

**The Relationships among Student-Teacher Interaction,
Academic Intrinsic Motivation, Learning Styles and
Grade 9 Students' Mathematics Achievement
In Addis Ababa**

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ABBREVIATION

AIM =	Academic Intrinsic Motivation
S-TI =	Student-Teacher Interaction
VAK =	Visual Auditory and Kinesthetic
MA =	Mathematics Achievement

Abstract

The present study attempted to examine the relationship among student-teacher interaction, academic intrinsic motivation, learning style and students' mathematics achievement of grade nine students in Addis Ababa.

Three sub-cities were selected from ten sub-cities using simple random sampling technique. One school was selected from each selected sub-city. From these three sample schools, 353 students participated in the research project. Using learning style scale, 180 students were selected for further investigation.

Four instruments (namely Learning Style Scale, Academic Intrinsic Motivation Inventory, Questionnaire on Student-teacher Interaction and Mathematics Achievement Test) were used to collect data. Initially, the instruments were administered on a pilot sample. Based on this item analysis was carried out and the instruments were improved.

Percentage, t-test, Pearson's product moment correlation, multiple and step-wise regression analyses and one way ANOVA were employed to analyze the data. The analyses indicated that auditory learning style was adopted by the majority of grade nine students. The results of the t-test indicated that there was no significant variation between male and female visual, auditory and kinesthetic learners on their academic intrinsic motivation, student-teacher interaction and mathematics achievement. Student-teacher interaction, academic intrinsic motivation and mathematics achievement were found to have significant positive correlation on visual, auditory and kinesthetic learners. In addition, the result of multiple regression analyses indicates that academic intrinsic motivation and student-teacher interaction combined together had significant contribution for the prediction of students' mathematics scores. The step-wise regression analyses revealed that academic intrinsic motivation had significant contribution on all groups of learners, whereas student-teacher interaction had only on mathematics achievement scores of auditory and visual learners. Moreover, one-way ANOVA showed that there was significant mean difference between auditory and visual learners on the bases of their mathematics achievement. Based on these findings conclusions are made and recommendations are forwarded.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The relationship between learning and individual difference is the center of educational researchers. Thus, this relationship received remarkable attention since the conference held in 1896 at the Learning Research and Development Center, University of Pittsburgh (Gagne, 1989).

This conference brought together researchers who were particularly devoted to investigating the influence of human difference in learning (Gagne, 1989). It was the end for considering learners as empty jars and teachers as prime sources of knowledge. The assumption that students receive whatever the teacher imparts come to an end. The learning environment made a paradigm shift to consider individual differences as they can facilitate or deter learning.

As these differences are reflected in the classroom activities, they determine what learners do during learning so that students achievement differ in any particular situation (Gagne, 1989; Good & Brophy, 1997) Therefore, in order to conduct successful instructional processes, considering learners differences has a paramount importance. Unless these differences are accommodated, there will occur disconnect in communications and information exchange between the student and the teacher (Driscoll, 2005; Backer & Yelich, 2002).As a result, learning will suffer.

These individual differences are magnified or reduced in the classroom where a variety of complex activities are conducted (Good & Brophy, 1997) with the aim of improving the learning of all students (Dimmock, 2000) i.e., improving achievement. Student-teacher interaction, learners' motivation and learners' learning style are relevant factors that determine achievement.

Student-teacher classroom interaction could encourage or discourage learning. Edwards-Groves (2001) underlines that the effectiveness of teaching and learning depends on the effectiveness of classroom interaction. From this one can deduce that effective classroom interaction motivates the learners to engage in the activities on the ground that teachers in such environment are capable of identifying their students preferred ways of learning which make learning easier to there students (Dimmock, 2000). "Students [who are] permitted to work in their preferred learning styles perform better and try harder" (Carbo, Dunn and Dunn, 1986:7). On this ground, they further say that teaching students through their preferred learning style, among others, tends to increase motivation. Achievement motivation researchers agree that motivation arousing conditions differ from person to person. Klein (1982) states, "all needs, including the need to achieve, could be aroused by environment unrelated to a given need will lower the level of that need" (1982:355). In other words, one event could be motivating and rewarding for some and the opposite for others. Fisher (1996:52) describes the case using analogy:

The same diet of experiences can be delivered to a class of children and their digestion of those experiences will be different. Some children will go hungry, some will end up feeling sick, some will turn up their noses because they don't like what's on offer, and some will eat the bits they enjoy and leave the rest on the plate.

This analogy clarifies the very fact that learners are differently motivated in different conditions. Learners' level of achievement motivation depends upon both the internal level and the prevailing environmental condition (Klein, 1982).

In a nut shell, the consideration of students' learning style, developing appropriate student-teacher interaction to create motivation-arousing-condition have paramount importance for the achievement of learning on the side of the learners.

To the present researcher's knowledge, Kifle (2004) and Amare (2004) have conducted their studies in connection with academic achievement motivation. For example, Kifle (2004) used t-test to compute academic achievement

motivation scores of male and female students. He found out that there is no significant means score differences between high achiever male and female students, while there is significant difference between low achievers. On this very issue, Amare (2004) studied the relationship between academic motivational orientations and academic achievement of junior and high school students as part of his research. He has found out that lower grade levels use of self-determined motivation is minimal and teachers' control seems higher to guide students' learning. He has also seen amotivation to predict negative learning outcome in all of the specified grade levels.

Workineh (2004) studied how teacher's behavior and students' self determination influence students' academic achievement as part of his research. He found out that these variables are highly correlated.

Belay (2009) researched the learning style as part of his study. He reported that auditory learning style was the most preferred learning style among supported and not-supported students by Wukro Social Development Program. He found out that for these students the learning styles—visual, auditory and kinesthetic—had no significant relation with their achievement in mathematics and physics subjects.

As far as the researcher's knowledge goes, none of these works were conducted to study the relationship among student-teacher interaction, academic intrinsic motivation, learning styles, and academic achievement. Therefore, this study is believed to add to the already accumulated knowledge in the area of educational psychology and mathematics.

1.2 Statement of the Problem

The purpose of this study was to examine the relationship among student-teacher interaction, academic intrinsic motivation, learning styles, and learners' academic achievement in mathematics classes. The study scrutinized the relationship between each independent variable with the dependent variable. More specifically this work attempted to answer the following basic questions:

- Which learning style is the most preferred among grade nine students, if at all?
- Do male and female students significantly differ in their academic intrinsic motivation, student- teacher interaction and mathematics achievement among the three learning style (auditory, visual and kinesthetic) groups?
- Are there significant differences in mathematics achievement among the three learning style groups?
- Is there a significant relationship between student-teacher interaction and academic intrinsic motivation for visual, auditory and kinesthetic learners?
- Do academic intrinsic motivation and student –teacher interaction significantly explain the variation in mathematics achievement for the three learning style groups separately and in combination?

1.3 Objectives of the Study

This research was primarily designed to examine the relationships among student-teacher interaction, academic intrinsic motivation, learning styles and learners' achievement in grade nine mathematics classes.

The study had the following specific objectives.

- To identify the most preferred learning style among grade nine students.
- To examine if there is any difference between male and female visual, auditory and kinesthetic learners in their academic intrinsic motivation, student-teacher interaction and mathematics achievement.
- To assess whether mathematics achievement varies across the three learning styles.
- To assess if student-teacher interaction and academic intrinsic motivation are related for visual, auditory and kinesthetic learners.

- To explore whether academic intrinsic motivation and student teacher interaction significantly explain the variation in mathematics achievement for the three learning style groups separately and in combination.

1.4 Significance of the Study

The results of this study may:

- help teachers to be aware of the role their interactions with their students play so that they help their students to be motivated for mathematics achievement.
- give light to curriculum designers to structure curriculum in a way it best suit to different students' learning styles.
- help teachers to consider different learning styles while teaching in order to accommodate learners' learning style with a purpose of accomplishing the set instructional objectives.
- Provide information for teacher training colleges to design their programs to produce teachers that could motivate their students through presenting their lessons to suit all kinds of learning styles.

1.5 Definition of Important Terms

Learning Style: Learning Styles are sensory preferences by which learners perceive, process, store and recall what they are attempting to learn.

Academic intrinsic motivation: Academic intrinsic motivation refers to students' motivation to engage in an activity with the intention of mastering the lesson under discussion.

Student-teacher interaction: an interaction between student(s) and mathematics teacher focusing on the accomplishment of classroom activities.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

In this section of the paper, relevant theoretical issues are discussed. First, student-teacher interaction is explained from two angles: teacher dominated and student-centered interaction. Next, it tries to raise motivation theories and elements of motivation. Besides, it discusses intrinsic academic motivation. Finally, it deals with types of learning styles, namely visual, auditory and kinesthetic. It also shows the characteristics of learners under these learning styles. The relationship among student-teacher interaction, academic intrinsic motivation, learning style and mathematics achievement are presented.

2.1 Student-Teacher Interaction

Classroom interaction has a long history back to 1950s. Flanders developed a method of classroom observation (probably the best known) with the aim of training teachers to reduce the relative proportion of teacher talk and to increase pupil initiated talk (Mayles, et. al., 2003). They further uncover his political intention. He wanted "to sustain democratic society in the face the perceived danger of the growth of extremist authoritarian factions as politically motivated Europeans settled in the USA after the Second World War" (2003:102). In general, he was against authoritarian and teacher-dominated classes.

Classroom is a complex busy place. Student-teacher interaction adds to its complexity. Teachers as one major participants involve in a variety of interactions with their students (Joyce, 1991; Good & Brophy, 1997). Student-teacher interaction is not a matter of someone saying something to someone. As Celik (2003) stresses the importance of converting the classroom into real life-like contexts where what is done in the classroom is as genuine as possible. This genuineness comes and sustains in the classroom when there is a belief that knowledge is not a fixed thing or a commodity to be grasped. It is not

something out there waiting to be discovered. Rather, it is an aspect of a process. It arises out of interaction. That is to say, the classroom teaching-learning process takes place through interaction. This interaction has a vital role in the acceleration or deceleration while doing classroom activities. So, it is the focus of educational researchers since the early 1960s (Ketabi, Amouzadeh & Shomoosi, 2008 and Anderson, 2004) on the assumption that it leads to better learning. Marched and Skinner (2007:66) explained the positive or negative consequences of student-teacher interaction in the following words:

Children's engagement, [which is] defined as their active enthusiastic participation in academic activities in the class room is the key motivational state that drives learning and school success. Its opposite, disaffection, which refers to a motivational state in which children are uninterested, apathetic, passive, or bored, is a critical risk factor for academic difficulties and eventual school drop out.

As can be understood from the arena of literature reviewed so far student-teacher interaction is worth getting attention. Broadly speaking, one can see student-teacher interaction in two different environments: teacher-directed and student-centered.

○ **2.1.1 Teacher-Directed Classroom Environment**

In such environments the teacher is the dominant figure. Such classroom gives the priority role and the responsibility to the teacher. Learning is predominantly teacher-controlled, and it focuses on communicating/ imparting knowledge, skills or attitude to the students (Davis, 1981; Perry, 1998). Perry (1998) further says that these teachers use comparisons which usually bring discouragement and disaffection on the side of the learners. Leder (1987) states that teachers interact differently with students they perceived as 'best' and 'weakest' in mathematics classes. In support of this Joyce (1991) reports that higher percentage of teachers' negative interactions are towards lower achievers. This is probably because the teachers follow the whole-class interaction with initiation- response- feedback (IRF) structure from which the

initiation and the feedback are the roles of the teacher (Ketabi, Amouzadeh & Shomoosi, 2008) and the response which might be right or wrong is the students' role. Those who are wrong are exposed for criticisms and discouragements. Turner et. al., (1998: 733) state:

Thus teacher-centered interaction can be limited by teacher control of what counts as mathematical knowledge. ... "Ownership" of mathematical knowledge would remain with the teacher or the textbook rather than be developed with the students.

Even though it has its own advantage, many scholars in the field of pedagogy have a position that it is more a disadvantage than an advantage. Since it is traditional and one way, it does not have variety. The interaction becomes monotonous and boring. The student-teacher interaction depends on the teacher's interest where the learner becomes passive (with limited role) during the interaction. Besides, such interaction inhibits active participation and encourages the learner to be submissive. Moreover, teacher dominated interaction focuses on content, emphasizes knowing what students work as individual and often in competition with each other. Students are highly dependent on the teacher's activities and learning objectives are imposed; lecture method dominates the mode of lesson delivery (Yallev, 1999). However, in order to have successful interaction no participant should dominate nor engage off task behavior. Therefore, such student-teacher interaction is considered traditional and is decreasing its relevance.

2.1.2 Student-Centered Classroom Environment

The shortcoming of teacher-dominated interaction has led to bring about changes for the new learner-centered student-teacher interaction. Student-teacher interactions are flexible. This paves the way for learners' active participation under the guidance of the teacher or in personal initiative forms. In this kind of environment priority is given to students' learning. In such classrooms, as (Patrick & Ryan, 2007:7) put it, "interaction ...is a critical component of student-centered instructional approach" because learners have

choices from diverse activities and materials the teacher brings to the classroom (Perry, 1998) with a prime target to accommodate a variety of learning preferences. "Tailoring...and matching activities with students' interests increase intrinsic motivation" (Middleton & Spanias, 1999: 81). In other words, if the teacher is aware of the different interests that the students bring to the classroom and is ready to encourage the students' learning style in a variety of classroom work (Good & Brophy, 1997; Celik, 2003), they work harder and persist longer in learning mathematics. If teachers establish such inclusive environment, the interaction between teachers and students, and students and students will be positive (Leder, 1987) and also creates co-operative atmosphere among students (Patrick & Ryan, 2007). Patrick & Ryan (2007) and Driscoll (2005) have added that classrooms are places where students work among peers, so cultivating positive classroom interaction has paramount importance. They further contend that the emphasis of creating positive classroom interaction boils down to fostering mutual support rather than encouraging competition among students. In connection with this, Driscoll (2005) raises Vygotsky's position that partners must come to joint understanding about the activities at hand through shared power and shared authority. Mathematics students should strive to establish such environment in their classes.

When classroom interaction is positive, various scholars suggest the benefits for the students. Some are listed below. Students:

- develop a sense of relatedness to peers (Wentzel, 1998)
- easily adjust themselves to school work (Wentzel, 1998)
- meet academic challenges (Wentzel, 1998; Wentzel, 1997; and Turer et. al., 1998)
- involve in informal help seeking and help giving during individual seat work (Patrick & Ryan, 2007 and Ryan et. al., 1998)
- develop interest in school (Wintzel, 1997)
- show academic effort and engagement in classroom (Wentzel, 1997)

- develop a more positive academic self-concept (Pantrick & Ryan, 2007)
- show greater expectancies for success (Pantrick & Ryan, 2007)
- reduce absenteeism and disruptiveness in the classroom (Pantrick & Ryan, 2007)

Similarly, Pintrick & Ryan (2007:7-8) put the benefit of positive classroom interaction in the following words:

When students are encouraged to interact and exchange ideas with each other during academic tasks they have opportunities to ask or answer questions, make suggestions, give explanations, justify their reasoning, and participate in discussions...interaction opportunities may foster students' feelings of confidence, or efficacy, sustain interest, and support a willingness to persevere with the task when experiencing difficulty or frustration.

In general, good interaction between a teacher and his/her pupils are very important as it reduces the likelihood of difficulties arising and if difficulties occur, devises a way to solve them (Cohen & Manion, 1989).

2.2 Motivation

Motivation has paramount importance in education because learning is underpinned by motivation. Motivation is a broad term derived from the Latin verb *movere* (to move) (Pintrich & Schunk, 2002, Pintrich, 2003 and Melendy, 2008). Melenday (2008) further puts the difficulty of setting standardized definition for motivation. Thus, various scholars give different definition for the concept. The following are some of the definitions given by scholars.

- Motivation is the activation or energization of goal oriented behavior (Smith, 2002).
- Motivation is emotion in motion (Smith, 2002)
- Motivation is a hidden force within us that causes us to behave in a certain way. (Davies, 1981)
- Motivation is the process where by goal-directed activity instigated and sustained (Pintrich & Schunk,2002)

From the above definitions the following key elements could be drawn.

1. Motivation is goal-oriented. Every student engages in a certain activity to attain a certain goal knowingly or unknowingly (Pintrich & Shunk, 2002). This learning goal may help learners to select a motivation strategy that fits the actual learning situation which improves the likelihood of accomplishing classroom tasks (Boekaerts, 2002). Then the students may measure their work against this standard (goal) with which accomplishment will be motivated (Good & Brophy, 1997). Goal-setting serves a motivational function, which may mobilize and sustain effort to achieve objective (Fuchs et al., 2003; Ford 1992, and Pervin, 1983 all in Wentzel, 1998).

2. Motivation is a process. One cannot directly observe motivation of students. It is a subjective experience of the students. The students' motivation is reflected through learners' classroom behavior such as choice of tasks, effort, persistence and verbalizations (self reports) (Good & Brophy, 1997; Pintrich & Shunk, 2002).

3. Motivation is domain specific. A student may have a motivation attached to one subject-matter but not to another. Even to the specific, one student may be motivated towards one classroom activity and the reverse towards another in a single subject matter (Boekaerts, 2002). Therefore, we cannot conclude that student 'A' is generally motivated, but student 'B is unmotivated'.

4. Motivation requires commitment. We have earlier seen that motivation is goal-oriented. This goal demands the commitment of the learners. More importantly, if the learner strives for a mastery (learning) goal, he/she values the improvement of skill or knowledge in a given domain and believes that success depends on working hard (Middleton & Spanias, 1999). The effort the learners invest is determined by the value they give and the goal they set to the classroom activities (Good & Brophy, 1997). Besides, the length of the time-on-task (Driscoll, 2005; Dickinson & Butt, 1997) increases as an indicator of commitment due to motivation. That's why motivation was found to be the best

predictor of student achievement in studies that investigated factors influencing student achievement (Shih & Gamon, 2001).

2.2.1 Motivation Theories

"Motivation theories are concerned with the energization and direction of behavior" (Pintrich, 2003:669). He further said that the theories attempt to come up with answers to question about what makes individual move toward activities and to what tasks. This has been a focus of psychologists of behaviorist theories whose literature dominated throughout most of the 20th century (Middleton & Spanias, 1999). "This theoretical orientation has provided powerful knowledge about student motivation in mathematics" Middleton & Spanias, 1999:68). However, because it focuses on observable behavior, its measurement of achievement motivations shows limitations; and because it is not concerned with individual differences it results in failure to provide information on how students define success and failure in mathematics (Middleton & Spanias,1999; Higgins & Kruglanski, 2000 in Pintrich, 2003). Pintrich & Schunk (2002) deal with present motivational basic theories of constructs among which achievement goal orientation is one (Pintrich, 2003 and Pantziara & Philippou, 2007) .Recently "goal orientation theory has become increasingly influential" (Patrick, 2004 and Urdan, 2004 both in Elliot, et. al., 2005:19).

2.2.2 Achievement Goal Orientation

Achievement goal orientation has become influential probably because the theorists are concerned with exploring why people, mathematics students in this research, are engaged in meaningful (or meaningless) activities or learning tasks (Middleton & Spanias, 1999; Marcou & Philippou, 2005). In connection with this, Wentzel (1998) says that goals direct learners' behavior toward outcomes that they would like to achieve. They are rationale for motivation.

Scholars (such as Elliot, et. al., 2005; Middleton & Spanias.1999) state that there are two kinds of goals: learning, task, or mastery goals and performance, ego, or ability goals.

Mathematics students with this goal orientation show concern for mastering classroom instruction to the level of being interested in challenges, improvements and personal learning regardless of the performance of others (Elliot, et. al. 2005; Middleton & Spanias, 1999; Pantziara & Philippou, 2007). This refers to the learner's prime target to value learning as an end. Students with this goal orientation increase time-on-task, persist challenges and engage on classroom activities. However, situational cues such as the students' environment and surroundings can affect the success of achieving a goal at any time.

Performance motivational goal on the other hand is set with a desire to appear more accomplished than others and to avoid situations where a lack of skill or ability might be perceived by on lookers (Elliot, et. al., 2005). Duda & Nicholls (1992), as quoted in Middleton & Spanias (1999), contend that mathematics students with this goal orientation target to establish superiority over others and believe that success depends on social comparison and assertion of superior ability. Supporting this position, Patrick & Ryan (2007:8) state, "The promotion of performance goals concerns an emphasis on competition and relative ability comparisons between students in the classroom."

By the time a mathematics teacher promotes ability (performance) goals, the classrooms will be highly competitive and it creates (emphasizes) a hierarchy of ability so that the students struggle for relatively better position with in the hierarchy (Patrick & Ryan, 2007). They further identify learners' behaviors that are detrimental to learning which steam from such classes (Patrick & Ryan, 2007). According to them, the following learners' behaviors are detrimental to learning.

- Students avoid engaging in tasks (Ryan, Gheen & Midgley, 1998)

- Academic self-handicapping (Urduan et., al. ,1998)
- Cheating (Anderman, Griensinger,& Westerfield,1998)
- Students' disruptive behavior (Kaplan, Gheen, & Midgley, 2002; Ryan & Patrick, 2001)

In academic settings, there are two types of academic motivation: intrinsic and extrinsic motivation. The distinction concerns whether the reason for engaging in an activity is seen to be mediated by the activity (Pitman, 1998). Since the focus of this paper is academic intrinsic motivation it is discussed here.

2.2.3 Academic Intrinsic Motivation

There is interplay between mastery goal orientation and intrinsic motivation. Middleton & Spanias (1999:73) say, "...possession of a mastery goal orientation will positively mediate intrinsic motivation."

Motivation theory defines two types of motivation: intrinsic and extrinsic motivation (Melendy, 2008). This distinction is made by Heider as early as 1958 (Marcou & Philippou, 2005).

Intrinsic motivation refers to motivation to engage in an activity for its own sake (Pintrich & Shunk, 2002; Smith, 2002 and Turner and et. al., 1998). Students need to get opportunity to engage themselves on tasks that are interesting and enjoyable for the students so that they will work without need for extrinsic incentives (Good & Brophy, 1997). This motivation brings satisfaction in doing the task and from involvement in the task (Pintrich, 2003). As Smith (2002) puts it, intrinsically motivated students see the classroom activity as relevant to like and the world and endeavor to master it.

Intrinsically motivated students develop need to achievement. The need to achievement is a desire to accomplish something difficult (Murray, in Klein, 1982), mathematical problem in this research context. Murray has further stated that the need to achieve causes a student to overcome obstacles not only to attain a high standard of excellence but also to surpass the success of

others. These intrinsically motivated high achievers, in Murray's view, are ambitious and competitive persons determined to be successful.

Academic intrinsic motivation is usually associated with learners' task preference on task persistence and involvement. Students with high need to achieve choose tasks in which success is probable. Klein (1982) also says that these learners participate only infrequently on the two extreme difficult level of a task: low risk in which success is assured and high risk in which achievement is unlikely. Therefore, high need to achieve students are more of moderate risk takers and less of an extreme risk taker than the low need to achieve students. Weiner (1985) has argued that the reasons why students with high need for achievement choose moderately difficult tasks because such tasks demonstrate how well they are doing. If the task is easy, they may not say achievement is as a result of their academic endeavor because everyone is capable of accomplishing the task. Similarly they will not involve in too difficult classroom activities because achievement is unlikely and they cannot evaluate the degree of their effort to success. Klein (1982) asserts that this is demonstrated in several studies.

When students are intrinsically motivated, they will adopt a positive attitude towards the task. They take enjoyment by engaging in the activities. These high achievements need stay longer with moderately challenging tasks with a belief that achievement is probable (Kelin, 1982). They work persistently to meet the desirable goal. This is likely to result in better performance (Marcou & Philippou, 2005). Therefore intrinsic forms of motivation positively affect math performance (Um, Corter & Tatsuoka 2005). With mathematics education, these learners, motivate themselves to acquire conceptual understanding and evaluate their progress toward their learning goals (De Corte et. al., 2000; Pape, 2005; Pape & Smith, 2002 all in Kaya, 2007). Therefore, intrinsically motivated students, "can establish realistic, attainable, and mastery oriented learning goals, and assess their progress by comparing their performance with a goal,

criterion, or standard” (Pintrich, 2000; and Schunck, 1990 as paraphrased by Kaya, 2007:2).

According to Zimmerman (2004), in Kaya (2007), being intrinsically motivated is one of the characteristics of self-regulated learners. Concerning the detrimental effects of performance goal orientation, scholars (Middleton and Spanias, 1999) have said, “ego goal orientation has much less effect on one’s developing active cognitive engagement patterns” (1999:73). This goal orientation is related to extrinsic motivation. Extrinsically motivated students engage themselves on tasks with an expectation of receiving reward, teacher praise or avoidance of failure (or punishment) (Melendy, 2008; Pintrich & Shunk, 2005; Good & Brophy, 1997; Elliot et. al., 2005). However, it is widely accepted that extrinsic motivators can often distract students from giving value to what they learn. The students target receiving the reward and/or avoiding punishment. Once the rewards or punishments are removed students lose their motivation. Besides, it is challenging to devise appropriate rewards and punishment for students to develop desirable behavior. Furthermore, the use of external rewards may suggest to the recipient that the activity may not worth doing for its own sake (Elliot, and et., al. 2005; Good & Brophy, 1997; Pintrich & Shunk, 2005). Good and Brophy (1997) and Middleton & Spanias (1999) contend that the teacher is advised only to use extrinsic motivation sparingly and with a target to enhance intrinsic motivation.

2.3 Learning Style

Learning style has received attention for over 35 years (Kratzig & Arbuthnott, 2006). Before these years, individual differences were judged based on their IQ score. However subsequent testing indicated that student with the same IQ score performed significantly differently with similar learning tasks (Harrison et. al., 2003 in Kratzig & Arbuthnott, 2006). The result of the testing turned the attention of scholars to the topic of learning styles and instruments to measure and to explain individual learning differences (Kratzig & Arbuthnott, 2006).

A person's learning style is hypothesized to be a combination of cognitive, affective and psychological characteristics that describe how that individual interacts with his or her environment (Cassidy, 2004 in Kratzig and Arbuthnott, 2006; O'Hara and Sternberg, 1999).

Various scholars (Dunn, Griggs, Olson and Beasley in Kratzig & Arbuthnott, 2006; Dunn & Dunn in Kutay, 2006) hold a position that learning style is a set of biological and developmental characteristics. According to Wehrwein, et al. (2007), learning style preferences are the manner in which, and the conditions under which, learners most efficiently and effectively perceive, process, store and recall what they are attempting to learn. Reiff, in Reed & Bergemann (1995: 401), on his part says, "Learning style can be described as a set of factors, behaviors, and attitudes that facilitate learning for an individual in a given situation." On the bases of the above definitions one can say that the match or mismatch of the learning style with classroom instruction brings about differences in achievement among learners (Kratzig & Arbuthnott, 2006). Therefore, if one says certain students are underachievers, they may be so because the classroom activities mismatch their learning styles. In connection with this, the words of Rayneri, Garber & Wiley (2003) show that underachieving students make significant gains in classroom performances when their learning preferences are accommodated. Their position reinforces the importance of identifying each student's learning style that makes identical instruction for learners either effective or ineffective. In order for education to satisfy the need to meet learner's individual learning style, researchers have evolved varieties of models to assess students' learning style. The model used in this study defines the preference in learning style based on the sensory modality in which a student prefers to take in new information. The three major modalities are defined by the neural system that is preferred when receiving information: visual (V), auditory (A), and kinesthetic (K), collectively known as VAK. In other words, VAK categorizes student learning based on the sensory preferences of the individual.

As listed in Kutay (2006:13) the following theoretical assumptions are the roots of the Dunn and Dunn Model.

- 1 *Most individuals can learn.*
- 2 *Instructional environments, resources, and approaches can respond to diverse learner style strengths.*
- 3 *Everyone has strengths, but different people have many different strengths.*
- 4 *Individual instructional preferences exist and can be measured using an instrument with excellent published reliability and validity.*
- 5 *Given responsive environments, resources, and approaches students attain statistically higher achievement and attitude test scores in matched, rather than mismatched learning styles treatments.*
- 6 *Most teachers can learn to use learning styles as a cornerstone of their instruction.*
- 7 *Many teachers can learn to capitalize on their learning style strengths when concentrating on a new or difficult academic material. Award winning natural and international doctoral research studies consistently support these statements.*

From the above discussion, one can conceptualize that a teacher should provide learning opportunities for all students by employing a variety of instructional methods. Loper, in Dimmock 2000:117, warns, “[T]eachers who teach in only one mode serve only students who prefer to learn in that mode”. Therefore, a teacher needs to identify the types of learning styles so that he/she can organize classroom activities to respond to individual differences in the classroom.

2.3.1 Types of Learning Styles

The most common way of identifying different learning styles is based on the senses. This model which is commonly known as VAK emphasizes the sensory modalities (Kratzig & Arbuthnott, 2006; Carbo, Dunn & Dunn, 1986). According to this model, there are three types of learners: visual, auditory and kinesthetic.

Various scholars such as Wehrwein, et al (2007) and Dobson (2009) forwarded the characteristics of the learners with the afore-mentioned learning styles. They are presented below.

2.3.1.1 Visual Learning Style

Visual learners are those who learn through seeing things. These students need to sit in the front seats of the classroom, a position with the best view. They have a tendency to describe what they see in terms of appearances. These learners love visual aids such as photos, diagrams, maps and graphs.

A visual learner:

- needs quiet study time.
- has to think for awhile before understanding lecture.
- is good at spelling.
- likes colors and fashion.
- understands/likes charts.
- is good with sign language.
- is good at mental pictures

Visual learners can benefit from:

- making outlines of everything
- asking the teacher to use diagram.
- watching videos.
- coloring code words, research notes.
- participating in group discussions
- outlining reading.
- looking at things
- using highlighters, circle words, underline.

2.3.1.2 Auditory Learning Style

Auditory learners are those who learn best through hearing things. They prefer to listen to teacher's lecture. It is estimated that auditory learners comprise about 30% of the population (Rourk et. al. 2002 as cited in Belay Gizaw, 2009). They tend to absorb information in a more efficient manner through sounds, music, discussions. They prefer oral presentations to written reports (Quesada, in Belay Gizaw, 2009).

An auditory learner:

- likes to read to self out loud.
- likes oral reports.
- is good at explaining.
- remembers names.
- notices sound effects in movies.
- enjoys music.
- is good at grammar and foreign language.
- reads slowly.
- memorizes facts
- follows spoken directions well.
- enjoys acting, being on stage.
- is good in study groups.

Auditory learners can benefit from:

- using word association to remember facts and lines.
- recording lectures.
- listening to radios.
- repeating facts with eyes closed.
- listening during classroom discussion
- using audiotapes for language practice.
- taping notes after writing them.

2.3.1.3 Kinesthetic Learning Style

The word 'kinesthetic' refers to the sense of using muscular movement. The word is derived from the Greek 'kino' meaning 'move' and 'aesthesis' meaning 'sensation' (Chapman & Chislett, 2005 in Belay Gizaw, 2009). Kinesthetic, therefore, describes a learning style which involves the stimulation of nerves in the body's muscles. These students learn best by experiencing, touching, doing, moving and being active in some manner. Experiential and hands on learning activities such as lab work, role playing and making models are the best teacher interventions to make learning successful. These students tend to be distracted or bored very easily within lectures.

Kinesthetic learners are those who learn through experiencing/doing things.

Kinesthetic learner:

- is good at sports.
- can't sit for long.
- is not great at spelling.
- does not have great handwriting.
- likes science lab.
- likes adventure books, movies.
- likes role playing.
- takes breaks when studying.
- builds models.
- is involved in martial arts, dance.
- is fidgety during lectures.

Kinesthetic learners can benefit from:

- studying in short blocks.
- taking lab classes.
- drawing pictures
- role playing
- taking field trips, visiting museums.
- copying what's on the board.
- studying with others.
- using memory games.
- using flash cards to memorize

In a nut shell, a simple explanation of learning styles is this: Some students remember best materials they have seen; some remember things they have heard, while others remember things they have experienced. In fact, there are other groups who may enjoy more than one learning style. These are bi-modal or multiple-modal learners (Wehrwein, et al 2007 and Dobson, 2009).

2.4 The Relationship among Student-Teacher Interaction, Academic Intrinsic Motivation Learning Style and Mathematics Achievement

According to *Cronbach & Snow* (1977), in *Dangwal & Mirta* (1998), learning styles could be used to predict what kind of student-teacher interaction would be most effective for a given individual and learning task. It is expected that styles of learning, if accommodated, can result in improved attitudes toward learning and an increase in academic achievement. It is further supposed that the most effective learning occurs when the learning activities, which are the centers of student-teacher interaction, most closely match the learners' preferred style because different learning styles require different learning techniques. In connection with this *Rourke, et al.* (2002), in *Belay* (2009), stated that matching the instructional style to individual learning strengths improves learning. If this condition is fulfilled, according to *Carbo, Dunn and Dunn* (1986:9), "we can help the students avoid experiencing self-defeating emotions by teaching them through the resources with which they are most likely to be successful." When students are taught through their learning styles, they achieve better and more easily. They enjoy the tasks; they also enjoy the interaction with their teacher.

Various studies report that high percentage of teachers develops positive attitude towards 'best' students (*Joyce*, 1991). Since this necessary interaction is a result of accommodating the learning choice of the students, it brings about learning. Supporting this position, *Domino* (1979), in *Reid* (1987), found that college students taught in preferred learning styles scored higher on tests

than those taught in different from their preferred learning styles. This means, if teachers can show students the variety of learning styles by providing experiences through student-centered interaction, the resulting awareness and expansion of student learning styles may better allow students to meet the demands of academic assignments. It is very well documented that the students' preferred learning styles paralleled their actual learning strengths which can also produce better achievement. Carbo, Dunn and Dunn strongly assert that "Children learn best *only* when they use their learning style characteristics advantageously" (1986:2).

This increases students' motivation (Carbo, Dunn & Dunn, 1986). The increase in motivation develops the learners' need to achieve. They take delight in solving mathematical problems. They also work persistently to meet the demands of classroom activities. When students are motivated, they reduce absenteeism and disruptiveness in the classroom (Pantrick & Ryan, 2007). These researchers further state that such students develop a more positive academic self-concept. Wentzel (1997), on his part, describes motivated students to show academic effort and engagement in classroom activities. These classroom desirable behaviors facilitate the student-teacher interaction on the one hand, and the students' achievement, on the other. Carbo, Dunn & Dunn (1986) said that motivation correlates with achievement.

As far as the researcher's review goes, literature does not take consistent position on which specific subjects (like mathematics) tend to favor which specific learning style. The teacher's success on this side, in turn, initiates the students' motivation to push their learning to wards achievement.

Therefore, student-teacher interaction, academic intrinsic motivation, learning style and mathematics achievement are related if the above conditions are fulfilled.

CHAPTER THREE

METHODS

3.1 Study Design

The current study is correlational in nature. It intends to examine the relationship among student-teacher interaction, academic intrinsic motivation, learning style and students' achievement in mathematics on grade nine students.

3.2 Sample and Sampling Technique

The participants of this study, grade nine students, were drawn from three government secondary schools which were selected from three sub-cities in Addis Ababa. The schools were Misrak Goh, Kokebe Tsibah and Haddis Alemayehu Secondary Schools from Kirkos Sub-City, Yeka Sub-City and Bole Sub-City, respectively. First, the researcher used simple random sampling technique (lottery method) to select the three sub-cities among ten sub-cities in Addis Ababa. Having done so, one school, among four secondary schools per sub-city, was selected from each selected sub-cities using, once again, lottery method. This yielded three schools from three different sub-cities.

The selection of grade nine students was conducted in two stages. The stages are presented below.

Stage I

To select the research participants, the researcher first studied the maximum number of sections a mathematics teacher was assigned to teach. This is conducted for two reasons. For one thing to select a teacher who is teaching many sections for it creates a room for the researcher to select many students. Second, selecting a single teacher per school may reduce the possible effect of the teacher variable which may otherwise contaminate the data gathered.

Having understood the fact that a few teachers were teaching a maximum of three sections, the researcher employed lottery method to select one mathematics teacher among other mathematics teachers with a similar load. One teacher per school was selected.

Then, students in the three sections of the selected teachers were selected to participate in the research project. Totally, ninety-nine, one-hundred and fifty and one-hundred and four students took part in the research from Haddis Alemayehu, Kokebe Tsibah and Misrak Goh Secondary Schools, respectively. This yielded a sample size of 353. The distribution is presented in the table below.

Table 1: Distribution of Sample of Students by Sex and School

School	Population			Sample		
	M	F	T	M	F	T
Haddis Alemayehu	178	239	417	46	53	99
Kokebe Tsibah	738	907	1645	66	84	150
Misrak Goh	353	416	769	44	60	104
Total	1269	1552	2831	156	197	353

Stage II

The present researcher administered a learning style scale on which code numbers were written for all selected students (N= 353). Then, the researcher told the students that she would identify them by their code numbers but not by their names nor by their sections.

Next, the scale was collected and analyzed by the researcher to identify the learning style of each student-participant. After this, the researcher selected twenty (20) students per learning style per school. This added up to sixty (60) students who were selected from each school for further participation in the research project. These students were selected on the basis of their score on the learning style scale. They are labeled auditory, visual or kinesthetic learners

based on which of the three sub-scales they received the highest score. Each item of the sub-scales was presented with five point scales ranging from 'mostly false for me' to 'mostly true for me'. The students' learning style was identified based on their scores on 'true for me' and 'mostly true for me'. Feldman (2004) advised us to disregard 1, 2 and 3 ratings and add up 4 and 5 ratings for each items in the learning style scale. Besides, he also suggests a "4" equals 4 points and a "5" equals 5 points to compute the scores of the learner's ratings.

The total of the students' rating points for any given sub-scales in the LSS ranged from a low of 0 to a high of 50. However, the researcher did not get the ranges of the scores to categorize the students in the three learning style groups. Therefore, the researcher decided to put the scores into ranges for two advantages. It helps to identify relatively 'truly' dominant auditory, visual and kinesthetic learners among students with a similar learning style. This identification in turn helps to select students to be included for further participation in studying the relationship between learning style and other independent and dependent variables with a prime target to come up with data to answer the basic research questions.

The second advantage, is it helps to identify scores to be rejected so that students within that range were not labeled auditory, visual or kinesthetic.

Table 2: Ranges and descriptions of scores

Ranges	Descriptions
35-50	Relatively most dominant
25-34	Relatively more dominant
20-24	Relatively dominant
0-19	Rejected

In the course of using the above ranges, decisions were made on the bases of the following possibilities.

Possibility One: when a student's score on each sub-scale fell within three different ranges, the maximum score which fell within any one range was used to determine the learning style of that student.

Possibility Two: when a student's scores on the two sub scales fell within the same range and the other score fell within any range higher in scores on, the sub-scale (VAK), the subscale on which the maximum score was obtained determined the learning style of that student.

Possibility Three: when a student's score on two sub-scales fell within the same range, and the other score fell within any range lower in scores, the student was considered to have two learning styles and was assigned under 'others' category.

Possibility Four: when a student's scores on the three sub-scales all fell within the same range, except in the range 0-19, the student was considered to have three learning styles and was assigned under 'others' category.

Possibility Five: when a student's score on the three sub-scales all fell within the range 0-19, the student with these scores were not be included in the research project. (However, no score was registered to meet this possibility)

On the basis of the above procedure the students were labeled auditory, visual, or kinesthetic learners. The report is presented in the following table.

Table 3: Distribution of Students across Learning Styles by sex and school

Learning style	Haddis Alemayehu			Kokebe-Tsibah			Misrak-Goh			N
	F	M	T	F	M	T	F	M	T	
Auditory	21	14	35	46	18	64	29	17	46	145
Visual	14	11	25	25	11	36	18	8	26	87
Kinesthetic	12	18	30	10	32	42	11	16	27	99
Others	6	3	9	3	5	8	2	3	5	22
Total	53	46	99	84	66	150	60	44	104	353

To continue the selection process, those who scored within the range 35-50 were selected for further participation. From Haddis Alemayehu 21 auditory, 20 visual and 23 kinesthetic learners scored within this range. From Kokeb-Tsibah, 43 auditory, 26 visual and 31 kinesthetic learners fell within this range. From Misrak-Goh 28 auditory, 22 visual and 21 kinesthetic learners found within this range.

From among these students, 20 students were selected from each learning style per school. Twenty students were selected because it is the least number of participant observed within the most dominant range. In fact, lottery method was used to select 20 students for the learning styles with more than 20 students. These students participated in completing the Academic Intrinsic Motivation Inventory, Questionnaire on Student-Teacher Interaction and in taking the mathematics achievement test.

3.3 Data Collection Instruments

The data used in this study were collected using four instruments. These were Learning Style Scale, Academic Intrinsic Motivation Inventory, Questionnaire on Student-Teacher Interaction and Mathematics Achievement Test.

Learning Style Scale

The learning style scale was designed to identify the most dominant learning style among grade nine students. A total number of three hundred and fifty three students filled in the learning style scale.

The scale contained thirty items which had three sub-scales for auditory learning style, visual learning style and kinesthetic learning style. The items were evenly distributed among the sub-scales. The respondents were requested to put a tick (✓) or (X) mark under the appropriate scale ranging from 'mostly false for me' to 'mostly true for me' for each item. Besides, it lays smooth ground to the selection of 20 students per learning style per school (refer section 3.2 in this document). Then, the students learning style was analyzed to

determine if they have relationship with the dependent and independent variables.

Prior to administering the tool to gather the actual data, a pilot test was conducted. The data were processed using SPSS 15.0 for all (the three subscales together) of the items and Cronbach's alpha reliability coefficient was found to be .78. The Cronbach alpha coefficient .62, .71 and .54 for visual, auditory and kinesthetic learners, respectively. These reliability coefficients were slightly different from Belay's (2009) findings which were .70, .71 and .66, respectively. To improve the reliability of the questionnaire, ambiguous and difficult languages were replaced by clear and simple words.

Academic Intrinsic Motivation Inventory

This inventory was designed to gather data on the participants' academic intrinsic motivation. The inventory contained thirty questions with five response options. The minimum value was thirty and the maximum value is hundred and fifty. The respondents were required to put a tick (✓) or (X) mark under the option which they think describe their academic intrinsic motivation. The response options range from 'mostly false for me' to 'mostly true for me' for each item.

Before distributing the inventory for the actual data, it was pilot tested. The data gathered through this inventory were fed to the SPSS 15.0. It was processed and Cronbach's alpha .89 was obtained. This was better than those reported by others such as Garuma's (2005) .80 and Shia's (2001) .77 as cited in Garuma (2005).

Questionnaire on Student-Teacher Interaction

This questionnaire was designed to illicit information on student-teacher interaction. The questionnaire contained twenty items with five point scales. The minimum value was twenty and the maximum value is hundred. The scale ranges from 'strongly disagree' to 'strongly agree' for each item. The

respondents were requested to put a tick (✓) or (X) mark under the scale they think fit the interaction they experience with their mathematics teacher.

Similar to the above data gathering tools, this questionnaire was administered to 48 grade 9 students for a pilot test. Before SPSS was run, items 2, 5, 8, 9, 11, 13, 18 and 19 were reverse scored. Then, the data gathered using this questionnaire were processed using SPSS 15.0 and Cronbach's alpha .83 was obtained. The reliability coefficient indicated that the Amharic version of the questionnaire was reliable enough to gather data. Therefore, the questionnaire was used for the actual research without making any amendments or changes.

Mathematics Achievement Test

This test was designed to assess students' mathematics achievement in grade nine. The test contains thirty multiple choice items with one correct answer and three destructors. The test was administered to 180 students (60 from each school). The sixty students in each school took the test in two classrooms. An invigilator was assigned for each room. The test was timed and 90 minutes were allotted. One item was weighted to have one point so that the test was marked out of thirty (30).

Prior to administering this test, a pilot study was conducted. The procedure is discussed as follows. First, a table of specification was prepared on the basis of the lesson plans prepared by the actual teachers for the actual mathematics classes. Then, test questions were developed accordingly. The test had two parts: twenty five multiple choice items and five short answer questions. The subject teachers were asked to examine or comment on both the table of specification and the test. The subject teachers had no negative comments; they expressed their agreement.

A teacher wanted to grade her students' performance on the items. On the basis of our agreement, the teacher informed her students that one week allotted for the students to revise the units covered in the test. Besides, she told

her students that the test was going to be marked and recorded so that the students would take the test seriously and exert much effort.

On the test date, the subject teachers invigilated the test for which 90 minutes were allotted. Then, the papers were collected. Except one item, all the items were scored. One of the items (item 22) was not scored because there was a typing error that spoiled the item. Then, the students' responses were organized in a table which had been made to have the students' code (given for the analysis) on a horizontal position and the items and their choices on a vertical position. This clearly showed how many students could get the correct answer and which distracters were effective (good). In other words, this lays a ground to calculate item difficulty level. The researcher decided to rearrange the items according to their level of difficulty—from the least difficult to the most difficult. In addition, descriptive statistics of the pilot achievement test were calculated. Mean (10.09), SD (4.47) and alpha (KR-20) 0.76 were found.

3.4 Pilot Study

Before collecting the actual data, a pilot test was conducted on 48 students from Kokebe-Tsibah Secondary School. The pilot test had the following major goals:

- To check if the data gathering tools were appropriate to collect the data that help to answer the research questions.
- To conduct item analysis with a view to refining the items.
- To establish that the survey instruments were reliable.
- To see whether the items were clear and understandable to the research participants.

General Description of the Self-Report Tools

Because the original versions of the questionnaire were in English, they were translated into Amharic by an individual who has training (MA) in English language (TEFL) and in Special Needs Education. This was done for two reasons. For one thing, the items would not lose their psychological flavor. Second respondents would understand the message of the items. It is only then that the research participants (grade nine students) could give reliable information. Then, the Amharic version was again translated back into English to check whether the items still carry the message (idea) of the original versions of the self-report tools. As a result, the Amharic version could serve replacing the original version developed in English language.

Having looked at the statistical outputs of the pilot test, the researcher made appropriate improvements on the questionnaires and the achievement tests. The procedures and the results of each data gathering tool are discussed under the section 'Data Collection Instruments' in this document.

3.5 Methods of Data Analysis

This study is quantitative in nature. The data gathered through the above instruments were analyzed quantitatively using the following methods.

- Mean, standard deviation and percentage were computed for general comparisons.
- Pearson product moment correlation coefficient was computed among learning style, academic achievement motivation, student-teacher interaction and mathematics achievement of grade nine students to see whether there exist relationships or not.
- To examine whether or not there existed significant difference in mathematics achievement on the basis of learning style one way ANOVA was computed.
- To examine whether or not there existed significant difference between male and female visual, auditory and kinesthetic learners on academic

intrinsic motivation, student-teacher interaction and mathematics achievement t-test was computed.

- Pearson product moment correlation was conducted to see the over all relationship of mathematics achievement with the independent variables.
- Multiple and step wise regression analysis was conducted to see the combined and independent contribution of academic intrinsic motivation and student-teacher interaction on mathematics achievement for visual, auditory and kinesthetic learners. Test of significance were performed using $\alpha = .05$ level of significance.

CHAPTER FOUR

RESULTS

This chapter presents the results of the study. First, descriptive statistics on the study variables is presented; then distribution of students across the three learning styles, independent t- test, correlation analyses, multiple and step-wise regression analyses, and one way ANOVA are presented.

4.1 Descriptive statistics on the study variables

Table 4: Means and standard Deviations of Mathematics Achievement (MA), Academic Intrinsic Motivation (AIM) and Student-Teacher Interaction scores by learning style

Variables	Learners	N	Mean	SD
AIM	Auditory	60	94.10	25.11
	Visual	60	85.93	18.64
	Kinesthetic	60	91.68	18.04
S-TI	Auditory	60	72.30	13.05
	Visual	60	66.73	15.50
	Kinesthetic	60	70.47	13.46
MA	Auditory	60	16.23	6.02
	Visual	60	12.52	4.99
	Kinesthetic	60	14.82	4.89

Table 4 shows the mean and standard deviations scores of auditory, visual and kinesthetic learners on the independent variables (academic intrinsic motivation and student-teacher interaction) and dependent variable (mathematics achievement).

4.2 Most Preferred Learning Style among the Research Participant?

Table 5: Distribution of the study participants across the Learning Styles by sex

Learning style	Male		Female		X ²	All respondents	%	X ²
	N	%	N	%				
Auditory	49	13.9	96	27.2	15.23**	145	41.1	30.26**
Visual	30	8.5	57	16.1	8.38**	87	24.6	
Kinesthetic	66	18.7	33	9.3	11**	99	28.0	
others	11	3.1	11	3.1	0.00	22	6.2	

**P<.01

Table 5 shows the least and most dominant learning styles among the study participants. One hundred and forty five (41.1 %) of the total respondents are auditory learners, whereas 99 (28.0 %) and 87 (24.6 %) are kinesthetic and visual learners, respectively. The remaining 22 (6.2 %) participants appeared to have adopted more than one dominant learning style. $X^2=30.26$, $df =2$ $p<.01$ indicate that the differences in the proportions are statistically significant. The data also show that a larger proportion of female students are auditory and visual learners. In fact, the number of female auditory students is greater than visual ones. On the other hand, a larger number of male students are kinesthetic learners followed by auditory style of learning.

Table 6: Gender differences on the dependent and independent variables for the Three –Learning style Groups

Learners	Variables	Sex	n	Mean	SD	SEM	t
Auditory	AIM	M	25	96.56	25.60	5.12	.64
		F	35	92.34	24.98	4.22	
	S-TI	M	25	72.64	10.77	2.15	.17
		F	35	72.06	14.61	2.47	
	MA	M	25	16.76	6.33	1.27	.57
		F	35	15.86	5.86	.99	
Visual	AIM	M	23	90.78	18.53	3.86	1.61
		F	37	82.92	18.31	3.01	
	S-TI	M	23	67.70	16.28	3.39	.38
		F	37	66.14	15.20	2.50	
	MA	M	23	13.22	5.45	1.14	.86
		F	37	12.08	4.72	.78	
Kinesthetic	AIM	M	39	91.10	17.81	2.85	-.34
		F	21	92.76	18.87	4.12	
	S-TI	M	39	70.38	13.48	2.16	-.06
		F	21	70.62	13.73	3.00	
	MA	M	39	14.64	4.97	.80	-.38
		F	21	15.14	4.84	1.06	

As shown in Table 6, the mean scores for male and female students for all groups of learners on AIM, S-TI and MA do not vary significantly.

4.3 Relationship between the Study Variables

Table 7: Correlations between AIM & MA and S-TI & MA

variable	Mathematics achievement			
	All respondents (n=180)	Auditory (n=60)	Visual (n=60)	Kinesthetic (n=60)
AIM	.76**	.83**	.66**	.74**
STI	.67**	.71**	.67**	.60**

**P < .01 (2-tailed)

Table 7 shows a significant positive correlation between AIM & MA ($r = .76, .83, .66$ and $.74, p < .01$, two tailed) and there is also positive significant correlation between S-TI & MA ($r = .67, .71, .67$ and $.60, P < .01$, two tailed) for all respondents, auditory visual and kinesthetic learners respectively. This indicated that, AIM & MA and S-TI & MA tend to move in the same direction for all VAK learners as well as for all respondents. This study therefore confirms that AIM & S-TI are significant predictors of students' mathematics achievement.

Table 8: Correlation between AIM and S-TI

Variable	Student – Teacher Interaction(S-TI)			
AIM	All respondents (n=180)	Auditory (n=60)	Visual (n=60)	Kinesthetic (n=60)
	.61**	.63**	.57**	.64**

**p < .01 (two tailed)

Table 8 shows a significant positive correlation between AIM & S-TI ($r = .61, .63, .57$ and $.64, p < .01$, two tailed) for all respondents, auditory, visual and kinesthetic learners, respectively. This indicates that as AIM increases S-TI also increases and vice versa for all respondents as well as for VAK learners.

4.4. The Relative Predictive Power of the Independent Variables

Table 9: Results of the multiple regression analysis (N=180)

Variables	B	SEB	Beta	t	AR ²
AIM	.15	.02	.56	9.89**	.65
S-TI	.13	.02	.33	5.84**	

**p < 0.01

AR² = Adjusted R²

Constant=-7.72

The data in Table 9 show that sixty-five percent of the variance in mathematics achievement was accounted for by academic intrinsic motivation and student-teacher interaction.

In order to know the relative contribution of each predictor variable to the predicting the mathematics achievement score of students, it is important to test each of the variables independently. Accordingly, stepwise regressions analysis was used to determine the proportion of variance in mathematics achievement that was accounted for by each of the independent variables considered in this study.

Table 10: Summary of stepwise regressions analysis (N=180).

Step	Variable	R	R ²	AR ²	Change in R ²	F-ratio
1	AIM	.76	.58	.57	.58	242.03**
2	AIM, S-TI	.80	.65	.64	.07	34.11**

**p < 0.001

The results in Table 10 show that academic intrinsic motivation (AIM) has entered into the stepwise regression first with the contribution of 57% of the variance in mathematics achievement. Besides student-teacher interaction (S-TI) entered into the stepwise regression model accounting only about 7% of the variance in mathematics achievement of the respondents. The independent contribution of each predictor variable was statistically significant.

Table 11: Results of multiple regression analyses of VAK learners (n=60).

Learners	variables	B	SEB	Beta	t	AR ²
Auditory	AIM	.15	.02	.62	7.26**	.74
	ST-I	.15	.04	.32	3.76**	
Visual	AIM	.11	.03	.40	3.77**	.55
	ST-I	.14	.03	.44	4.15**	
Kinesthetic	AIM	.16	.03	.60	5.31**	.56
	ST-I	.08	.04	.22	1.98	

**p < 0.01 AR²= Adjusted R²

As shown in Table 11, the proportion of variance in mathematics achievement of the 60 students from each group of learning style studied, 74%, 55% and 56% are explained by linear combination of academic intrinsic motivation and student teacher interaction for auditory, visual and kinesthetic learners, respectively.

Table 12: Summary of stepwise regression analyses results for each learning style group (N=60).

Learners	Step	Variable	R	R ²	AR ²	Std. error	Change in R ²	F-ratio
Auditory	1	AIM	.83	.68	.68	3.43	-	124.27**
	2	AIM,S-TI	.86	.75	.74	3.09	.06	14.14**
Kinesthetic	1	AIM	.74	.55	.54	3.32	-	69.46**
	2	AIM,S-TI	-	-	-	-	-	-
Visual	1	S-TI	.67	.67	.45	3.37	-	47.79**
	2	S-TI,AIM	.75	.75	.56	3.73	.11	14.21**

**p < 0.001 AR²= Adjusted R²

The results from Table 12 show that academic intrinsic motivation (AIM) accounted for 68% and 54% of the variance in mathematics achievement (MA) for auditory and kinesthetic learners, respectively. In the second step, student-

teacher interaction (S-TI) entered into the stepwise regression model and accounted for only 6% of the variance in mathematics achievement for auditory learners, but S-TI has no significant contribution for kinesthetic learners. For visual learners, S-TI has entered first into the stepwise regression accounting for 45% of the variance in MA and in the second step AIM accounted only for 11% of the variance in MA.

This implies that AIM contributed to the MA of VAK learners. Where as S-TI had significant contribution for MA of auditory and visual learners, but did not have for MA of Kinesthetic learners.

Table 13: Summary of One-way Analysis of Variance

Variables	Source	SS	df	MS	F
MA	Between groups	422.21	2	211.11	7.44**
	Within groups	5020.70	177	28.37	
	Total	5442.91	179		

**p<.05

One-way analysis of variance was carried out in order to see whether there is a significant difference between auditory, visual and kinesthetic learners in their mathematics achievement. Three groups were significantly different in their mathematics achievement (F=7.44, df=2,177, p<0.05). A follow-up post-hoc analysis using Scheffe's procedure indicates that the only significant difference observed was between auditory (Mean=16.23) and visual (Mean=12.52) learning style groups. More specifically, the students who adopted auditory learning style received a mean score that was significantly greater than that of visual learners.

This may stem from the teacher's style of teaching mathematics. It is very well known that the teacher method is dominantly 'Chalk and talk' which claims the students' listening to the teacher. Therefore, these who enjoy listening could benefit form such classes.

CHAPTER FIVE

DISCUSSION

5.1 Which Learning Style is Most Preferred among Grade 9 Students?

Identifying the most preferred learning style among learners has paramount importance to meet the learning needs of our students. On this ground, this research has found that auditory, kinesthetic and visual learning styles take from the most to the least, respectively. In fact, a small number of students (6.2%) adopted either two or three learning styles. Belay (2009) reported the same findings. However, according to Rourk et al. (2002 in Belay) 65%, 30% and 5% of the world's populations are visual, auditory and kinesthetic learners, respectively. In connection with this, Dobson (2009) conducted a research on students who were taking physiology course and found out that auditory, visual and kinesthetic learning styles from the most to the least dominant, respectively. According to the researcher's report, this disproportionately low preference for kinesthetic style of learning was unexpected. His justification was that the course (physiology course) had a laboratory component which demands the students' movement. The current research is partly inconsistent with findings of studies conducted in other countries. This is probably because of the difference in research context such as the nature of the course and nature of respondents. Dobson's research centered a physiology course which is different from mathematics (mine). Besides, the respondents were college students for Dobson's, whereas grade 9 students for this research.

On the basis of the above discussion, one can suggest that teachers need to be mindful that their classes include students with different learning styles. Therefore, it is wise to use a variety of teaching strategies to accommodate different types of students. In this regard Bichno & Younger (2004) assert that

if schools make their pupils aware of their learning style, learners can extend their learning styles repertoire and become more effective.

5.2 The Relationships among Academic Intrinsic Motivation, Student-Teacher Interaction and Mathematics Achievement

On the basis of the findings, one can understand that student-teacher interaction, academic intrinsic motivation and mathematics achievement are significantly positively correlated for all learning style groups. This means that when the teacher establishes a classroom interaction centering learning style of the students, the students may be intrinsically motivated and vice versa. It is also true that the increasing of the teacher's devotion to accommodate different learning styles also results in improvement in the students' achievement and the reverse is also true. Moreover, if students are intrinsically motivated, their mathematics achievement also increases.

The parallel increase between student-teacher interaction and academic intrinsic motivation is widely accepted among researchers. Carbo, Dunn & Dunn (1986), in this connection, contend that one of the ways to increase the motivation of learners is teaching through learning style that is natural to them. This research is in agreement with their (Carbo, Dunn & Dunn) position in that student-teacher interaction and academic intrinsic motivation are moderately positively correlated for all learning style groups. To put it in clear terms, student-teacher interaction found to be supportive in igniting (provoking) the learners to use their academic intrinsic motivation to learn mathematics. Middleton (1995), in Middleton & Spanias (1999), advise teachers that those who want to improve their students' motivation must adjust their classroom practice to the students' need. Whrwein et al. (2007) state that one way of improving the motivation and performance of students is adapting their classroom interaction to meet the learning style of the students. Other sources corroborate this finding. According to Carbo, Dunn and Dunn (1986), teachers

who match their relationship with students' learning style observe increases in their learners' motivation in taking responsibility to accomplish classroom assignments.

The other thing this research has come up with is the correlation between student-teacher interaction and mathematics achievement. They are strongly correlated for auditory learners and moderately correlated for visual and kinesthetic learners. Even though the degree of correlation differs, when student-teacher is supportive for visual, auditory and kinesthetic learners, mathematics achievement also increases. On this point, Dobson (2009) found out that there was a significant relationship between preferred learning style and course performance. Carbo, Dunn & Dunn (1986:2) state that, "Children learn best only when they use their learning style characteristics advantageously". Wherwein et al (2007), Kutay (2006) and Dobson (2009) strongly contend that everyone can learn if their preferences are addressed. Wherwein et al (2007) further explain that the underlying principles of the model encourage teachers to respect differences and to use methods appropriate to their students' learning style.

As described above, if the student-teacher interaction is in favor of each learning style, mathematics achievement also becomes in favor of each learning style; and the reverse is also true. Therefore, this research is in agreement with other researches.

According to this research, academic intrinsic motivation and mathematics achievement are strongly positively correlated for auditory and kinesthetic learners, and moderately correlated for visual learners. It is widely accepted that once students are motivated, they perform better. It increases the learners' satisfaction in doing mathematical problems. They also engage in classroom activities and persist longer even while solving challenging tasks. Deci & Ryan (2000), in Workineh (2004), have come up with a similar finding that academic intrinsic motivation is associated with better performance also enhances

academic intrinsic motivation of grade 9 mathematics students. It is also widely accepted that past attainments push an individual for further and additional attainments. That is, an individual's success in mathematics can in turn be a motivation to engage in the subject matter. Therefore, the significant correlation between academic intrinsic motivation and mathematics achievement is in consistent with other research findings.

5.3 The Relative Predictive Powers of Academic Intrinsic Motivation and Student-Teacher Interaction

Dobson (2009) and Wehrwein et, al. (2007) found that there is a difference in achievement with a variation in learning style. In the same manner, the present study found that there is significant difference among auditory, visual and kinesthetic learners in their mathematics achievement. However, statistically significant difference occurs only between visual and auditory learners in favor of the latter group. This difference in mathematics achievement was further examined. First, the combined contribution of academic intrinsic motivation and student-teacher interaction was computed. It was found out that academic intrinsic motivation and student-teacher interaction significantly contributed for the variation of mathematics achievement. In fact, the proportion of the combined contribution of these two variables is greater for the prediction of mathematics achievement of auditory learners. Even though the proportion is less compared to the one for auditory learners' mathematics achievement, academic intrinsic motivation and student-teacher interaction had a significant combined contribution for the prediction of mathematics achievement of visual learners.

On the bases of the above results, one can have a position that auditory learners benefited from the interaction they have with their mathematics teacher. Besides, the task based interaction provokes their academic intrinsic motivation which also makes them enjoy the tasks and work harder in mathematics.

This research has also found out the relative contribution of academic intrinsic motivation and student-teacher interaction separately. Academic intrinsic motivation of the learners, among other variables, has strong positive contribution for the learners' mathematics achievement. In a similar manner, Garuma (2005) found out that academic intrinsic motivation significantly and positively predict mathematics achievement, among other subjects. In addition, academic intrinsic motivation has significant contribution to the prediction of students' achievement that was accounted for by academic intrinsic motivation was the least to the largest for auditory, kinesthetic and visual learners, respectively.

The other thing this research has come up with is that student-teacher interaction has a significant contribution in predicting students' mathematics achievement. Besides, student-teacher interaction has a significant contribution to the prediction of students' mathematics achievement for greater proportion of visual learners than auditory learners. However, student-teacher interaction did not have significant contribution in predicting mathematics achievement of kinesthetic learners. From this one can understand that student-teacher interaction took the largest share for visual learners' mathematics achievement. This may boil down to the classroom task based interaction. It is known that majority of classroom time is taken by a plasma-Tv which may contributes to some proportion of predicting mathematics achievement.

The above discussion shows that student-teacher interaction and academic intrinsic motivation play significant roles in contributing to the prediction of mathematics achievement jointly and separately. Therefore, student-teacher interaction should create rooms to accommodate a variety of learning style for the betterment of all learners' mathematics achievement. Bricheno & Younger (2004) advise teachers to incorporate a learning style approach in their subject areas. Dobson (2009) in the same way found out that accommodating students' learning style improves course performance. Besides, teachers are advised to

create mechanisms to promote their learners' academic intrinsic motivation so that the learners enjoy learning mathematics. The capability of teachers in accomplishing these responsibilities makes student-teacher interaction and academic intrinsic motivation greatly contribute to the students' mathematics achievement.

5.4 Sex Differences for Visual, Auditory and Kinesthetic Learners in their Academic Intrinsic Motivation, Student-Teacher Interaction and Mathematics Achievement

The current research has studied if there is a variation of academic intrinsic motivation and student-teacher interaction and mathematics achievement with the variation of sex and learning style. The finding indicates that mathematics achievement does not vary with the variation of sex and learning style. It is also found out that auditory, visual and kinesthetic male and female learners do not show any significant difference in their academic intrinsic motivation. That is, no matter what the dominant learning style of the learner is, intrinsic motivation does not differ for males and females. For example, male and female auditory learners have more or less the same level of motivation.

The finding further shows that there is no significant difference between male and female visual, audio and kinesthetic learners on student-teacher interaction. This suggests that teachers are not biased in favor of one or the other sex.

The current study has, moreover, examined if there is a difference mathematics achievement with the variation of sex. However, the finding revealed that there was no significant mean difference in mathematics achievement between male and female students. In other words, male and female learners do not show significant difference in mathematics achievement with a variation of dominant learning styles. That is, achievement in mathematics does not favor males or females.

CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary

The objective of the present study was to examine the relationship among student- teacher interaction, academic intrinsic motivation, learning style and students' mathematics achievement in grade nine in Addis Ababa. Accordingly, the following specific questions were formulated for investigation:

- Which learning style is the most preferred among grade nine students, if at all?
- Do male and female students significantly differ in their academic intrinsic motivation, student- teacher interaction and mathematics achievement among the three learning style (auditory, visual and kinesthetic) groups?
- Are there significant differences in mathematics achievement among the three learning style groups?
- Is there a significant relationship between student-teacher interaction and academic intrinsic motivation for visual, auditory and kinesthetic learners?
- Do academic intrinsic motivation and student -teacher interaction significantly explain the variation in mathematics achievement for the three learning style groups separately and in combination?

Three sub-cities were selected from among ten sub-cities using lottery method. One school was selected from each selected sub-city. From these three sample schools, 353 students participated in the research project. Using learning style scale, 180 students were selected for further investigation.

Four instruments (namely Learning Style Scale, Academic Intrinsic Motivation Inventory, Questionnaire on Student-teacher Interaction and Mathematics Achievement Test) were used to collect data. Initially, the instruments were administered on a pilot sample. Based on this item analysis was carried out and the instruments were improved.

Percentage, t-test, Pearson's product moment correlation, multiple regression analyses and one way ANOVA were used to analyze the data. The analyses indicated that auditory learning style was adopted by the majority of grade nine mathematics students. The results of the t-test indicated that there was no significant variation between male and female visual, auditory and kinesthetic learners on their academic intrinsic motivation, student-teacher interaction and mathematics achievement. Besides, student-teacher interaction, academic intrinsic motivation and mathematics achievement were found to have significant positive correlation. In addition, the result of multiple regression analyses indicates that AIM and S-TI combined together had significant contribution for the prediction of students' mathematics scores. It was also seen that AIM has significant contribution for all VAK learners, whereas S-TI had significant contribution only for auditory and visual learners. Moreover, one-way ANOVA showed that there was significant mean difference between auditory and visual learners in mathematics achievement.

6.2 Conclusions

From the above findings, the following conclusions have been made.

1. Grade nine mathematics classes include students who adopted all three learning styles. However, auditory learners were greater in number.
2. Academic intrinsic motivation, student-teacher interaction and mathematics achievement do not favor either sex of visual, auditory and kinesthetic learners.

3. Mathematics achievement and academic intrinsic motivation are closely related variables that play important roles in learning mathematics for all groups of students.
4. Supportive student-teacher interaction enhances students' academic intrinsic motivation, and vice versa.
5. The combined contribution of student-teacher interaction and academic intrinsic motivation was found to be significant in predicting mathematics achievement for visual and auditory learners. However, only academic intrinsic motivation contributed significantly in predicting kinesthetic learners mathematics achievement

6.3 Recommendations

Based on the above conclusions the following recommendations are forwarded:

- Teachers are advisable to use different teaching techniques to accommodate the diversity of learning style so that students will be motivated to perform better and will have a long attention span when doing things in a way natural to them.
- Curriculum designers are better if they try to develop materials considering the variety of learning styles. To put it in different terms, text-book writers should consider the three learning styles while designing the activities and tasks. This will guide (remind) the teacher to vary methods to match the learning styles.
- Teacher training colleges (universities) are better train teachers on how to create student-centered interaction.

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Appendix A
Mathematics Test for Grade 9 Students

Code No. _____ Section _____ School _____

General Direction: This test paper contains 30 questions. Attempt all the questions. You are allowed to work on the test for 1½ hours.

Direction: The following are 30 mathematics questions. Each question is followed by four suggested alternatives (choices). Thus indicate the correct answer by circling the letter of your choice.

1. Which of the following set is equal to $A = \{a, c, b\}$
 A. $\{a, \{b\}, c\}$ B. $\{b, a, c\}$ C. $\{\{a, b, c\}\}$ D. $\{2, 3\}$
2. The number of proper subset of the set $\{1, 2, 3, 4\}$ is
 A. 15 B. 16 C. 4 D. 7
3. Given $A = \{a, b, c, d\}$ and $B = \{a, c, e, f\}$, then $A \cup B =$ _____
 A. $\{a, b, c, d, e, f\}$ B. $\{a, c\}$ C. $\{b, d\}$ D. $\{b, d, e, f\}$
4. $((\sqrt{2} + \sqrt{3}))^0 + 3 =$ _____
 A. 3 B. 0 C. 4 D. 1
5. If $a + 1/a = 2$, then $a^2 + 1/a^2$ is equal to
 A. 4 B. 6 C. 9 D. 2
6. The solution set of the equation $4(3x+1) = 6x+10$ is
 A. $\{3/2\}$ B. $\{6\}$ C. $\{1\}$ D. $\{7/2\}$
7. When the denominator of $\frac{\sqrt{5} - \sqrt{2}}{\sqrt{5} + \sqrt{2}}$ is rationalized it gives
 A. $\frac{7+2\sqrt{10}}{3}$ B. $\frac{3+2\sqrt{10}}{3}$ C. $\frac{7-2\sqrt{10}}{3}$ D. $\frac{3-2\sqrt{10}}{3}$
8. $a^2b^2 - 6ab + 9$ is equal to:
 A. $(ab-3)^2$ B. $(ab-3)(ab-6)$ C. $(ab-3)(ab+3)$ D. $9(ab-1)$
9. The solution set of the inequality $-3x+2 \leq -16$
 A. $\{x: x \leq 6\}$ B. $\{x: x \geq 6\}$ C. $\{x: x \geq 14/3\}$ D. $\{x: x \leq \frac{14}{3}\}$
10. The solution set of simultaneous equations $\begin{cases} 6x-9y=18 \\ -6x+9y=-36 \end{cases}$ is
 A. $\{(-2, 5)\}$ B. $\{(3, 7)\}$ C. $\{(9, 2)\}$ D. \emptyset

11. Which of the following pairs of equations are equivalent?
- A. $2(x-2)=1$; $2x = 2$ C. $2x+1=1/2$; $x = -1/4$
 B. $7x=5$; $x=7/5$ D. $-5x+4= 5$; $x = 5$
12. The solution set of $|5x-2| < 4$ is
- A. $(6/5, \infty)$ B. $(-2/5, 6/5)$ C. $(-\infty, -2/3)$ D. $[-3/2, 5/7]$
13. For any real number a , which of the following is always true?
- A. $\frac{2 + (3a)^2}{a^2 + 1} = 9$ B. $\frac{(a+1)^3}{a+1} = a^2 + 2a + 1$
 C. $a^{-1/2} = \frac{1}{\sqrt{a}}$ D. $a^0 = 1, a \neq 0$
14. If an operation $*$ is defined on the set of rational numbers by $a*b = \frac{ab}{2}$, then which of the following is not true?
- A. If $a*4=2$, then $a = 1$ C. if $a, b \in \mathbb{Z}$, then $a * b \in \mathbb{Z}$
 B. For each $a \in \mathbb{Q}$, $4*a = a*4 = 2a$ D. $*$ is commutative
15. Which of the following is true?
- A. $0 \in \emptyset$ B. $\{0\} \in \{0,1\}$ C. $0 \subset \{0, 1\}$ D. $\emptyset \subseteq \{0\}$
16. If A and B are two sets and $n(A) = 15$, $n(B) = 7$, and $n(A \cap B) = 5$, then $n(A \cup B) =$ _____
- A. 12 B. 17 C. 15 D. 7
17. If A is the subset of B , then which of the following is true?
- A. $A \cup B = A$ B. $A' \cap B' = B'$ C. $B/A = \emptyset$ D. $A \cap B = B$
18. If a and b are real numbers such that $a < b < 0$, then which of the following is true?
- A. $ab < 0$ B. $0 < a/b < 1$ C. $b < \frac{a+b}{2} < 0$ D. $a/b > 1$
19. If $X = 0.1010010001\dots$
 $Y = 0.0101101110\dots$, then $x+y$ is
- A. 1.1 B. $1/10$ C. $1/9$ D. $2/3$
20. Which of the following is an identity element of W with respect to multiplication?
- A. 0 B. 1 C. -1 D. 2

21. Which one of the following is the expanded notation of 35026?
 A. $3 \times 10^4 + 5 \times 10^3 + 2 \times 10^2 + 6$ C. $3 \times 10^5 + 5 \times 10^4 + 2 \times 10^2 + 6$
 B. $3 \times 10^4 + 5 \times 10^3 + 2 \times 10 + 6$ D. $3 \times 10^3 + 5 \times 10^2 + 2 \times 10 + 6$
22. The decimal notation of $7 \times 10^2 + 10 + 3 \times 1/10 + 9 \times 1/10^2$
 A. 710.39 B. 701.93 C. 7003.9 D. 700.39
23. If $2^x = 16$, then x is equal to
 A. -2 B. 8 C. 4 D. 2
24. Which of the following is not true?
 A. $a^2 + b^2 = (a+b)(a+b)$ C. $(a+b)^2 = b^2 + a^2 + 2ab$
 B. $a^2 - b^2 = (a+b)(a-b)$ D. $(a-b)^2 = b^2 + a^2 - 2ab$
25. The solution set of the equation $2x + 3(5 - 3x) = 7(5 - x)$ is equal to
 A. $\{5/3\}$ B. $\{5\}$ C. \emptyset D. IR
26. Let the operation * and Δ be defined on the set of real numbers by
 $a * b = \frac{a+b}{2}$ and $a \Delta b = (3a+b)^2$. What is the value of $(2 * 6) \Delta (-4 * 2)$?
 A. 8 B. 376 C. 169 D. 121
27. The most simplified form $(81)^{0.75}$ is _____
 A. 4 B. 3 C. 27 D. 14
28. The simplest form of $\sqrt{20} + 2\sqrt{45} - \sqrt{125}$ is equal to
 A. $3\sqrt{5}$ B. $2\sqrt{5}$ C. 1 D. $8\sqrt{5}$
29. The most simplified value of $\frac{(x^2y^4)^2}{y^8}$, $y \neq 0$, is _____
 A. x^4 B. Y^8 C. Y^4 D. X^2
30. The solution set of $|2x+5| = -5$ is _____
 A. 9 B. -5 C. -2 D. \emptyset

APPENDIX B

Code No _____

Addis Ababa University
School of Graduate Studies
Institute of Psychology
Student's Learning Style Scale

Dear students,

I would like to convey my heartfelt gratitude for the co-operation you have shown to fill out this questionnaire. The main aim of this questionnaire is to identify your preferred way of learning mathematics; the response you give by completing the questionnaire have much importance for the success of this study.

On the next page there are 30 questions. For each sentence on the questionnaire, put a (✓) or (X) mark under the number you think most applies to you.

DO NOT WRITE YOUR NAME

Sex M _____ F _____ Grade _____ School _____

Thank you!

No	Item	Mostly false for me	False for me	Neither true nor false for me	True for me	Mostly true for me
1	I want my mathematics teacher to tell me what I am supposed to do.					
2	I understand the day's lesson by reading my textbook prior to the teacher's delivery					
3	I enjoy when my mathematics teacher gives me a chance to work on the black board					
4	I usually prefer to stand and move while studying mathematical concepts					
5	I need to look at mathematical issues before I understand it.					
6	I frequently relate mathematical points to jokes and stories to understand what I have learnt					
7	I first see my friends calculate mathematical questions so that I can do it later.					

8	I enjoy visiting pedagogical center to see mathematical objects (models)					
9	I can imagine my self doing mathematical concept before I actually do it.					
10	I prefer listening during group discussion on mathematical issues.					
11	I must read to remember mathematical concepts.					
12	I prefer watching other students perform a mathematical task before I actually try it.					
13	I remember mathematics best by writing down or drawing pictures.					
14	I need to watch my mathematics teacher's facial expressions and body language to understand what he/she means.					
15	I am good at figuring out how mathematics is worked out					
16	I often choose writing than listening to mathematical issues					
17	I mostly study mathematics while listening to music.					
18	I prefer my mathematics teacher explain the lesson using pictures and models					
19	I try my best to understand geometry by preparing models					
20	I do not feel I have learnt the lesson if I do not watch my mathematics teacher.					
21	I write the mathematics formula many times when I study new formula.					
22	I can retell once I heard what my mathematics teacher said.					
23	I understand my mathematics teachers' explanation of the steps more than I read the steps on the textbook					
24	I do my best to learn mathematics by doing what other students have done.					
25	I usually do more listening than watching while others are doing mathematics					
26	I have difficulty to sit in a place for a long time studying mathematics.					
27	I try out by practicing to see if they work mathematical sentences.					
28	I learnt mathematics best by repeating key points in my head.					
29	I tend to listen to lectures of my mathematics teacher in order not to miss the lesson.					
30	I enjoy in mathematics classes when I involve practically.					

APPENDIX C

Code No _____

Addis Ababa University
School of Graduate Studies
Institute of Psychology
Academic Intrinsic Motivation Inventory

Dear Student,

I would like to convey my heartfelt gratitude for the co-operation you have shown to fill out this questionnaire. The main aim of this questionnaire is to identify your preferred way of learning mathematics. The responses you give by completing the questionnaire have much importance for the success of this study.

On the next page there are 30 questions. For each sentence on the questionnaire, put a (✓) or (X) mark under the number you think most applies to you.

Do not write your name.

Sex: M_____ F_____ Grade_____ School_____

Thank You!

No	Item	1 Mostly false for me	2 False for me	3 Neither true nor false for me	4 True for me	5 Mostl true for m
1	I do more than I have to on mathematics assignment to understand the lesson					
2	I keep working on mathematical problem until I solve it.					
3	I never boast of my grades in mathematics					
4	I do all that I can to make my mathematics assignment turn out best					
5	Learning mathematics holds my full attention.					
6	When I learn mathematics, I set high goals for my self.					
7	I have high expectations of my self					
8	I think learning is my main activity.					

9	I enjoy learning about various topics in mathematics					
10	I tried to do my best on every assignment.					
11	High school program helps me to get valuable knowledge					
12	I like to learn every thing I am expected to learn					
13	I feel good about my effort when others do not understand mathematical questions that is clear to me					
14	My ability in mathematics is higher than most of my classmates					
15	I think that challenging mathematics questions special learning experiences					
16	I would sign up for a mathematics club only if it helped me to reach a long term goal.					
17	I am well-informed in many areas in mathematics					
18	I feel very competent on something I have learnt in mathematics class					
19	When I learn mathematics I learn with decision					
20	I prefer difficult tasks as opposed to moderate classroom tasks					
21	I feel good about my self when I finish a difficult mathematics assignment					
22	I like to do more mathematics questions than I have to					
23	I enjoy doing hard mathematics examination					
24	I believe that learning mathematics by itself is valuable					
25	No matter how much I dislike a mathematics class I still try to learn something from it					
26	I like to spend time reading about things that interest me					
27	I wait till the last minute to complete my mathematics assignments					
28	When I learn mathematics I think about how much I enjoy the lesson					
29	When I get bored on the day's lesson, I look for ways to learn new things in school					
30	I give special attention to mathematics topics					

APPENDIX D

Code No _____

**Addis Ababa University
School of Graduate Studies
Institute of Psychology
Questionnaire on Student-Teacher Interaction**

Dear Student,

I would like to convey my heartfelt gratitude for the co-operation you have shown to fill out this questionnaire. The main aim of this questionnaire is to identify your preferred way of learning mathematics. The responses you give by completing the questionnaire have much importance for the success of this study.

On the next page there are 30 questions. For each sentence on the questionnaire, put a (✓) or (X) mark under the number you think most applies to you.

Do not write your name.

Sex: M _____ F _____ Grade _____ School _____

Thank You!

No	Item	strongly disagree	disagree	un decided	agree	strongly agree
1	Our mathematics teacher conducts student-centered approach					
2*	Our mathematics teacher becomes angry when we make mistake					
3	Our mathematics teacher explains the lesson to us					
4	We ask our mathematics teacher mathematical concepts we do not understand					
5*	Our mathematics teacher does not hold our attention					
6	Our mathematics teacher tries his best to make us understand the lesson					
7	Our mathematics teacher actively attends the teaching-learning process in the classroom					

8*	If we have something to say about the teaching-learning process our teacher does not listen to us					
9*	Our mathematics teacher thinks we cheat on academic matters(cheating on tests, assignments)					
10	Our mathematics teacher approaches us like a friend even outside the classroom					
11*	Our mathematics teacher thinks that we know nothing about mathematics					
12	Our mathematics teacher knows the subject-matter very well					
13	Our mathematics teacher's tests are hard					
14	Our mathematics teacher uses a variety of teaching methods					
15	Our mathematics teacher knows each of us					
16	Our mathematics teacher gets satisfied when we participate					
17	Our mathematics teacher's lesson delivery is pleasant					
18*	Our mathematics teacher gives attention to clever					
19*	We are afraid of our mathematics teacher					
20	Our mathematics teacher helps us with our work on mathematics					

* The scores were reversed

Appendix E

መለያ ቁጥር _____

አዲስ አበባ ዩኒቨርሲቲ የድህረ ምረቃ ትምህርት የስነ-ልቦና ትምህርት ክፍል

የተማሪዎች የመማር ይትብሃል (Learning Style) ላይ ለ9ኛ ክፍል የተዘጋጀ መጠይቅ

ውድ ተማሪ

ይህንን መጠይቅ ለመሙላት ለምታደርግልኝ(ጊልኝ) ትብብር በቅድሚያ ከልብ የመነጨ ምስጋናዬን አቀርባለሁ። የመጠይቁ አላማ በሒሳብ ትምህርት የምትከተለው/ይው የመማር ስታይል (ይትብሃል) ለመለካት ሲሆን የምትሰጠኝ(ጭኝ) ምላሽ ለጥናቱ መሳካት እጅግ አስፈላጊ ነው።

ከዚህ በመቀጠል 30 ጥያቄዎች አሉ። በእያንዳንዱ ዓ/ነገር ፊት ለፊት ይስማማኛል (ይገልፀኛል) በምተለው(ይው) ላይ (✓) ወይም (X) ምልክት በማድረግ መልስ(ሺ)።

ስም መጻፍ አያስፈልግም።

ፆታ ወንድ ሴት ትምህርት ቤት _____

ስለትብብርህ/ሽ/ በጣም አመሰግናለሁ።

ተ.ቁ	ጥያቄዎች	1 ብዙ ጊዜ ለኔ ሀሰት ነው	2 ለኔ ሀሰት ነው	3 ለኔ ሀሰትም እውነትም አይደለም	4 ለኔ እውነት ነው	5 ብዙ ጊዜ ለኔ እውነት ነው
1	በሒሳብ ትምህርት ጉዳይ ላይ ማድረግ የሚገባኝን መምህራ እንዲነግሩኝ እፈልጋለሁ።					
2	ዘወትር ከሚሰጠው የሒሳብ ትምህርት አስቀድሜ የመማሪያ መፅሐፌን በማንበብ ትምህርትቱን እረዳለሁ።					
3	የሒሳብ መምህራ ጥቁር ሠሌዳ ላይ እንድሰራ እድል ሲሰጡኝ ያስደስተኛል።					

4	ሒሳባዊ ፅንሰ ሀሳቦችን ሳጠና በተለምዶ መንቀሳቀስ እመርጣለሁ።					
5	አንድ ሒሳባዊ ትምህርትን ለመረዳት የሚሰጠውን ትምህርት በአትኩሮት ማየት ያስፈልገኛል።					
6	የተማርኳቸውን ሒሳባዊ ነጥቦች ለመረዳት ከማውቃቸው ቀልዶችንና ታሪኮች ጋር አዛምዳቸዋለሁ።					
7	የሒሳብ ጥያቄዎችን ጓደኞቼ ሲያሰሱ ከተመለከትኩ በኋላ ለብቻዬ ማስላት እችላለሁ።					
8	የትምህርት ማበልፀጊያ ክፍል በመሄድ በሒሳብ ትምህርት ላይ የተሰሩ ስራዎችን መመልከት ያስደስተኛል።					
9	አንድን የሒሳብ ጥያቄ ከመስራቴ በፊት እንዴት እንደምሰራው አስባለሁ።					
10	ሒሳባዊ በሆኑ የቡድን ውይይቶች ጊዜ ማዳመጥን እመርጣለሁ።					
11	የተማርኩትን የሒሳብ ፅንሰ ሀሳቦች ለማስታወስ የግድ ማንበብ አለብኝ።					
12	አንድን የሒሳብ ሥራ (assignment) ከመሞከሪ በፊት ሌሎች ተማሪዎች ሲሰሩት መመልከት እመርጣለሁ።					
13	የሒሳብ ትምህርት ፅንሰ ሀሳብን በሥዕል ላስቀምጥ ለማስታወስ ይቀለኛል።					
14	የሒሳብ መምህራችን ለማለት የፈለጉትን ለመረዳት የሰውነት እቅስቃሴያቸውንና የፊት ገፅታቸውን ማንበብ ያስፈልገኛል።					
15	ሒሳባዊ የሆነን አንድ ነገር እንዴት እንደሚሠራ አስቀድሜ ጉዳዩ በአእምሮዬ አስለዋለሁ።					
16	ብዙ ጊዜ ሒሳባዊ የሆኑ ጉዳዮችን ከማድመጥ ይልቅ መጻፍን እመርጣለሁ።					
17	የሒሳብ ትምህርትን ሳጠና ብዙ ጊዜ ሙዚቃ እየሰማሁ ነው።					

18	የሒሳብ መምህራ የሒሳብ ትምህርት ሲያስረዱ ሥዕሎችንና ቅርፃቅርፆችን ቢጠቀሙ እመርጣለሁ።					
19	ለጂኦሜትሪ ትምህርቶች ቅርፃቅርፅ (model) በማዘጋጀት ትምህርቱ እንዲገባኝ ጥረት አደርጋለሁ።					
20	የሒሳብ መምህራ እያየሁ ሒሳብ ካልተማርኩ በቀር የተማርኩ አይመስለኝም።					
21	አዲስ የሒሳብ ቀመር (formula) ሳጠና ደጋግሜ እፅፈዋለሁ።					
22	የሒሳብ መምህራን አንዴ ከሰማሁ በኋላ የሰማሁትን ደግሜ መናገር እችላለሁ።					
23	የሒሳብ መማሪያ መፅሐፍ ላይ ካለው የስሌት ቅደም ተከተል (steps) ይልቅ የሒሳብ መምህራ የሚያስረዱት የስሌት ቅደም ተከተል የበለጠ ይገባኛል።					
24	ሌሎች ተማሪዎች የሠሩትን የሒሳብ ጥያቄዎች ደግሜ በመሥራት ትምህርቱ እንዲገባኝ ጥረት አደርጋለሁ።					
25	የሒሳብ ስራዎችን ከመመልከት ይልቅ ብዙ ጊዜ የሚሰራው ሰው ሲናገር ማዳመጥ እመርጣለሁ።					
26	ሒሳብ ትምህርት ሳጠና አንድ ቦታ ብዙ ጊዜ መቀመጥ ይቸገረኛል።					
27	የሒሳብ ዓረፍተ ነገሮችን እንዴት እንደሚሠሩ ለማረጋገጥ በተግባር እሞክራቸዋለሁ።					
28	በይበልጥ የሒሳብ ትምህርትን ለመረዳት ዋና ዋና ነጥቦችን በአእምሮዬ አሰላስላለሁ።					
29	የክፍለ ጊዜው ትምህርት እንዳያመልጠኝ ከመፃፍ ይልቅ የመምህራን ገለፃ (lecture) ማዳመጥ ላይ አዘነብላለሁ።					
30	በሒሳብ ትምህርት ክፍለ ጊዜ ተግባራዊ ተሳትፎ ሳደርግ ያሰደስተኛል።					

Appendix F

መለያ ቁጥር _____

አዲስ አበባ ዩኒቨርሲቲ

የድህረ ምረቃ ትምህርት

የስነ-ልቦና ትምህርት ክፍል

የትምህርት የውስጥ ተነሳሽነት (Intrinsic Motivation) መለኪያ ለ9ኛ ክፍል

የተዘጋጀ መጠይቅ

ውድ ተማሪ

ይህንን መጠይቅ ለመሙላት ለምታደርግልኝ(ጌልኝ) ትብብር በቅድሚያ ከልብ የመነጨ ምስጋናዬን አቀርሳሁ። የመጠይቁ አላማ የሒሳብ ትምህርት የመማር ተነሳሽነትህን(ሺን) ለመለካት ሲሆን የምትሰጠኝ(ጭኝ) ምላሽ ለጥናቱ መሳካት እጅግ አስፈላጊ ነው።

ከዚህ በመቀጠል 30 ጥያቄዎች አሉ። በእያንዳንዱ ዓ/ነገር ፊት ለፊት ይስማማኛል (ይገልፀኛል) በምተለው(ይው) ላይ (✓) ወይም (X) ምልክት በማድረግ መልስ(ሺ)።

ስም መጻፍ አያስፈልግም

ፆታ ወንድ ሴት ትምህርት ቤት _____

ስለትብብርህ/ሽ/ በጣም አመሰግናለሁ።

ተ.ቁ	ጥያቄዎች	1 ብዙ ጊዜ ለኔ ሀሰት ነው	2 ለኔ ሀሰት ነው	3 ለኔ ሀሰትም እውነትም አይደለም	4 ለኔ እውነት ነው	5 ብዙ ጊዜ ለኔ እውነት ነው
1	የሒሳብ ትምህርት በደንብ እንዲገባኝ የሚሰጠኝን የቤት ስራ (assignment) ከሚጠበቅብኝ በላይ አሰራለሁ።					
2	አንድን የሒሳብ ትምህርት ችግር (Problem) ውጤት እስከማግኘት ድረስ መሥራት አቀጥላለሁ።					
3	በሒሳብ ትምህርት ውጤቱ በፍፁም ጉረኛ አልሆንም (አልከራራም)።					
4	የተሰጠኝን የሒሳብ ትምህርት ጥሩ አድርጌ ለመስራት የምችለውን ሁሉ ጥረት አደርጋለሁ።					

5	የሒሳብ ትምህርትን መማር ሙሉ ትኩረቱን ይስጠዋል።					
6	የሒሳብ ትምህርትን ስማር ለራሴ ከፍተኛ ግቦችን አስቀምጣለሁ።					
7	ለራሴ ከፍተኛ ግምት እሰጣለሁ።					
8	ትምህርቴን መከታተል ዋና ሥራዬ ነው ብዬ አስባለሁ።					
9	የተለያዩ የሒሳብ ትምህርት ርዕሶችን መማር ያስደስተኛል።					
10	ማንኛውም ሥራ (assignment) ለመስራት የቻልኩትን ያህል ጥረት አደርጋለሁ።					
11	የሁለተኛ ደረጃ ትምህርት ጠቃሚ እውቀት እንዳገኝ እረድቶኛል።					
12	መማር የሚጠበቅብኝን ነገር ሁሉ መማር እወዳለሁ።					
13	ለኔ እንዴት እንደሚሰራ ግልፅ የሆነልኝ ሒሳባዊ ጥያቄዎች ሌሎች ባልተረዱት ጊዜ በራሴ ጥረት ደስ ይለኛል።					
14	የኔ የሒሳብ ትምህርት ችሎታ ከአብዛኛዎቹ የክፍል ጓደኞቼ የበለጠ ነው።					
15	ከባድ የሒሳብ ጥያቄዎች (challenging questions) ልዩ የመማር አጋጣሚዎች ሲሆኑ ይችላሉ ብዬ አስባለሁ።					
16	በትምህርት ቤት የሒሳብ ክበብ አባል የምሆነው የረጅም ጊዜ ግቤን የሚያሳካልኝ ከሆነ ብቻ ነው።					
17	በብዙ የሒሳብ ትምህርት ርዕሶች ላይ በቂ መረጃ አለኝ።					
18	በተማርካቸው የሒሳብ ትምህርቶች ላይ ብቁ ተወዳዳሪ እንደሆንኩ ይሰማኛል።					
19	ሒሳብ ትምህርትን ስማር መማር አለብኝ ብዬ ወስኜ ነው።					
20	ከቀላል የክፍል ውስጥ ተግባራት (assignment) ይልቅ መካከለኛ ክብደት ካላቸው ተግባራት እመርጣለሁ።					
21	ከባድ የሒሳብ የቤት ሥራ (assignment) ሠርቼ ሳጠናቅቅ ሥለ ራሴ ጥረት ጥሩ ይሰማኛል።					

22	መሥራት ከሚገባኝ የሒሳብ ጥያቄዎች በላይ መሥራት እወዳለሁ።					
23	ጠንካራ የሒሳብ ትምህርት ፈተናዎችን መሥራት ያስደስተኛል።					
24	የሒሳብ ትምህርትን መማር በራሱ ዋጋ አለው ብዬ አምናለሁ።					
25	የምማርበትን የሒሳብ ክፍለ ጊዜ ምንም ያህል ብጠላውም ከክፍለ ጊዜው አንድን ነገር ለመማር ጥረት አደርጋለሁ።					
26	የምፈልጋቸውን ነገሮች በማንበብ ጊዜዬን ማሳለፍን እወዳለሁ።					
27	የተሰጠኝን የሒሳብ የቤት ሥራ (assignment) ለማጠናቀቅ እስከ መጨረሻዎ ደቂቃ ድረስ እሠራለሁ ።					
28	የሒሳብ ትምህርት ስማር ትምህርቱ ምን ያህል እንደሚያስደስተኝ አስባለሁ።					
29	በዕለቱ የሒሳብ ትምህርት ብሰላች እንኳ አዲስን ነገርን ለመማር ሌላ ዘዴ እፈልጋለሁ።					
30	ለወደፊት ህይወቴ ለሚያዘጋጀኝ የሒሳብ ትምህርት ርዕሶች ልዩ ትኩረት እሰጣለሁ።					

Appendix G

መለያ ቁጥር _____

አዲስ አበባ ዩኒቨርሲቲ የድህረ ምረቃ ትምህርት የስነ-ልቦና ትምህርት ክፍል

የተማሪ-መምህር መስተጋብር (interaction) ለ9ኛ ክፍል የተዘጋጀ መጠይቅ ውድ ተማሪ

ይህንን መጠይቅ ለመሙላት ለምታደርግልኝ(ጊልኝ) ትብብር በቅድሚያ ከልብ የመነጨ ምስጋናዬን አቀርላሁ። የመጠይቁ አላማ አንተን/ቺን ከሒሳብ መምህር/ሽ ጋር የምታደርገውን/ጊውን መስተጋብር (interaction) ለመተንተን ያለመ ሲሆን የምትሰጠው/ጭው ምላሽ ለጥናቱ እጅግ አስፈላጊ ነው።

በሚቀጥለው ገፅ 20 ጥያቄዎች አሉ። በእያንዳንዱ ዓ/ነገር ፊት ለፊት የምትማርበትን/ሪበትን በሚገልፀው ስር የ(✓) ወይም (X) ምልክት በማድረግ መልስ(ሽ)።

ስም መጻፍ አያስፈልግም

ፆታ ወንድ ሴት ትምህርት ቤት _____

ስለትብብርህ/ሽ/ በጣም አመሰግናለሁ።


ተ.ቁ	ጥያቄዎች	በጣም አልሰማላም	አልሰማላም	መውሰን አልችልም	እስማማለሁ	በጣም እስማማለሁ
1	ሒሳብ መምህራችን ተማሪ አሳታፊ የትምህርት ሂደትን ይከተላሉ።					
2	ሒሳብ መምህራችን በምንሳሳትበት ጊዜ በእኛ ይናደዳሉ።					
3	ሒሳብ መምህራችን በጥሩ ሁኔታ ያስረዱናል።					
4	በሒሳብ የትምህርት ክፍል ጊዜ ያልገባንን የሒሳብን ፅንሰ ሀሳብ የሒሳብ መምህራችንን እንጠይቃለን።					
5	የሒሳብ መምህራችን ሲያስተምሩ የተማሪዎችን ትኩረት አይስቡም።					

6	የሒሳብ መምህራችን የሒሳብ ትምህርት በደንብ እንዲገባን ጥረት ያደርጋሉ።					
7	የሒሳብ መምህራችን በክፍል ውስጥ የሚካሄደውን የመማር ማስተማር ሂደት በንቃት ይከታተላሉ።					
8	በመማር ማስተማር ሂደቱ ላይ የምንናገረው (የምንጠይቀው) ሲኖረን የሒሳብ መምህራችን እያዳምጡንም።					
9	የሒሳብ መምህራችን እኛን ተማሪዎችን ትምህርታዊ በሆኑ ጉዳዮች (በፈተና ጊዜ መከረጃ፣ ያልሰሩትን ሰርቻሊሁ ብሎ ማቅረብ የመሳሰሉት) ላይ ሊያታልሉ ይችላሉ ብለው ያስባሉ/ይገምታሉ።					
10	የሒሳብ መምህራችን ከክፍል ውጪም ቢሆን እንደጓደኛ ይቀርቡናል።					
11	የሒሳብ መምህራችን በሒሳብ ትምህርት እኛን ተማሪዎችን ምንም አያውቀም ብለው ያስባሉ/ይገምታሉ።					
12	የሒሳብ መምህራችን የሚያስተምሩትን የሒሳብ ትምህርት በደንብ ያውቁታል።					
13	የሒሳብ መምህራችን የሚያዘጋጁትን የምዘና ጥያቄዎች ከባድ ናቸው።					
14	የሒሳብ መምህራችን የተለያዩ የማስተማር ዘዴዎችን ይጠቀማሉ።					
15	የሒሳብ መምህራችን እያንዳንዳችንን ያውቁናል።					
16	የሒሳብ መምህራችን በሒሳብ ትምህርት ላይ በምናደርገው የክፍል ውስጥ ተሳትፎ ይደሰታሉ።					
17	የሒሳብ መምህራችን የሒሳብ ትምህርት አሰጣጥ ያስደስታል።					
18	የሒሳብ መምህራችን ትኩረት የሚሰጡት ለጎብዝ ተማሪዎች ብቻ ነው።					
19	የሒሳብ መምህራችን እንፈራቸዋልን።					
20	በምንሰራው የሒሳብ ነክ በሆኑ ስራዎች ላይ የሒሳብ መምህራችን ያግዙናል።					

DECLARATION

I, the undersigned, declare that this thesis is my original work and has not been presented for a degree in any other university.

Name: **Fikirte Lakew Abebe**

Signature: _____ 

Place: **Addis Ababa University**

Date of Submission: **July 05, 2010**

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