges and computation. The phenomenon is further confounded in Africa where sex stereotyping is so pervasive that from birth, society fixes gender roles and conditions males to play and act with in the confined of intellectually and physically more challenging tasks like construction, football, agriculture, fishing and the like. Women on the other hand are 'sentenced' to the kitchen and related domestic chores, including child rearing. By extension, female students in the school tend to choose for subjects like Biology. Chemistry, Physics and Mathematics are male dominated subjects.

Both feminist empiricists and 'liberal feminist critics' agree on that females in principle will produce exactly the same achievement as males provided that sufficient empowerment is taken in scientific

inquiry (Barton 1998 and Sinnes, 2006). These studies show that initiatives to build on the assumption that females and males are equal in their approach to mathematics and the inequality in it is caused by external factors (Social, educational or political), which would be focused on removing these external obstacles. Therefore it is must to give boys and girls exactly the same opportunities and challenges. However gender inequality in mathematics learning that favor male, has remained as problem (UNESCO, 2003; Sileshi, 1995; Mulatu, 2011) in our secondary schools.

On the other hand, other investigators have found no sex difference at the level of elementary schools (Fennema and Carpenter, 1981; Hilton and Berglund, 1974; Fennema and Sherman, 1978; Burton, 1979). Despite this, Hilton and Berglund (1974) used data from educational testing service in 1959 grades five, seven, nine and eleven students. The study disclosed the significant gender differences in favor of male at grade levels 7,9 and 11, and with higher boys mean score in grade 5. They further reported that the differences increase with age. Benbow and Stanely (1983) seconded by their repot that there is substantial gender difference in mathematics achievement in favor of boys in intellectually gifted 9927 grade 7 and 8 students.

In Ethiopian context, after examining the scores in grades six and eight National Examinations, Gennet (1991) concluded that grills in grade 6 and 8 performed poorly compared with boys over the last ten years (1978-1987) in mathematics and science. In line with this, in a

study of gender difference in math's achievement in grades 8 to 11, Silashi (1995) has found significant difference between males and females in mathematics achievement in favors of boys in all grade levels.

On the other hand many researches have been conducted on the factors of the difference on performance. Boswell (1985) argued that there are two main factors. One of which is student related and the other is believed to be from family influence and socio- economic status of parents; cultural and traditional influences. Such factors were believed to be significant in the trend toward learning of mathematics and could influence girls on subject and job selection.

As Abraham (1989) noted, curricular materials used in the schools have also been singled out as an influencing factor in the study of mathematics. Other studies argue that how teachers treat boys and girls during the teaching – learning process need to be an issue. Investigators suggested that teaches treat boys and girls differently in mathematics classes and that this differential treatment reinforces sex difference in achievement of mathematics as a male dominant (Jakobson, 1985; Fennema, 1980; Fox, 1981). There is a fact in most schools most mathematics teaches are males (in grades above 5) is taught to present strong message of male dominance of mathematics achievement. However, this could be solved by producing as many female teachers as males by the deliberate effort of elimination of gender difference in mathematics achievement.

CHAPTER THREE RESEARCH METHODS

The purpose of this study is to examine the factors that influence Mathematics Learning of males and female students in first cycle secondary schools of Hadiya Zone. Specifically, it aims to investigate the school based and student related factors that play a determinant role for the learning. In this regard, the research design, participants and sampling, research instruments used and the method of analysis are described below.

3.1 Research Design

To enables the researcher to examine the extent that the school –and student – level factors influence students' learning of mathematics, the study employed mostly quantitative techniques and the qualitative one as an integrated part. To realize this objective descriptive survey instruments was designed to answer the research questions.

3.2 The Study Area and Target Population

The area of the study, Hadiya Zone, is one of the 15 Zones and Special Woredas of SNNPR of Ethiopia, situated in 230 km to the south from Addis Ababa. It has 10 Woredas and one Town Administration, called Hossana Town. This site was selected purposefully because the present researcher has been working there, so he could get better cooperation than other areas.

The target population consisted of 23,243 (male = 12,335 female = 10,908; grade 9 = 12,966 and grade 10 = 10,277) students who have been learning in the first cycle secondary schools, in the academic year 2004 E.C. in the Zone.

3.3 Participants and Sampling

There are 10 woredas and 1 Town Administration in the Zone. The Woredas were grouped in to four clusters according to their geographic characteristics (vicinity). To reach the participants of the study one school was selected randomly from each stratum of the Woredas and the Town Administration randomly. From the total 19 First Cycle Secondary Schools (Governmental First Cycle Secondary Schools) located in the Zone, 5 Schools (One school from the Town administration and the rest 4 from each of the cluster woredas) were selected using simple random sampling technique.

From the population of 8458 students in the selected First Cycle Secondary School students in 2004 academic year, 305 (50% male and 50% female) students were selected randomly within the schools. The sample size was determined on the basis of a table developed by Krejcie and Morgan as cited in Koul and Bhatt, (2001).The sample distribution of the students is shown in the following table.

Table 1: Sample Distribution of the Students

Cluster	Name of sampled schools	Number of students in the sampled schools			Number of sampled students of the strata		
		M	F	T	M	F	T
East	Fonko	530	298	828	16	16	37
Centeral (Town)	Yekatit 25/67	1576	1689	3265	55	55	110
North	Morsiot	462	529	991	18	19	32
West	Gimbichu	805	604	1409	24	24	48
South	Shone	1272	693	1965	39	39	78
Total = 19 Schools	5 Schools	4645	3813	8458	152	153	305

From the 37 mathematics teachers found in the selected schools who teach in the targeted grade level, 10 (27 %) teachers, 2 from each selected schools were participated by random sampling in the study. All school directors of the selected schools were included purposefully to get reliable and valid information about the issue. Similarly, focused grouped discussion was conducted by the participants of all Zonal Education Department experts and Woreda Education Office Leaders – called technique committee, selected purposefully as they are the frontier stakeholders of the education process in the Zone. The discussion was made in Amharic language and then translated to English for the analysis.

3.4 Data Gathering Instruments

The data gathering instruments of the study include questionnaires, interviews and focused group discussion used as a data collection instruments. The detail of each of these is presented as follows.

3.4.1 Questionnaire

This tool helped the researcher to get perceptions (opinions) of the students about the factors that influence mathematical achievement and it was the major tool to collect the data. The items were adapted from TIMSS (Trends in International Mathematics and Science Study) based on observation readings and the comment of advisor. The instrument was consisted of two sections (in which the first section contains three parts and the second section contains one). The first part consisted of school - related factors in which 14 items were about teachers' competency and 17 items were related to school contexts and facilities. The items were measured using five point Likert Scales "Very Effective, Effective, Less Effective, Ineffective and No Comment for teacher competency; Very High, High, Low, Very Low and No Comment for School Contexts and Facilities."

The second part consisted of student – related factors in which 6 items were related to students self directed learning and 7 items were related to students motivation. These items were measured using five point Likert Scale "Strongly agree, Agree, Disagree, Strongly Disagree

and No Comment." The third part consisted of 4 items which were related to the influences of the factors among the male and female students and measured using five point Likert Scale "Strongly agree, Agree, Disagree, Strongly Disagree and No Comment." For all the items of section one, students marked their responses in related columns on the charts.

Finally in the second section of the questionnaires have consisted of an open ended question to allow the students give their intention up on the issues (See Appendex - A).

3.4.2. Interviews

The other instruments developed and used was interviews for the mathematics teachers and school principals of the selected schools. The interview was aimed to get more detail information on the factors that affect secondary school students' mathematics learning (See Appendex - B).

3.4.3 The Focus Group Discussion

To gather the reliable and valid information on the issue, the researcher has also used the discussion with Zonal Education Department Experts and all Woreda Education Office Leaders of the Zone (technique committee of education quality). The discussion has made in Amharic language and then translated to English for the analysis (See Appendex - C).

3.4.4 Document Review

Since the study focuses on students' learning of mathematics, review of 4 years mathematics result of grade 10 students of the Zone was naturally an important instrument of data collection. To gather further information on the determinant factors of learning, the researcher has assessed different years' students' scores of the Zone (the detail is presented in the statement of the problem and Appendix D).

3.5 Procedures in Data Gathering

3.5.1. About Reliability and Validity of the Instruments

Following the design and preparation of the instruments the questionnaire and the interviews was submitted to the researcher colleagues for a comment. Its purpose was to check the appropriateness of the items in the instrument and to make the necessary correction based on the obtained feed backs.

The advisor of the researcher has also validated the questionnaire and shaped in a way to gather relevant information.

On the other hand, the reliability of the questionnaires has also kept by using pilot study (The detail is presented in the pilot study topic of this study).

In general, the reliability and validity of the study has been kept by using as many methods as possible (triangulation), for both collection and analysis of data.

3.5.2. Piloting the Instrument

The pilot test was administered among 20 students (7%) of total sample population of the students to cheek the reliability of the items in the questionnaire of the study. 16 items in which option 5 representing strongly agree, 4 representing agree, 3 representing disagree, 2 representing strongly disagree and 1 representing no comment was conducted for each parts of the part 1 & 2. And 14 items with similar scales was conducted for part 3 and 4 collectively. Lastly, 6 items with similar scales was conducted for part 5. The variables to which the items (two items for each independent variables) were focused are teacher competency, school contexts & facilities, students self directed learning, motivation and the difference of the influence of the factors among boys and girls.

After the response was collected, the split half method was applied by dividing the questions in to odd (O) and even (E). Then the reliability of the questionnaire of the pilot study was correlated by Spear Man Brown Prophecy formula using the reliability coefficient calculated by Pearson correlation formula. The reliabilities for these factors are 0.72, 0.74, 0.65 and 0.63 respectively. After approving the reliability of the items, only few amendments were made on questionnaire before

the final version was prepared. Thus, based on feedback from the pilot test the items were improved and final copies of the questionnaire were distributed to the respondents (Refer Appendex - E).

3.5.3 Data Gathering Procedures

After the data collection instruments were prepared and pilot-tested to obtain reliability, the selected school directors were contacted and the purpose of the study was explained. And yearly calendar was reviewed to identify the most appropriate date and time of participants for the actual subjects' retrieve. It was in the month May, in which teachers cover most of their portions and the students more or less finishes their academic year education plan. Prospective participants were reached through classes reserved for tutorial purposes with the help of mathematics teachers of the selected schools. To decrease the probability of getting unreliable data, the purpose of the study was explained for respondents by the present researcher and their voluntary participation was requested.

The questionnaire was administered on individual bases face to face by the researcher in order to give additional explanation in the reply of the questionnaire and to avoid discussions. Participants were allowed to fill the questionnaire without time limit and then collected after they completed. And the researcher conducted the interviews for the school directors and the mathematics teachers in each selected schools individually and collected the relevant data. Lastly a one day

CHAPTER FOUR PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

The purpose of this study was to identify the extent that school - and student - related factors influence mathematics learning as well as to examine the difference of the influences among the boys and girls of students in first cycle secondary school. For this purpose the data has been gathered from students, teachers, directors and educational expertise using questionnaires, interviews, focused group discussion and document analysis.

In this chapter, data obtained by the above ways are presented in quantitative and qualitative ways. The response to each research question is analyzed from quantitative and qualitative data.

4.1. General Characteristics of Respondents

The number of students that responded to questionnaires is 305. The general characteristics of the respondents are presented below.

Table 2: Characteristics of the Student

Sex	**Grade**			**Age**		
	9	**10**	**Total**	**Below 13**	**13 - 16**	**Total**
Male	75	77	152	67	85	152
Female	75	78	153	84	69	153
Total	150	155	305	151	154	305

From 305 sample students, 150 were from grade nine and 155 were from grade 10. And regarding sex, 152(75 from grade 9 and 77 from grade 10) are male and 153(75 from grade 9 and 78 from grade 10) are female students. In the case of age group, student that fall in the age range below or equal to 13 years were 151(49.5%) and that fall in the interval 14 - 16 years were 154(50.5%).

As indicated in the table 3 below, five School directors (one from each selected schools), 10 mathematics teachers (two from each selected schools) and 24 education experts were participated in the sample for the interviews. Their characteristics are presented below.

Table 3: Characteristics of the School Directors, Mathematics Teachers and Education Experts by Sex and Age

Respondents	Sex		Age in years					
	M	F	21- 25	25 - 29	29 - 33	33 - 37	37 - 41	Total
Teachers	10	-	-	3	3	2	2	10
Directors	5	-	2	1	2	-	-	5
Experts	23	1	4	5	7	5	3	24
Total	38	1	6	9	12	7	5	39

In the case of gender 38 (97%) of the participants were males and the remaining 1 (3%) was females, that participated in the interviews and the group discussions.

The teachers and directors participated in the interviews were males. This is because there is neither female teacher who teach mathematics in grade 9 and 10 nor director who are females in the selected schools. Here obviously, there is a gender imbalance between male and female participants.

In the case of age, participants which fall within the age interval 21 - 25 years were 6(15%), 25 - 29 years were 9(23%), 29 -33 years were 12(31%), 33 – 37 years were 7(18%) and the remaining 5 (13%) fall within the age interval 37 - 41years. Here the majority of the participants are adults that fall within the age interval 29 - 33 years and they are expected to have better understandings about factors that influence academic achievements due to the knowledge and practices they have on the education field. The remaining 24 participants were participated in the focused group discussion.

Table 4: Characteristics of the School Directors, Mathematics Teachers and Education Experts by Educational Backgrounds and Service Years

Respondents	Educational Back ground			Service Year					
	First Degree	Second Degree	Other	1 - 5	5 - 10	10 - 15	15 - 20	20 - 25	25 - 30
Teachers	10	-	-	6	2	2	-	-	-
Directors	2	3	-	-	2	2	1	-	-
Experts	20	4	-	3	4	4	6	3	4
Total	32	7	-	9	8	8	7	3	4

As shown in table 4 above, those having first degree are 32(82%) and those having second degree are 7(18%).

And regarding with their experiences, experts with 1-5 years of experience are 9(23%), with 5 – 10 years of experience are 8(20%), with 10 – 15 years of experience are 8(20%), with 15 – 20 years of experience are 7(18%), with 20 – 25 years of experience are 3(8) and with 25 – 30 years of experience are 4(10%). From this, it is possible to see a large number of participants have good relevant educational experiences. In general the majority of participants in interview and group discussion are male, those lie within age range 29 – 33 and have average work experience with relevant educational background.

4.2 Data Analysis

4.2.1 The Extent to which School Level Factors Influence Students' Mathematics Learning.

The first concern of this study was to examine to what extent do school level factors; including, teacher competency and school contexts and facilities influence students' learning in mathematics.

4.2.1.1 The Extent to which Teachers Competency Influence Students' Mathematics Learning.

The instrument set for the factor teacher competency, was consisted of 14 items with a 5 point Likert Scaled instrument.

The descriptive statistics presentation and analysis using the scores of the respondents was presented as follows.

Table 5: Summary of Data on Teacher's Competency

Factor	N	Mean ($\overline{X}$)	Std. Deviation
Teacher Competency	305	58	3.9

As indicated in the table 5 above, participants' response shows that school level factors influence students' mathematics learning greatly (with mean score, $\overline{X}$ = 58 and Standard deviation = 3.9). When it is observed in terms of the number of items its mean value is 4.1, which shows that teachers competency influence students' mathematics learning strongly.

When an independent t-test is computed to assess the statistical significant difference between groups of the respondents, the results are as presented below.

Table 6: An Independent T – test Results on Teachers Competency

		N	Mean	Std. Dev.	t	df	Sig. (2-tailed)	P-value
Grade	9th	150	57.67	4.03	1.9	303	0.057	<0.05
	10th	155	58.52	3.78				
Gender	Male	152	57.6	4.1	-2.1	303	0.037	<0.05
	Female	153	58.6	3.7				
Age	Under 13 years	151	58.2	3.9	0.5	303	0.628	<0.05
	13 – 16 years	154	57.99	3.9				

As indicated in table 6 above, there is no significant difference between grade 9 and grade 10 respondents ($t=1.9$, $df = 303$, $p<0.05$) since the significance (0.057) is *greater* than the sampling error (0.05) (Muijs 2004). Similarly no significant difference between age groups under 13 and the age groups 13 – 16 years in which the respondents are categorized ($t= 0.5$, $df = 303$, $p<0.05$). This shows that the influence of teachers' competency for grade 9 and 10 students on mathematics learning is similar.

On the other hand, there is a statistical significant difference between male and female group ($t = -2.1$, $df = 303$, $p<0.05$), since the significance is less than 0.05.

Participants' response from the open ended questions, interviews and focused group discussion about teacher competency analyzed thematically is presented as follows. The participants noted the degree of the influence of teacher competency on students' mathematics learning based on their experiences that they had encountered in their working places. Accordingly, the theme ideas and their details of their response is summarized as follows;

Teachers play the frontier role in students' learning of mathematics.

Under this theme, participants' response stressed that teachers' competency influences students' mathematics learning because he/she leads the students' learning by:-

- Demonstrating to the students how to do mathematics problems.
- Explaining to the student rules and definitions to every lesson in mathematics and
- Giving students group and/or individual project works on Mathematics to enable the students to share experiences.

As expressed by the participants of the open ended questions like; "... a mathematics teacher is Mathematics specialist and classroom director of the grade level."

To develop students' learning of mathematics a teacher has to be successful in applying student - centered and active teaching approaches

Accordingly, a teacher (especially a mathematics teacher) has to understand the individual differences of his students and has to teach accordingly. And a teacher has to be effective in planning to create student's interest on the subject. One of the interviewees answered the interview question "Do you think teacher competency of mathematics education influence strongly students' mathematics learning? If yes, how?" as "Teacher competency on mathematics education influence strongly students' mathematics learning because it is the teacher who create student's interest on the subject and monitor the students learning by giving feedback to students or to their parents about the student's performance."

One of the other interviewees in the response of the extensions of the questions of the interview forwarded the idea "If a mathematics teacher is not competent, his students cannot be competent because he cannot use suitable teaching aids and teaching methods depending on the students' ability other than the common lecture methods". It is possible to suggest from this that to improve students' critical thinking or problem solving skills in mathematics, teachers' competency is very important. Effective and competent teachers use the principles and techniques of a good teacher so that he/she can improve the students learning and in turn

their achievement. Learning occurs when active participation (student centered approach) of the learners is insured.

The other interviewees in response to the question, "Do you think teacher competency of mathematics education influence strongly students' mathematics learning? If yes, how?" also said, "It influence strongly. To increase students mathematics learning, the major roles is that of the teachers". Hence a teacher needs to plan for the active involvement of the students in the instruction so that their learning will be enhanced.

This finding is supported by many investigations. Broussard and others mentioned the role of a teacher as that of facilitating and monitoring to create highly motivated students that can make reasoning, interpretations, and can solve problems, mathematical issues, and concepts (Broussard et al. 2004). In their further explanations a teacher has a role of coach, acting as a mentor, assistant and collaborator who with blend of empathy, guides and instructs. Darling also point out that teachers have to prepare an ever more diverse group of students for much more challenging work like 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).

It is well known that teacher competency is closely linked to student thinking, understanding and learning in mathematics education. Competent mathematics 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. Ball and others also showed that there is no doubt that students' learning in mathematics 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.

Much of the students' educational achievements also depend up on the teachers' beliefs, expectation and attitude about their students learning and achievement. Coombs supports this in that the quality of education and learning of students depend heavily on competence, personality and education of teachers (Coombs, 1985). Accordingly, what teachers know and believe about mathematics is directly connected to their instructional choices and procedures.

Hence, 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). They need to have skills and knowledge to apply the philosophy of teaching and instructional decisions.

In general, the role of a teacher is an essential link in the relationship between the teachers function (diagnosis, mediating and facilitating) and his/her behavior and attitude. He/she is Mathematics specialist, classroom director as employee and curriculum implementer.

4.2.1.2 The Extent to which School Contexts and Facilities Influence Students' Mathematics Learning.

To examine to what extent school contexts and facilities influence students' mathematics learning, one of the instruments used was a survey instrument consisted of 17 items with a 5 point Likert Scaled. The respondents' answers were put in SPSS for the analysis and analyzed as follows.

Table 7: Summary of Participants' Responses on School Contexts and Facilities

Factor	N	Mean ($\overline{X}$)	Std. Deviation
Teacher Competency	305	69.2	4.55

As indicated in the table 7, school contexts and facilities influence students' mathematics learning very effectively (with mean score, $\overline{X}$ = 69.2 and Standard deviation = 4.55 and in terms of the number of items its mean value is 4.07). This shows that school contexts and facilities influence students' mathematics learning strongly.

When an independent t-test is computed to assess the statistical significant difference between groups of the respondents, the results are as presented below.

Table 8: An Independent T – test Results on the Factor of School Contexts and Facilities

		N	Mean	Std. Dev.	t	df	Sig. (2-tailed)	P-value
Grade Level	9th	150	68.4	4.6	-2.775	305	0.006	<0.05
	10th	155	69.8	4.4				
Gender	Male	152	68.5	4.7	-2.758	305	0.006	<0.05
	Female	153	69.88	4.3				
Age	Under 13 years	151	68.6	4.4	-2.261	305	0.024	<0.05
	13 – 16 years	154	69.8	4.7				

As shown in the table 8, there is a significant difference between grade levels, gender and age. Their t- values are ($t= -2.775$, $df = 303$, $p<0.05$), ($t= -2.758$, $df = 303$, $p<0.05$) and ($t= -2.261$, $df = 303$, $p<0.05$) respectively. This shows that there is mean difference between grade 9 and 10 students, between male and female students as well as between students fewer than 13 and in between 13 to 16 age groups concerning the influence of school contexts and facilities.

Participants' response for the open ended questions, answered repeatedly for the items on the factor school contexts and facilities is presented as follows.

School contexts and facilities such as adequate availability of school facilities, instructional materials and quality teachers have greater impact on students learning mathematics.

School contexts and facilities are the major factors in determining students learning. Instructional materials (e.g., textbooks, references materials, etc), qualified teachers and facilitated buildings for mathematics instructions are the outmost inputs to improve learning. Because learning requires availability of facilitated environment and planed context of learning. As expressed by one of the interviewees as "as schools are environments at which learning occurs, it must be improved and equipped with instructional materials and learning experiences in order to improve students' learning particularly in mathematics." This shows that it is the school contexts and facilities that engage students learning. Again it was added by the other interviewee "societal (PTA) contribution in reviewing school finances and plans need to be maximized to make the schools suitable for learning of all subjects in general and mathematics in particular."

With regard to this, Heartel (1981) revealed that perception of classroom environment as critical factor in determining students' actions such as motivation, achievement and satisfaction. According to him, the issue of teaching mathematics within a good educational environment is deeply related with the idea of being facilitator because students (especially females) need an appropriate environment where they can understand a mathematical knowledge in more active ways.

Reyonds and others add that student's learning is associated with a safe and orderly school climate (Reyonds et al., 1996). According to Haile, in developing countries including Ethiopia, school contexts and facilities such as adequate availability of school facilities, instructional materials and quality of teachers have more impact on students learning (Haile, 2002).

School stakeholders and family need to participate to increase school contexts and facilities in order to increase students' learning of mathematics.

School leaders and mathematics departments need to be monitored and supported so that they can be initiated to supply the inputs in mathematics learning. As explained by one of the interview participants "To make the students like the subject and build a positive attitude towards the subject, parental follow up and support on their children's learning is very important."

Lewin (1936), as quoted by David (2001) proposed that human behavior is a result of two independent influences the person and the environment. Moos (1997), as quoted by Back (2002) argued similarly.

Other researchers have shown the positive relationship between the school variable and students' attitudes towards mathematic (Jacobs, 1974; Field, 1975; Evans, 1978). Mammalian (1992) also provided evidence that aspects of the classrooms learning or climate are positively related to Mathematics attitude. He relates it as teaching mathematics within a good educational environment (school contexts) is deeply related with the idea of teaching attractively being facilitator because appropriate environment make the students to understand a mathematical knowledge in more active ways.

Therefore, school contexts and facilities determine students' mathematics achievement greatly (supplementing the quantitative analysis of the study).

4.2.2. The Extent to which Student Level Factors Influence Students' Learning in Mathematics.

The second research question investigated to what extent student - level factors categorized as self-directed learning and motivation or concentration influence first cycle secondary school students' mathematics learning.

4.2.2.1 The Extent to which Students Self-directed Learning Influence Students' Learning in Mathematics.

The survey instrument of 6 items related to the students self directed learning, with a 5 point Likert Scale was administered to the participants of the questionnaires. The descriptive statistics presentation and analysis using the scores of the respondents was presented as follows.

Table 9: Summary of Responses on Students' Self Directed Learning

Factors	N	Mean ($\bar{X}$)	Std.dev
Students' Self Directed Learning	305	24.4	2.6

As indicated in the table 9, students' response shows that student self directed learning influence students' mathematics learning strongly (with mean ($\bar{X}$) = 24.4 and Standard deviation = 2.6). When it is observed in terms of the number of the items of the student self directed learning, the mean score equals 4. This shows that student self directed learning influence students' mathematics learning strongly.

An independent t-test to assess the statistical significant difference between groups of the respondents was computed as follows.

Table 10: An Independent T – test results on the Student Self Directed Learning

		N	Mean	Std. Dev.	t	df	Sig. (2-tailed)	P-value
Grade Level	9th	150	24.40	2.8	-0.065	305	0.948	<0.05
	10th	155	24.42	2.4				
Gender	Male	152	24.24	2.5	-1.12	305	0.266	<0.05
	Female	153	24.57	2.6				
Age	Under 13 years	151	24.41	2.8	0.005	305	0.996	<0.05
	13 – 16 years	154	24.40	2.4				

As shown in the table 10, there is no significant difference between grade levels, gender and age. Their t- values are ($t = -0.065$, $df = 303$, $p<0.05$), ($t = -1.12$, $df = 303$, $p<0.05$) and ($t = 0.005$, $df = 303$, $p<0.05$) respectively. This shows that there is no mean difference between grade 9 and 10 students, between male and female students as well as between students fewer than 13 and in between 13 to 16 age groups concerning the influence of students self directed learning.

The qualitative data also shows students' self directed learning influence students' mathematics learning strongly.

Students need to do well in mathematics knowing the purpose that it has in their daily life.

As discussed in the literature part(2.3.2) of this study, there is no perfect, well-structured, planned or prescribed system that lets students think and act mathematically unless and otherwise, students play their assigned roles in their learning progress.

One of the participants in the focused group discussion mentioned as "One of the factors that hinder students' academic learning and their future study is that the students do not work or study mathematics deliberately". According to the participant, the reason that students need to do well mathematics is to learn other school subjects quickly and to get into the university or college of their choice.

Knowles notifies self-directed learning as it has an important place in successful mathematics learning in that 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). Took & Lindstrom (1998) connect self – directed learning with attitude that the students have. Accordingly, students who have high level of positive attitude in mathematics will have high level of self directed learning in life (in mathematics).

Therefore, as it is essential in learning mathematics, students need to play their assigned roles in their learning progress.

4.2.2.2 The Extent to which Students' Motivation Influence Students' Learning of Mathematics.

The survey instrument of 7 items related to the students' motivation, with a 5 point Likert Scale was administered to the participants of the questionnaires. The descriptive statistics analysis using the scores of the respondents was presented as follows.

Table 11: Summary of Responses on Students' Motivation in Learning Mathematics

Factors	N	Mean ($\overline{X}$)	Std.dev
Students' Motivation	305	28.1	2.9

As indicated in the table 11, students' response shows that students' motivation influence students' mathematics learning strongly (with mean ($\overline{X}$) = 28.1 and Standard deviation = 2.9). When it is observed in terms of the number of the items of the students' motivation, the mean score equals 4. This also shows students' motivation influence students' mathematics learning strongly.

An independent t-test to assess the statistical significant difference between groups of the respondents on the factor was computed as follows.

Table 12: An Independent T – test Results on the Students' Motivation in Learning Mathematics

		N	Mean	Std. Dev.	t	df	Sig. (2-tailed)	P-value
Grade Level	9th	150	27.99	2.8	-0.629	303	0.53	<0.05
	10th	155	28.2	2.9				
Gender	Male	152	27.88	2.9	-1.3	303	0.188	<0.05
	Female	153	28.31	2.8				
Age	Under 13 years	151	28	2.7	-0.55	303	0.58	<0.05
	13 – 16 years	154	28.18	2.99				

As shown in the table 12, there is no significant difference between grade levels, age and gender ($t= -0.629$, $df = 303$, $p<0.05$; $t= -0.55$, $df = 303$, $p<0.05$ and $t= -1.3$, $df = 303$, $p<0.05$respectively).

This shows that there is no mean difference between grade 9 and 10 students; between students of age fewer than 13 and in between 13 to 16 groups and between male and female students, which shows that the influence of students' motivation in learning mathematics is similar among the groups.

Similar discussions are observed from the interviews, open ended questions and focused group discussion. The following points could be generalized in what and how motivation influence students' mathematics learning.

The subject mathematics requires highly motivated students.

Mathematics education requires highly motivated students because it requires reasoning, making interpretations, and solving problems, mathematical issues, and concepts. Broussard and Garrison concluded in their investigation that motivation has an important place in successful mathematics learning in that students can take the initiative in their learning by diagnosing their needs, formulating goals, identifying resources for learning, and evaluating or monitoring learning(Broussard and Garrison: 2004).

Participants in the interviews justified that the issue requires the attention of all school community. It was said as "students, teachers and students' family show less attention, motivation, interest and intelligence in learning such a 'calculation subject' thinking as if it is a hard science and requires some gifted mind that takes more time, effort and devotion". The another interviewee also suggested as: "... as it has important place in their learning, schools and teachers have to do their planed job of assigning students to different programs or tasks and planning for students future lessons and collecting, correcting, keeping and then returning assignments to students."

From these, the role of schools and that of teachers is to engage students to have positive attitude towards mathematics by helping to organize and assist them as they take the initiative in their own self-directed explorations, instead of directing their learning autocratically. Students who have high level of positive attitude in mathematics will have high level of mathematics achievement and hence highly motivated in learning mathematics.

Researches also show that competition for rewards can stimulate students to learn (Tauer and Harackiewicz, 1999; Tyler et al., 2006). Schools which have shown high performance in comparison studies are characterized by a competitive academic atmosphere.

Therefore, subject interest is the main predictor of students' academic performance (learning). Students with higher subject interest are motivated for more self-regulated learning strategies and show higher performance than students with lower subject interest (Pintrich, 1999; Pokay and Blumenfeld, 1990; Schiefele, 1992). Based on these, motivation on mathematics education is very influencing factor for learning mathematics.

4.2.3. Do School - Level Factors Influence Female Students more than that of Male Students?

The instrument set for the factor, was consisted of 2 items with a 5 point Likert Scale. The descriptive statistics using the scores of the respondents was presented as follows.

Table 13: Summary of Participants' Responses on Gender wise Influence of the School Level Factors

No	Items	N	Mean	Stan. deviation
1	Influence of teachers' competencies of mathematics education is greater on girls than on boys	305	4.13	0.89
2	Influence of school context and facilities is greater on girls than on boys	305	3.95	1.041
	Total	**305**	**8.088**	**1.38**

As indicated in the table 13 above, participants' response shows that school level factors influence female students' mathematics learning greatly than that of male students (with mean score, $\overline{X}$ = 8.088 and Standard deviation = 1.38). When it is observed in terms of the number of items its mean value equals 4, which shows that the factors influence female students' mathematics learning strongly. From school related factors, influence of school context and facilities is greater on girls than on boys, when compared to teachers' competency.

Independent t-test results computed to assess the statistical significant difference between the groups of the respondents are presented below.

Table 14: An Independent T – test Results on Gender wise Influence of the School Level Factors

		N	Mean	Std. Dev.	t	df	Sig. (2-tailed)	P-value
Grade	9th	150	8.1	1.36	0.142	303	0.887	<0.05
	10th	155	8.07	1.4				
Gender	Male	152	8.06	1.4	-0.286	303	0.775	<0.05
	Female	153	8.11	1.36				
Age	Under 13 years	151	8.086	1.4	-0.03	303	0.976	<0.05
	13 – 16 years	154	8.09	1.37				

From table 14 one can see that, there is no significant difference between grade 9 and grade 10 respondents ($t=0.142$, $df = 303$, $p<0.05$), between males and females ($t=-0.286$, $df = 303$, $p<0.05$) and between age groups under 13 and from 13 to 16($t=-0.03$, $df = 303$, $p<0.05$). This shows that school related factors influence females more than that of males.

Participants' response from the open ended questions, interviews and focused group discussion about the gender wise influence of school level factors is presented as follows.

School contexts and facilities determine female students' mathematics learning more than that of male students.

The curriculum relevance, teacher's efficiency and generally the school feasibility should be adjusted so as to deliver the modern and updated skill, knowledge and attitudes to its client fairly for both girls and boys. Most of the researchers studied on the issue so far agree that there is no reason why women cannot succeed in mathematically demanding fields. There is a fact in most schools most mathematics teaches is males (in grades above 5) and this is taught to present strong message of male dominance of mathematics learning. Boswell (1985) argued that family, socio- economic status of parents, cultural and traditional influences influence girls' mathematics learning. Such factors were believed to be significant in the trend toward learning of mathematics and could influence girls on subject and job selection.

Despite these conclusions girls still are underrepresented in mathematics (Barton: 1998, Sinnes: 2006). These studies stress that initiatives to build on the assumption that females and males are equal in their approach to mathematics and the inequality in it is caused by external factors (Social, educational or political), which would be focused on removing these external obstacles.

Gender inequality in providing exactly the same opportunities and challenges that favor male, has remained as problem (UNESCO, 2003; Sileshi, 1995; Mulatu, 2011) in our secondary schools.

Teachers and schools treat boys and girls differently in mathematics learning (favoring male students).

Schools do not treat boys and girls in mathematics learning as a result of society. Investigators suggested that teaches and schools treat boys and girls differently (favoring male) in mathematics classes and that this differential treatment reinforces sex difference in achievement of mathematics as a male dominant (Jakobson, 1985; Fennema, 1980; Fox, 1981). Female students need to be motivated in mathematical problem solving activities, as explained by one of the interviewee as "mathematics is a male dominant subject that is why most of mathematics teachers are male". Schools need to be appropriate for both males and female students. School environments' appropriateness to teaching - learning process, especially to girls need to be improved in order to acquire the desired behavioral changes among boys and girls equally. Providing exactly the same opportunities and challenges for both girls and boys makes fair mathematics learning.

Therefore, school related factors influence female students more than that of male students in mathematics learning.

4.2.4. Do Student - Level Factors Influence Female Students more than that of Males?

The instrument set for the influence of student - level factors was consisted of 2 items with a 5 point Likert Scale. The descriptive statistics using the scores of the respondents was presented as follows.

Table 15: Summary of Participants' Responses on the Gender wise Influence of the Student Level Factors

No	Items	N	Mean	Stan. deviation
1	Influence of self-directed learning is greater on girls than that of boys	305	4.05	0.972
2	Influence of motivation of Students is greater on girls than that of boys	305	4.06	0.943
	Total	**305**	8.1	1.4

As indicated in the table 15 above, participants' response shows that student level factors influence female students' mathematics learning greatly than that of male students (with mean score, $\overline{X}$ = 8.1 and Standard deviation = 1.4). When it is observed in terms of the number of items its mean value equals 4, which shows that the factors influence female students' mathematics learning strongly. From student level factors students self directing learning has a greater score (mean ($\overline{X}$) = 4.05 and st.dev = 0.972) and it shows that it more influence girls, than boys.

Independent t-test results computed to assess the statistical significant difference between the groups of the respondents are presented below.

Table 16: An Independent T – test Results on the Gender wise Influence of the Student Level Factors

		N	Mean	Std. Dev.	t	df	Sig. (2-tailed)	P-value
Grade	9th	150	8.11	1.4	0.127	303	0.899	<0.05
	10th	155	8.09	1.39				
Gender	Male	152	8.087	1.42	-0.184	303	0.854	<0.05
	Female	153	8.11	1.37				
Age	Under 13 years	151	8.086	1.399	-0.192	303	0.848	<0.05
	13 – 16 years	154	8.11	1.4				

Table 16 shows that there is no significant difference between grade 9 and grade 10 respondents (t=0. 127, df = 303, p<0.05), between males and females (t=-0.184, df = 303, p<0.05) and between age groups under 13 and from 13 to 16 (t=-0.192, df = 303, p<0.05). This shows that all the groups agree similarly on that student related factors influence females more than that of males. Participants of the interview and focused group discussion also suggested similarly as follows.

Mathematics learning requires disciplined study, concentration and motivation, particularly for female students.

As suggested by one of the interviewees of the present study, "Students' willingness towards Mathematics initiated by him/her self as well as motivated internally/externally is believed to play a significant role in learning mathematics", students (particularly female students) need to play their assigned roles in their learning progress.

It is supported by the investigators such as Knowles, who concludes self-directed learning as it has an important place in successful mathematics learning in that 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). According to Took & Lindstrom students who have high level of positive attitude in mathematics will have high level of self directed attitude in life (Took & Lindstrom 1998).

Students also need to be satisfied internally in what they do in the class, and they need to be externally motivated to be successful in their mathematics learning. Bandura (1977) claims that an individuals' expectation of their individual ability to successfully perform a given task is a reliable predictor of whether or not they will attempt the task, the amount of effort they will expend and their level of perseverance in the face of unanticipated difficulties. Broussard and Garrison (2004) also examined the relationship between classroom motivation and academic

achievement in elementary-school-aged children (122-first grade and 129-third grade participants). They concluded that for a higher level of mastery, motivation was related to higher math grades.

Therefore, Mathematics learning requires a student who is highly motivated and initiated by himself to face doing mathematical activities like reasoning, making interpretations, and solving problems, mathematical issues, and concepts.

To sum up, teacher competency in Mathematics education, school context and facilities, students' self directed learning and motivation influence female students more than that of males on their mathematics learning.

CHAPTER FIVE SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1. Summary of the findings

The purpose of this study was to identify the extent that school - and student - related factors influence mathematics learning as well as to examine the difference of the influences among the boys and girls of students in first cycle secondary school. For this purpose the specific research questions set are:

1. To what extent do school level factors, including, teacher competency and school contexts as well as facilities influence students' learning in mathematics?
2. To what extent do student level factors, including, motivation and self-directed learning influence students' learning in mathematics?
3. Do school - level factors influence female students more than that of males?
4. Do student - level factors influence female students more than that of males?

To this effect, as shown in the last chapter the descriptive survey approach was employed as method of study to answer the aforementioned questions. The instruments used to the study are the questionnaires, interview and focused group discussion as the main data collecting tools. The data collected through questionnaires were

organized and analyzed quantitatively using descriptive analyses and an independent t - test. The data collected through open ended questions, interviews and focused group discussion was organized and analyzed qualitatively by deriving theme idea from each qualitative data on the basis of the factors.

On the basis of the analysis made on the data secured through the above ways, the major findings of the study are summarized as follows.

1. It was found that teacher's competency of mathematics education influence students' mathematics learning strongly (with mean score, $\overline{X}$ = 58 and Standard deviation = 3.9). An independent t – test also revealed that there is no significant difference between students of grade 9 and 10 ($t=1.9$, $df = 303$, $p<0.05$) as well as students of age group under 13 and from 13 – 16 ($t= 0.5$, $df = 303$, $p<0.05$), where as there is a significant difference between male and female students ($t= -2.1$, $df = 303$, $p<0.05$).
   It was also analyzed from qualitative data that teachers need knowledge of subject matter of mathematics and need to have pedagogical knowledge and knowledge of their students. i.e., as a competent teacher, teachers play the frontier role in students' mathematics learning by:-
   - explaining to the student rules and definitions to every lesson in mathematics
   - understanding the students' individual differences and teach accordingly.

- being successful in applying student centered and active teaching approaches
- planing for the active involvement and interest of every and each student on the subject and topic of mathematics so that their learning will be ensured.

This finding concurs with MOE (1995), Chaube (1996), Coombs (1985), Brophy (1990), Brown (1985), NaCTM (1989), Thompson (1992), Wilson (1990a, b), Bransford et al., (2000) which underlines that teachers not only need knowledge of a particular subject matter but also need to have pedagogical knowledge and knowledge of their students to enhance their learning.

2. The second finding of this study suggests that school contexts and facilities influence mathematics learning of the first cycle secondary school students greatly (with mean score, $\overline{X}$ = 69.2 and Standard deviation = 4.55). From an independent t – test analysis there is a significant difference between groups of the students by grade 9 and 10, by age fewer than 13 and from 13 – 16 as well as by male and female students ($t = -2.775$, $df = 303$, $p<0.05$), ($t = -2.758$, $df = 303$, $p<0.05$) and ($t = -2.261$, $df = 303$, $p<0.05$) respectively.

Here it is revealed that to make the schools suitable in learning mathematics:-

- Adequate availability of school facilities, instructional materials and quality teachers of mathematics have more impact on students learning mathematics.
- School stakeholders especially, family need to participate in schools to increase the students' learning in mathematics by providing:-

  a) instructional materials (e.g., textbooks, references, boards, etc) of mathematics,

  b) school buildings and instructional spaces (e.g., classrooms) and

  c) library materials relevant to mathematics instruction.
- School directors, mathematics department leaders and education office experts have to give special attention to the provision of teaching - learning materials(including reference books), to develope students attitude toward mathematics and to capacitate teachers with the effective teaching – learning process.

It supports the findings of Heartel (1981), which is stated as that perception of classroom environment is critical factor in determining students' actions such as motivation, achievement and satisfaction. According to him, the issue of teaching mathematics within a good educational environment is deeply related with the idea of being facilitator because students (especially females) need an appropriate

environment where they can understand a mathematical knowledge in more active ways. Reyonds and others also add that student's learning is associated with a safe and orderly school climate (Reyonds et al., 1996). According to Haile, in developing countries including Ethiopia, school contexts and facilities such as adequate availability of school facilities, instructional materials and quality of teachers have more impact on academic achievements (Haile, 2002).

3. The third finding of this study suggests that students' self directed learning influence highly their mathematics learning (with mean ($\overline{X}$) = 24.4 and Standard deviation = 2.6). An independent t – test analysis shows that there is no significant difference between grade levels, gender and age ($t = -0.065$, $df = 303$, $p<0.05$), ($t = -1.12$, $df = 303$, $p<0.05$) and ($t = 0.005$, $df = 303$, $p<0.05$) respectively.

   There is no perfect, well-structured, planned or prescribed system that lets students think and act mathematically unless and otherwise, students play their assigned roles in their learning progress.

   Therefore, students by themselves need to do well mathematics having understood the purpose that it has in their present and future life. i.e.,

   - It will help them in their daily life.
   - It helps them to learn other school subjects quickly.
   - It helps them to get into the university or college of their choice.

This is supported by literatures such as Knowles suggested that self-directed learning has an important place in successful math learning in that 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). Strommen & Lincoln proposes that, 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 & Lincoln, 1992). Took & Lindstrom connect self – directed learning with attitude that the students have. Accordingly, students who have high level of positive attitude in mathematics will have high level of self directed attitude in life (Took & Lindstrom 1998).

Therefore, self-directed learning has an important place in successful mathematics learning in that 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).

4. In the fourth place the finding shows that students' motivation for the subject influence greatly their mathematics learning (with mean ($\overline{X}$) = 28.1 and Standard deviation = 2.9). An independent t – test revealed that there is no significant difference between grade levels and the age categories ($t = -0.629$, $df = 303$, $p<0.05$; $t = -0.55$, $df = 303$, $p<0.05$ respectively). This shows that there is no mean difference between grade

9 and 10 students and between students of age fewer than 13 and in between 13 to 16 groups, which shows that the influence of students' motivation in learning mathematics is similar among the groups.

On the other hand there is significant difference between male and female students ($t= -1.3$, $df = 303$, $p<0.05$), which shows that there is mean difference between male and female students in that the influence of students' motivation varies from male to female students.

Mathematics education requires highly motivated students because it requires reasoning, making interpretations, and solving problems, mathematical issues, and concepts. In the focused group discussion it was concluded that:-

- Assigning students to different programs or tasks and
- Collecting, correcting, keeping and then returning assignments to students.
- Planning for the students' future lessons motivate the students, otherwise influence their learning mathematics.

Broussard and Garrison concluded in their investigation that motivation has an important place in successful mathematics learning in that students can take the initiative in their learning by diagnosing their needs, formulating goals, identifying resources for learning, and evaluating or monitoring learning(Broussard and Garrison: 2004).

Participants of the study justified that the issue requires the attention of all school community. It was said by one of the respondents of open

ended question, as "students, teachers and students' family show less attention, motivation, interest and intelligence in learning such a 'calculation subject' thinking as if it is a hard science and requires some gifted mind that can invest more time, effort and devotion". The another interviewee also suggested as: "... as motivation has important place in their learning, schools and teachers have to do their planed job of assigning students to different programs or tasks and planning for students future lessons and collecting, correcting, keeping and then returning assignments to students."

From these, stakeholders of schools need to play the role of in motivating the students to develop positive attitude towards mathematics by helping them to take the initiative in their own self-directed explorations, instead of directing their learning autocratically. Students who have high level of positive attitude in mathematics will have high level of mathematics achievement and hence highly motivated in learning mathematics.

Researches also show that competition for rewards can stimulate students to learn (Tauer and Harackiewicz, 1999; Tyler et al., 2006). Schools which have shown high performance in comparison studies are characterized by a competitive academic atmosphere. Students with higher subject interest use more self-regulated learning strategies and show higher performance than students with lower subject interest (Pintrich, 1999; Pokay and Blumenfeld, 1990; Schiefele, 1992). Tauer

and others addresses that competition for rewards can stimulate students to learn (Tauer and Harackiewicz, 1999; Tyler et al., 2006). Therefore, subject interest is the main predictor of students' academic performance (learning).

5. The other point investigated here is that there is a difference in the influence of school level factors among boys and girls. Participants' response shows that school level factors influence female students' mathematics learning greatly than that of male students (with mean score, $\overline{X}$ = 8.088 and Standard deviation = 1.38). From school related factors, influence of school context and facilities is greater on girls than on boys, when compared to teachers' competency.

   Independent t-test results computed to assess the statistical significant difference between the groups of the respondents show that there is no significant difference between grade 9 and grade 10 respondents ($t=0.142$, $df = 303$, $p<0.05$), between males and female students ($t=-0.286$, $df = 303$, $p<0.05$) and between students of age groups under 13 and from 13 to 16($t=-0.03$, $df = 303$, $p<0.05$). This shows that school related factors influence female students more than that of male students.

   Many investigators have discussed that teachers and schools treat boys and girls differently in mathematics classes and that this differential treatment reinforces sex difference in achievement of mathematics as a male dominant (Jakobson, 1985; Fennema, 1980; Fox, 1981). There is a

fact in schools (in grades above 5) most mathematics teaches are males and this is taught to present strong message of male dominance of mathematics achievement, which is the result of the influence in learning mathematics. Boswell (1985) argued that family, socio- economic status of parents, cultural and traditional influences influence girls' mathematics achievement. Such factors were believed to be significant in the trend toward learning of mathematics and could more influence girls on subject and job selection, than boys.

School environment need to be appropriate to teaching - learning process in order to acquire the desired behavioral changes among both girls and boys. The curriculum relevance, teacher's efficiency and generally the school feasibility should be adjusted so as to deliver the modern and updated skill, knowledge and attitudes to its client's fairly for both girls and boys.

6. The study also investigated that there is a difference in influence of student level factors such as students' self directed learning and motivation among boys and girls. The factors more influence girls, than boys (with mean score, $\overline{X}$ = 8.1 and Standard deviation = 1.4). From student level factors students self directing learning has a greater score (mean ($\overline{X}$) = 4.05 and st.dev = 0.972) and it shows that it more influence girls, than boys.

   There is no significant difference between grade 9 and grade 10 respondents (t=0. 127, df = 303, p<0.05), between males and females (t=-

0.184, df = 303, $p<0.05$) and between age groups under 13 and from 13 to 16 ($t=-0.192$, df = 303, $p<0.05$). This shows that all the groups agree similarly on that student related factors influence female students more than that of male students.

Female students need to be motivated in mathematical problem solving activities, as explained by one of the interviewee as "mathematics is a male dominant subject that is why most of mathematics teachers are male". Schools need to be appropriate for both males and female students. School environments' appropriateness to teaching - learning process, especially to girls need to be improved in order to acquire the desired behavioral changes among boys and girls equally. Sinnes and others stressed that initiatives to build on the assumption that females and males are equal in their approach to mathematics and the inequality in it is caused by external factors (Social, educational or political), which would be focused on removing these external obstacles (Sinnes, 2006; Barton, 1998). Providing exactly the same opportunities and challenges for both girls and boys has remained as problem (UNESCO: 2003; Sileshi: 1995; Mulatu: 2011).

Therefore, in school system it needs to give due consideration to the role of pupils and the effects of tracking and streaming on classroom learning (motivating) giving the boys and girls exactly the same opportunities and challenges.

5.2. Conclusion

On the basis of the analysis and interpretation of the collected perceptions, the following conclusions were drawn.

1. Teacher's competency of mathematics education influence students' mathematics learning strongly. Mathematics teachers need to play their main role of using interactive instruction methodology in their teaching learning process. i.e.,

    - Have to understand the individual differences of the students' and teach accordingly.
    - Need to plan to create student's interest on the subject.
    - Be successful in applying student centered and active teaching approaches.

2. School contexts and facilities are also revealed to influence students' mathematics learning greatly. It is a critical factor in determining students' actions such as motivation, achievement and satisfaction (Reyonds et. al., 1996).

    Appropriate library with updated mathematics reference materials and availability of teaching learning materials & equipments related to mathematics in optimum amount are outstanding points to be considered in teaching learning activities of mathematics.

3. The study also found that students' self directed learning influences students' mathematics learning significantly. It is suggested that (by this study) self-directed learning has an important place in successful mathematical learning in that 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). Papanastasiou (2000) also claims that solving problems requires patience, persistence, perseverance, and willingness to accept risks. Therefore, students have to:-

   - Develop attitude or interest in learning mathematics.
   - Need to take more time, effort and devotion to work mathematical problems according to its unique property, which concurs with

4. The other phenomenon revealed by the study is that students' motivation for the subject influences their mathematics learning. As discussed by this study, mathematics education requires highly motivated students because it requires reasoning, making interpretations, and solving problems, mathematical issues, and concepts (Broussard and Garrison; 2004). Therefore;

   - assigning students to different programs or tasks.
   - collecting, correcting, keeping and then returning assignments and tasks to students are not regular.

Improving school contexts and facilities as well as teachers' competency of mathematical education are significant factors that influence students' mathematics learning.

5. The study also investigated that there is a difference in the perceived effects of school level factors among boys and girls. Influence of teacher competency in education and school context and facilities is greater on girls' mathematical learning than that of boys.

   This may be because equal attention is not given to students, regardless of their gender. Since teachers' competency and school contexts as well as school facilities to treat and motivate boys and girls equally in their mathematical learning is not adequate, affirmative action need to be strengthened for girls to make the achievement distributed fairly across both sex.

6. It is also investigated that there is a difference in the perceived effects of student - level factors such as students' self directed learning and students' motivation among boys and girls. The factors more influence girls, than boys.

   As mentioned above, girls are not motivated and threatened equally as boys by the school stakeholders. And most of the mathematics teachers in first cycle secondary schools are male. These in turn, discourage the female students not to play their assigned roles in their learning progress.

Thus, to ensure students' learning in mathematics; teachers, students, education officials and other stakeholders of the education sector should play their own roles and responsibilities and should carry out their duty at the standardized performance in order to maximize the students' academic excelling, particularly that of mathematics.

5.3 Recommendations

Based on the conclusions of this study, the researcher offers the following recommendations for first cycle secondary schools in Hadiya Zone.

1. Mathematics teachers should provide competitive instruction in an interactive and/or in a collaborative way creating highly motivated students in order to build more practical learning environment. Literatures suggest that mathematics learning situations ought to be selected and implemented in a way that it allows the students to apply higher order operations (Wilson, 1996).

2. School directors, education experts and other stakeholders should improve school contexts and provide school facilities particularly related to mathematical instruction. Equipping the schools with mathematics teaching – learning materials, capacitating the mathematics teachers enabling them to provide competency based mathematics education for the level, and facilitating the students to be engaged in the teaching learning experiences actively are some laudable domains.

3. Schools should encourage students to take the initiative in their learning by diagnosing their needs, formulating goals, identifying resources for learning, and evaluating or monitoring learning outcomes. For this, mathematics clubs in which all the students participate actively, may be used in order to increase students' motivation, self directed learning and working habit of problem solving activities, preparing them to the required skills and competencies.

4. Mathematics departments should play their assigned roles of: -

   - Monitoring and evaluation of the attainment of learning goals (separately from teaching).
   - Creating a new position on empowering the mathematics teachers for the consistent scientific way of problem solving (conducting action researches on mathematics learning of students).

5. A Mathematics teacher should plan not only to cover the contents but also to ensure the students' learning in mathematics. The move from objectives-based to competency-based education (total educational outcome) should be evaluated constantly throughout the entire education structure and system.

6. Equal attention should be given to the students, regardless of their gender in mathematics learning. Teachers, school directors, education experts and students' representatives (councils) should promote both

male and female students' to be motivated and have their own self directed learning in mathematics.

7. Instructional designs, plans and strategies carried out at any level of the education system should give attention to the students' motivation and self directed learning in mathematics curriculum processes. Researchers suggest that high achievement is related to high motivation (Adelman and Taylor, 1986; Gottfried, 1985; Singh et al., 2002).

8. Students' commitment, motivation, confidence and their emotional feelings about learning mathematics should be supported constantly by investigations.

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Appendix A Students' Questionnaires

Addis Ababa University School of Graduate studies College of Education and Behavioral Studies Institute of Educational Research and Evaluation

Questionnaires for students

The purpose of these questionnaires is to collect information about factors influencing mathematics learning of first cycle secondary school students of Hadiya Zone. Your genuine responses and cooperation are very important in achieving the purpose of the study. Therefore, you are kindly requested to give sincere responses to all the questions. The researcher wants to assure you that this research is only for academic purpose and your ideas and comments are highly honored and confidential. Finally, the researcher would like to thank you in advance, for your time, effort, and thought in completing this questionnaire!

The researcher

Section I: Personal information

Respond by checking (√) one box only or filling in the appropriate response.

1. Name of your school:

Yekatit secondary school ☐ Fonko secondary school ☐ Morsito school ☐

Gimbichu secondary school ☐ Shone secondary school ☐

2. Are you female or male? Female ☐ Male ☐

3. What is your age? ☐

4. What is your grade? Grade 9 ☐ Grade 10 ☐

5. What about your marital status? Single ☐ Married ☐

Divorced ☐ widowed ☐

Section II: Information about factors influencing students' mathematics learning.

Respond by checking (√) one box only in each of the following rows.

1. **How much do you think the following teachers' competencies of mathematics education are effective in influencing mathematics learning of students?**

	Very Effective	Effective	Less Effective	Ineffective	No Comment
a) Demonstrates to the students how to do Mathematics problems.	☐	☐	☐	☐	☐
b) Connects lessons to students' everyday life.	☐	☐	☐	☐	☐
c) Explain to the students rules and definitions to every lesson in mathematics.	☐	☐	☐	☐	☐
d) Gives a quiz or test frequently	☐	☐	☐	☐	☐
e) Gives project works on mathematics	☐	☐	☐	☐	☐
f) Encourages students to work from worksheets or text books on their own.	☐	☐	☐	☐	☐
g) Allow the students to use computers and/or calculators.	☐	☐	☐	☐	☐
h) Make the students to use things from everyday life in solving mathematics problems.	☐	☐	☐	☐	☐
i) Make the students to work in pairs or in small groups.	☐	☐	☐	☐	☐
j) Give and Check student's homework frequently.	☐	☐	☐	☐	☐
k) Allow students to check each other's homework or group work	☐	☐	☐	☐	☐
l) Allow students to discussion on their completed work	☐	☐	☐	☐	☐
m) The use of board and overhead projector by the teacher to demonstrate ideas in mathematics	☐	☐	☐	☐	☐
n) Making the students to work individually, in pairs or in small groups with assistance from the teacher on a problem or project	☐	☐	☐	☐	☐

2. To what extent the following school context and facilities influence the students' mathematics learning?

	Very high	High	Low	Very low	No Comment
a) Instructional materials (e.g., textbooks, references, boards, etc) of mathematics.	☐	☐	☐	☐	☐
b) Budget for supplies (e.g., school & grant block)..	☐	☐	☐	☐	☐
c) School buildings and instructional space (e.g., classrooms).....	☐	☐	☐	☐	☐
d) Special equipment for handicapped students.	☐	☐	☐	☐	☐
e) Computers (software) for mathematics instruction.....	☐	☐	☐	☐	☐
f) Calculators for mathematics instruction.....	☐	☐	☐	☐	☐
g) Library materials relevant to mathematics instruction.	☐	☐	☐	☐	☐
h) Audio-visual resources for mathematics instruction.....	☐	☐	☐	☐	☐
i) Qualified teachers to teach mathematics.....	☐	☐	☐	☐	☐
j) Notification of parents about any problems of their child.	☐	☐	☐	☐	☐
k) Parents serving as teacher aides in the classroom.....	☐	☐	☐	☐	☐
l) Stakeholders participation in raising funds for the school.	☐	☐	☐	☐	☐
m) Societal volunteer ness for school projects and programs	☐	☐	☐	☐	☐
n) Parental follow up of their child's homework.....	☐	☐	☐	☐	☐
o) Societal assistance on teachers' educational trip.....	☐	☐	☐	☐	☐
p) Scaling up the best practices.	☐	☐	☐	☐	☐
q) Societal (PTA) contribution in reviewing school finances and plans.....	☐	☐	☐	☐	☐

3. How much do you agree with the following students' self-directed learning?

	Strongly agree	Agree	Disagree	Strongly Disagree	No Comment
a) I like learning mathematics because it will help me in my daily life.....	☐	☐	☐	☐	☐
b) I need mathematics to learn other school subjects quickly.	☐	☐	☐	☐	☐
c) I need to do well in mathematics to get into the university or college of my choice.	☐	☐	☐	☐	☐
d) I need to do well in mathematics to get the job I want.	☐	☐	☐	☐	☐
e) I need to do well in mathematics to please my parent(s).	☐	☐	☐	☐	☐
f) I need to do well in mathematics to please myself.	☐	☐	☐	☐	☐

4. Rate the following students' motivations that influence their mathematics learning by checking (√) one box in each row.

	Strongly agree	Agree	Disagree	Strongly Disagree	No Comment
a)Assigning students to different programs or tasks.....	☐	☐	☐	☐	☐
b) Planning for students future lessons.	☐	☐	☐	☐	☐
c) Collecting, correcting, keeping and then returning assignments to students	☐	☐	☐	☐	☐
d) Giving feedback on performance of the student to the parents.	☐	☐	☐	☐	☐
e) Encouraging small investigation(s) or gathering data	☐	☐	☐	☐	☐
f) Working individually or as a small group on long term projects or experiments.....	☐	☐	☐	☐	☐
g) Preparing educational trips individually or in group.	☐	☐	☐	☐	☐

Section III. Information about the gender wise influence of the factors.

Respond by checking (√) one box only in each of the following rows.

1. How much do you agree about the following school- and student- level determinant factors of students' mathematics lesrning?

	Strongly agree	Agree	Disagree	Strongly Disagree	No Comment
a) Influence of teacher competency in Mathematics education is greater on girls than on boys	☐	☐	☐	☐	☐
b) Influence of school context and facilities is greater on girls than on boy.....	☐	☐	☐	☐	☐
c) Influence of motivation of Students is greater on girls than on boy.....	☐	☐	☐	☐	☐
d) Influence of self-directed learning is greater on girls than on boys	☐	☐	☐	☐	☐

2. What are the major factors that influence mathematics learning of students in the first cycle secondary schools?

_____

_____

_____

_____

_____

The End

THANK YOU for the thought and effort you have put into answering these questions.

I wish you well in all that you do.

Appendix B Interviews for teachers and directors

Addis Ababa University School of Graduate studies College of Education and Behavioral Studies Institute of Educational Research and Evaluation

Interviews for teachers and directors

The purpose of these interviews is to collect information about factors influencing mathematics learning of first cycle secondary school students of Hadiya Zone. Your genuine responses and participation on this study are very important in achieving the purpose of the study. Therefore, you are kindly requested to give sincere responses to all the questions. The researcher wants to assure you that this research is only for academic purpose and your ideas and comments are highly honored and confidential.

Finally, the researcher would like to thank you in advance, for your time, effort, and thought in completing these interviews!

The researcher

Leading questions for the interview

- Do you think teacher competency of mathematics education influence students' mathematics learning strongly? If yes, how?
- How do you characterize school contexts and facilities in students' mathematics learning?
- What are the main roles that students need have to play to improve their mathematics learning?
- Do you think the school- and student- related factors (and also the others) influence girls more than boys in their learning mathematics? How
- What do you suggest measures to be taken to improve the mathematics learning of students?

Appendix C Focused Group Discussion

በሀድያ ዞን 2ኛ ደረጃ 1ኛ ሳይክል ተማሪዎች የሂሳብ ትምህርት መማር ላይ ተጽዕኖ የሚያደርጉ ችግሮች ላይ የተደረገ የቡድን ውይይት

ሀ) መሪ ጥያቄዎች

1. በተማሪዎች የሂሳብ ትምህርት መማር ላይ ተጽዕኖ የሚያደርጉ ችግሮች ምን ምንድን ናቸው
2. ችግሮቹን ተማሪውን የሚመለከቱና ት/ቤቱን የሚመለከቱ በማለት በሁለት ቢንከፍል በየክፍሎቹ የሚስተዋሉ ችግሮች ምን ምንድን ናቸው

ለ) ማጠቃለያ

በርዕሱ ላይ መድረክ በያዙት በአቶ ብርሃኑ ወ/ግዮርጊስና በአጥኚው በአቶ አባይነህ ኤርጎጎ አማካይነት ዝርዝር ማብራሪያ በሰፊው ከቀረበ በኋላ የውይይቱ ተሳታፊዎች ተራ በተራ ሀሳባቸውን ሲገልጹ፡-

- አቶ ተስፋዬ ወ/መስቀል ሀሳባቸውን ሲሰጡ ለተማሪዎች ለሂሳብ ትምህርት መማር ወሳኝ የሆኑ ሁለት ዋና ዋና ጉዳዮች ላይ ሀሳቤን መስጠት እፈልጋለሁ በማት ሲያብራሩ የመጀመሪያው የመምራን የትምህርት አቀራረባቸው በተማሪው የትምህርት አቀባበል ማለትም በፍጥነት መማር የሚችሉትን፣ በመካከለኛ ደረጃ መማር የሚችሉትንና በቀስታ መማር የሚችሉትን በመለየት አለመሆን ሲሆን ሁለተኛው ደግሞ በህብረተሰቡ ዘንድ ሂሳብና እንግሊዝኛ ከባድ ትምህርቶች ተደርገው ስለሚታሰቡ ተማሪዎችም ይህንን በመቀበል እንደ ሌሎቹ የትምህርት ዓይነቶች ትኩረት ሰጥተው ስለማይሰሩ ነው ብለዋል።

- አቶ ሰለሞን ዳምጠው እንዲሁ የጉዳዩን 85% ድርሻ የሚወስደው መምህሩ ነው። ምክኒያቱም የዓመቱን ትምህርት በአግባቡና በብቃት ማለትም ተማሪ ተኮር የማስተማር ዘዴ በመጠቀም ተገቢ ክህሎት፣ ዝንባሌና አመለካከት በማስጨበጥ በማስተማር ውጤታማ ማድረግ ስለሚቻል ነው ብለዋል።
- አቶ ኃይሌ አቦሴ ሀሳባቸውን ሲሰጡ ከላይ የተናገሩት እንዳለ ሆኖ የትምህርቱ ባህሪይ ይህም ከቀላል ወደ ውስብስብ ስለሚሄድ ይህንን አቀራረብ ተከትለው መምህራን ለማስተማር ያለመቻል ነው። ሌላው ከተማሪ ዝንባሌ አንጻር ጊዜ ወስደው ሀሳባዊ ተግባራት ላይ ከመጣር ይልቅ በአቋራጭ ሸምድደው ማለፍን ስለሚመርጡ ነው ብለዋል።
- አቶ ወርቅነህ ኤሊያስ ሲያነሱ ህብረተሰቡ ውስጥ ያሉ ስለሂሳብ ትምህርት ያሉ ከባድ አድርጎ የማየት ችግር አንዱ ነው። ሌላው የሂሳብ ትምህርት ውጤት ልፋትን የሚጠይቅ መሆኑን ነው። አብዛኛው የሂሳብ ትምህርት መልመጃዎች ውጤት ላይ ለመድረስ ብዙ ስቴፖችን ይጠይቃሉ። ከዚህ በተጨማሪ መምህራን ዘንድ በተለይም በፈተና ወቅት አዋቂ ለመምሰል የሚያደርጉት ፈተና የማክበድ ልማድ ተማሪዎችን ያሰለቻል በማለት ሀሳባቸውን ሰጥተዋል።
- አቶ ኃይሌ ቴጳሞ ተማሪዎች ትምህርቱን ከባድ አድርገው በመቁጠር እንዲያውም ሂሳብ በተፈጥሮ ስጦታ ያላቸው ሰዎች ትምህርት ብቻ አድርገው በመቁጠር ቢያንስ የሌላውን የትምህርት ዓይነት ያክል ትኩረት ሰጥተው ያለማጥናት ነው። መምህሩም ራሱን የተለየ ሰው አድርጎ ስለሚያስብ የማስተማር ሁኔታው፣ የምዘናውና የአቀራረቡ ሁኔታ አስቸጋሪ የሚሆንበት ሁኔታ በመኖሩ ነው። ከዚህ ሌላው ደግሞ ህብረተሰቡ ዘንድ መደበኛ ስሌቶቹን

ብቻ ማወቅ በቂ ክህሎት አድርገው መውሰድ የሚታዩ ምክኒያቶች ናቸው ብለዋል።

- በመጨረሻም አቶ ብርሃኑ ሲያጠቃልሉ ከተማሪ አንጻር የሚታዩ ችግሮች ትምህርቱን አክብደው በማየት አክቲቪቲዎቹን ደጋግመው አለመስራት፤ ህብረተሰቡና ወላጅ ልጆቻቸው የትምህርቱ ወዳጆች እንዲሆኑ የሚደረግ ጥረት ውስን መሆን፤ የሂሳብ መምህራን ከሌክቸር ሌላ ዘዴ ለመጠቀም ያላቸው ፈቃደኛ አጥጋቢ ያለመሆን፤ ተማሪዎችን በተለያዩ ፕሮግራሞችና ኃላፊነቶች ላይ ያለማሳተፍ፣አሳይመንቶችን ሰጥቶ አርሞ ክትትል ያለማድረግ፣ ለቀጣይ የትምህርት ደረጃቸው ያለማቀድ እንዲሁም ካሪኩለሙ ተማሪን የሚያሳትፍ ሆኖ ያለመገኘትና ለትምህርቱም የተሰጠው ክፍለ ጊዜ አነስተኛ መሆን ናቸው ብለው ስብሰባውን ዘግተዋል።

Appendix D Academic Achievement of five years of Students of First Cycle Secondary Schools (Grade 10) in Relation to Enrollment in Hadiya Zone

Year in E.C.	Number of students registered			Students got at least C in Mathematics					
	M	F	T	M	%	F	%	T	%
1999	1920	1054	2974	742	25	496	16.7	1238	42
2000	2448	1122	3570	1408	39.4	873	24.4	2281	64
2001	2453	1715	4168	1316	31.6	1036	24.8	2352	56
2002	2227	1620	3847	2032	52.8	1490	38.7	3522	92
2003	1922	1743	3665	1455	39.7	1563	42.6	3018	82
Total	10970	7254	18224	6953	38.2	5458	30	12411	68

APPENDIX E Piloting Questions

Pilot test Results of:

1. Teachers' competency as a determinant factor of students' mathematics learning in Fonko First Cycle Secondary School.
2. School Contexts and facility as a determinant factor of students' mathematics learning in Fonko First Cycle Secondary School.
3. Students self directed learning as a determinant factor of students' mathematics learning in Fonko First Cycle Secondary School.
4. Students' motivation as a determinant factor of students' mathematics learning in Fonko First Cycle Secondary School.

1. Spear man – Brown Prophecy Formula used for pilot testing to find Teachers competency items reliability

Sampled Students	Items																ΣO	ΣE	$(\Sigma O)^2$	$(\Sigma E)^2$	ΣOE
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16					
1	5	2	5	1	5	4	5	5	4	5	5	5	5	2	5	5	39	29	1521	841	1131
2	3	4	1	2	4	5	4	1	5	5	5	5	5	5	3	5	30	32	900	1024	960
3	5	5	4	1	5	5	2	3	4	4	4	4	5	3	5	4	34	29	1156	841	986
4	2	4	2	2	3	4	1	3	5	4	3	3	3	4	5	3	24	27	576	729	648
5	1	4	4	4	4	4	3	2	4	4	5	4	5	3	4	5	30	30	900	900	900
6	5	1	5	5	1	5	5	1	5	5	5	4	5	1	1	5	32	27	1024	729	864
7	4	4	5	1	4	5	5	4	5	5	5	5	4	4	1	5	33	33	1089	1089	1089
8	5	2	5	2	4	4	1	4	5	4	4	5	4	2	2	5	30	28	900	784	840
9	5	5	3	5	2	3	3	5	4	4	4	5	1	1	3	2	25	30	625	900	750
10	4	2	5	5	1	5	5	2	4	5	5	5	4	1	4	4	32	29	1024	841	928
11	5	4	4	4	4	4	4	4	3	4	2	4	4	2	4	5	30	31	900	961	930
12	5	4	4	2	4	2	2	5	4	4	3	1	4	4	5	3	31	25	961	625	775
13	5	4	5	3	5	5	5	4	1	5	5	5	5	4	5	5	36	35	1296	1225	1260
14	5	2	5	4	5	4	4	3	5	5	4	5	5	2	4	4	37	29	1369	841	1073
15	2	3	2	2	2	3	3	4	3	4	4	5	3	1	4	3	23	25	529	625	575
16	5	5	5	2	4	5	5	4	5	5	5	5	5	5	5	5	39	36	1521	1296	1404
17	4	4	5	2	4	3	1	4	5	3	4	5	4	5	2	5	29	31	841	961	899
18	4	5	3	2	2	3	5	5	4	5	4	5	3	1	3	2	28	28	784	784	784
19	3	2	5	5	2	5	5	5	4	5	3	5	4	1	5	4	31	32	961	1024	992
20	3	5	4	4	5	4	4	5	3	4	3	4	4	4	4	5	30	35	900	1225	1050
	Σ																623	601	19777	18245	18868

The actual correlation between the halves (R_{OE}) is:

$$R_{OE} = \frac{N\sum OE - \sum O \sum E}{\sqrt{\left(N\sum O^2 - (\sum O)^2\right)\left(N\sum E^2 - (\sum E)^2\right)}}$$

where, N≅ the number of respondents
O ≅ is is the sum of odd scores
E ≅ is the sum of even scores

then,

$$R_{OE} = \frac{N\sum OE - \sum O \sum E}{\sqrt{\left(N\sum O^2 - (\sum O)^2\right)\left(N\sum E^2 - (\sum E)^2\right)}}$$

$$R_{OE} = \frac{20 \times 18868 - 623 \times 601}{\sqrt{(20 \times 19777 - 388129)(20 \times 18245 - 361201)}}$$

$$R_{OE} = \frac{377360 - 374423}{\sqrt{(395540 - 388129)(364900 - 361201)}}$$

$$R_{OE} = \frac{2937}{\sqrt{(7411)(3699)}}$$

$$R_{OE} = \frac{2937}{\sqrt{27413289}} = \frac{2937}{5235} = 0.56$$

$$R_{OE} = 0.56$$

By Spearman—Brown formula:

$R_{XX} = \frac{2R_{OE}}{1 + R_{OE}}$, where R_{xx} is the reliability of the items.

$$R_{XX} = \frac{2 \times 0.56}{1 + 0.56} = \frac{1.12}{1.56} = 0.72$$

Rxx = 0.72, the reliability of teachers competency as determinant factor of students' mathematics learning.

2. Spearman – Brown prophecy Formula used for pilot testing to find School Contexts and facility items reliability.

Sampled Students	Items																ΣO	ΣE	$(\Sigma O)^2$	$(\Sigma E)^2$	ΣOE
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16					
1	5	3	5	4	4	4	4	4	5	4	3	4	5	4	4	5	35	32	1225	1024	1120
2	4	5	5	1	4	4	5	5	5	4	4	5	4	5	5	5	36	34	1296	1156	1224
3	5	2	4	2	4	5	4	4	4	5	4	4	4	4	5	4	34	30	1156	900	1020
4	4	2	4	4	5	4	4	4	2	5	5	5	5	1	5	5	34	30	1156	900	1020
5	5	2	5	4	4	4	4	4	4	4	4	4	2	5	3	5	31	32	961	1024	992
6	5	4	5	5	4	4	4	4	5	4	4	5	4	2	4	5	35	33	1225	1089	1155
7	3	2	2	4	3	4	4	3	2	3	4	3	3	3	4	2	25	24	625	576	600
8	5	2	5	2	4	2	5	4	4	4	4	4	4	3	4	4	35	25	1225	625	875
9	5	1	5	5	5	5	4	5	5	5	4	5	4	1	4	5	36	32	1296	1024	1152
10	4	4	5	2	5	4	5	4	4	4	5	5	5	1	5	5	38	29	1444	841	1102
11	5	1	5	4	4	4	5	5	4	4	4	5	5	2	4	5	36	30	1296	900	1080
12	4	3	5	5	5	5	4	4	5	4	4	5	3	2	5	3	35	31	1225	961	1085
13	4	4	5	5	5	4	5	3	3	3	4	5	3	2	4	4	33	30	1089	900	990
14	5	4	5	4	2	5	4	4	4	4	4	5	4	4	5	4	33	34	1089	1156	1122
15	5	1	5	5	5	4	5	5	5	4	5	5	5	4	4	5	39	33	1521	1089	1287
16	4	2	5	4	4	4	4	4	4	4	4	5	4	1	5	5	34	29	1156	841	986
17	4	2	4	2	4	2	4	4	4	4	4	4	4	4	4	4	32	26	1024	676	832
18	4	1	4	5	4	4	5	4	4	4	4	5	5	4	4	4	34	31	1156	961	1054
19	5	4	5	5	4	4	4	4	5	4	4	5	4	3	2	5	33	34	1089	1156	1122
20	2	3	3	4	5	4	3	4	4	2	3	5	3	4	5	4	28	30	784	900	840
Σ																	676	609	23038	18699	20685

The actual correlation between the halves (R_{OE}) is:

$$R_{OE} = \frac{N\sum OE - \sum O \sum E}{\sqrt{\left(N\sum O^2 - (\sum O)^2\right)\left(N\sum E^2 - (\sum E)^2\right)}}$$

where, N≅ the number of respondents
O ≅ is is the sum of odd scores
E ≅ is the sum of even scores

then,

$$R_{OE} = \frac{N\sum OE - \sum O \sum E}{\sqrt{\left(N\sum O^2 - (\sum O)^2\right)\left(N\sum E^2 - (\sum E)^2\right)}}$$

$$R_{OE} = \frac{20 \times 20685 - 676 \times 609}{\sqrt{(20 \times 23038 - 456976)(20 \times 18699 - 370881)}}$$

$$R_{OE} = \frac{413700 - 411684}{\sqrt{(460760 - 456976)(373980 - 370881)}}$$

$$R_{OE} = \frac{2016}{\sqrt{(3784)(3099)}}$$

$$R_{OE} = \frac{2016}{\sqrt{11726616}} = \frac{2016}{3424} = 0.59$$

$$R_{OE} = 0.59$$

$$R_{XX} = \frac{2R_{OE}}{1 + R_{OE}}$$

$$R_{XX} = \frac{2 \times 0.59}{1 + 0.59} = \frac{1.18}{1.59} = 0.74$$

R_{xx} = 0.74, the reliability of school context and facilities as determinant factor of students' mathematics achievement.

3. Spearman – Brown prophecy Formula used to conduct pilot test for students' self directed learning items reliability.

Sampled Students	Items														ΣO	ΣE	$(\Sigma O)^2$	$(\Sigma E)^2$	ΣOE
	1	2	3	4	5	6	7	8	9	10	11	12	13	14					
1	3	4	4	4	3	2	2	2	2	3	4	3	4	4	22	22	484	484	484
2	3	3	2	2	2	1	4	1	1	1	1	3	2	2	15	13	225	169	195
3	4	3	4	2	3	2	1	2	1	3	3	4	3	4	19	20	361	400	380
4	4	2	3	2	3	2	4	2	1	3	4	3	3	3	22	17	484	289	374
5	4	3	4	3	2	2	3	1	3	3	3	2	3	4	22	18	484	324	396
6	4	3	3	4	3	2	4	1	2	3	3	3	4	4	23	20	529	400	460
7	4	4	3	3	3	2	3	2	1	2	3	3	4	3	21	19	441	361	399
8	4	3	3	2	2	3	3	3	3	3	2	3	4	2	21	19	441	361	399
9	4	4	3	2	2	3	3	1	1	3	3	3	2	3	18	19	324	361	342
10	3	2	4	3	2	2	3	1	1	3	3	3	2	2	18	16	324	256	288
11	4	3	3	3	1	1	3	1	3	3	3	1	3	3	20	15	400	225	300
12	4	2	4	3	1	1	4	1	1	1	1	1	4	4	19	13	361	169	247
13	3	3	4	3	3	3	3	1	2	3	3	4	4	3	22	20	484	400	440
14	4	3	4	2	3	3	4	1	2	2	3	3	3	2	23	16	529	256	368
15	4	4	3	3	4	3	4	2	3	3	3	4	4	4	25	23	625	529	575
16	3	4	2	3	3	3	3	3	1	3	3	3	3	3	18	22	324	484	396
17	3	2	3	3	2	2	3	2	3	3	3	3	3	3	20	18	400	324	360
18	3	4	3	2	3	1	3	1	3	2	4	3	2	3	21	16	441	256	336
19	3	4	3	3	2	3	4	3	3	3	2	3	1	2	18	21	324	441	378
20	4	4	4	3	3	2	3	1	2	3	3	3	3	4	22	20	484	400	440
Σ															409	367	8469	6889	7567

The actual correlation between the halves (R_{OE}) is:

$$R_{OE} = \frac{N\sum OE - \sum O \sum E}{\sqrt{\left(N\sum O^2 - (\sum O)^2\right)\left(N\sum E^2 - (\sum E)^2\right)}}$$

where, N≅ the number of respondents
O ≅ is is the sum of odd scores
E ≅ is the sum of even scores

then,

$$R_{OE} = \frac{N\sum OE - \sum O \sum E}{\sqrt{\left(N\sum O^2 - (\sum O)^2\right)\left(N\sum E^2 - (\sum E)^2\right)}}$$

$$R_{OE} = \frac{20 \times 7567 - 409 \times 367}{\sqrt{(20 \times 8469 - 167281)(20 \times 6889 - 134689)}}$$

$$R_{OE} = \frac{151340 - 150103}{\sqrt{(169380 - 167281)(137780 - 134689)}}$$

$$R_{OE} = \frac{1237}{\sqrt{(2099)(3091)}} = \frac{1237}{2547} = 0.486$$

$$R_{OE} = 0.486$$

$$R_{XX} = \frac{2R_{OE}}{1 + R_{OE}}$$

$$R_{XX} = \frac{2 \times 0.486}{1 + 0.486} = \frac{0.972}{1.486} = 0.65$$

R_{xx} = 0.65, the reliability of students' self directed learning and motivation as determinant factor of students' mathematics achievement.

4. Spearman – Brown prophecy Formula used to conduct pilot test for gender wise variables items' reliability.

Sampled Students	Items						ΣO	ΣE	$(\Sigma O)^2$	$(\Sigma E)^2$	ΣOE
	1	2	3	4	5	6					
1	3	4	5	4	3	2	11	10	121	100	110
2	3	3	2	2	2	5	7	10	49	100	70
3	4	3	4	2	5	2	13	7	169	49	91
4	4	2	5	2	3	2	12	6	144	36	72
5	4	3	4	3	5	2	13	8	169	64	104
6	4	3	5	4	3	2	12	9	144	81	108
7	4	4	3	3	3	5	10	12	100	144	120
8	4	3	3	5	2	3	9	11	81	121	99
9	4	4	3	2	2	5	9	11	81	121	99
10	3	5	4	3	2	2	9	10	81	100	90
11	4	3	3	5	1	4	8	12	64	144	96
12	4	2	4	3	1	5	9	10	81	100	90
13	3	3	4	3	3	5	10	11	100	121	110
14	4	3	4	2	3	5	11	10	121	100	110
15	5	4	3	3	4	3	12	10	144	100	120
16	3	4	5	3	3	3	11	10	121	100	110
17	3	2	3	3	2	2	8	7	64	49	56
18	5	4	3	2	3	1	11	7	121	49	77
19	4	3	5	4	3	2	12	9	144	81	108
20	4	3	4	2	3	5	11	10	121	100	110
Σ							208	190	2220	1860	1950

The actual correlation between the halves (R_{OE}) is:

$$R_{OE} = \frac{N\sum OE - \sum O \sum E}{\sqrt{\left(N\sum O^2 - (\sum O)^2\right)\left(N\sum E^2 - (\sum E)^2\right)}}$$

where, N≅ the number of respondents
O ≅ is is the sum of odd scores
E ≅ is the sum of even scores

then,

$$R_{OE} = \frac{N\sum OE - \sum O \sum E}{\sqrt{\left(N\sum O^2 - (\sum O)^2\right)\left(N\sum E^2 - (\sum E)^2\right)}}$$

$$R_{OE} = \frac{20\times 1950 - 208\times 190}{\sqrt{(20\times 2220 - 43264)(20\times 1860 - 36100)}}$$

$$R_{OE} = \frac{39520 - 39000}{\sqrt{(44400 - 43264)(37200 - 36100)}}$$

$$R_{OE} = \frac{520}{\sqrt{(1136)(1100)}} = \frac{520}{1118} = 0.465$$

$$R_{OE} = 0.465$$

$$R_{XX} = \frac{2R_{OE}}{1 + R_{OE}}$$

$$R_{XX} = \frac{2\times 0.465}{1 + 0.465} = \frac{0.93}{1.465} = 0.63$$

R_{xx} = 0.63, the reliability of items of gender wise influence of factors that determine students' mathematics achievement.