The Development and Validation of Mathematics Learning Motivation (MLM) Instrument and the Effect of MLM on Academic Achievement: The Case of Undergraduate Students in Selected Public Universities of Ethiopia

A PhD DISSERTATION

BELAY BEKELE WOLDEMICHAEL
HAWASSA UNIVERSITY
COLLEGE OF EDUCATION
SCHOOL OF TEACHERS EDUCATION
MEASUREMENT AND EVALUATION UNITS

JANUARY, 2024
HAWASSA
ETHIOPIA

The Development and Validation of Mathematics Learning Motivation (MLM) Instrument and the Effect of MLM on Academic Achievement: The Case of Undergraduate Students in Selected Public Universities of Ethiopia

BELAY BEKELE WOLDEMICHAEL ID: PHDR /001/10

ADVISOR: TESFAYE SEMELA (PROFESSOR)

CO-ADVISOR: ABRAHAM TULU (ASSOCIATE PROFESSOR)

A PhD Dissertation in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosopy in Educational Measurement and Evaluation

HAWASSA UNIVERSITY

COLLEGE OF EDUCATION

SCHOOL OF TEACHERS EDUCATION

MEASUREMENT AND EVALUATION UNITS

JANUARY, 2024

HAWASSA

ETHIOPA

HAWASSA UNIVERSITY

Examiners Approval Sheet

We, the undersigned, members of the Board of Examiners of the final PhD Dissertation open defense by Belay Bekele Woldemichael have read and evaluated his PhD Dissertation entitled "The Development and Validation of Mathematics Learning Motivation Instrument and the Effect of MLM on Academic Achievement: The Case of Undergraduate Students in Selected Public Universities of Ethiopia", and examined the candidate. This is, therefore, to certify that the Dissertation has been accepted in partial fulfillment of the requirements for the degree PhD in Educational Measurement and Evaluation

_____	_____	_____
Name of External Examiner	Signature	Date
_____	_____	_____
Name of Internal Examiner	Signature	Date
_____	_____	_____
Name of Chair Person	Signature	Date
_____	_____	_____
Name of Principal Advisor	Signature	Date
_____	_____	_____
Name of Co- advisor	Signature	Date
_____	_____	_____
SGS Approval	Signature	Date

Final Approval and acceptance of the proposal is contingent upon the submission of the final copy of the proposal to the School of Graduate Studies (SGS) through the School Graduate Committee (DGC/SGC) of the candidate's department.

Stamp of SGS Date _____

STATEMENT OF DECLARATION

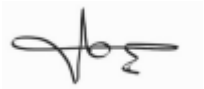
I hereby declare that this dissertation entitled "The Development and Validation of Mathematics Learning Motivation (MLM) Instrument and the Effect of MLM on Academic Achievement: The Case of Undergraduate Students in Selected Public Universities of Ethiopia" is original work of my own and had not been presented for a partial fulfillment for any educational qualification at this University or any other and in any projects by any means, and all the resources materials used for this dissertation had been accordingly acknowledged.

Belay Bekele_____

Date_____

CERTIFICATE

We, hereby certify that, Mr. Belay Bekele Woldemichael student of PhD of Educational Measurement and Evaluation, at Hawassa University, College of Education, School of Teacher Education, has completed his Dissertation entitled **"**The Development and Validation of Mathematics Learning Motivation (MLM) Instrument and the Effect of MLM on Academic Achievement: The Case of Undergraduate Students in Selected Public Universities of Ethiopia**"** under our advice, guidance and supervision.

Principal Advisor	Signature	Date
AbrahamTulu(Ph.D.)		
Co-Advisor	Signature	Date

Dedication

This dissertation is dedicated to my mother, Abaynesh Woldemariam, who had been carrying the local food ‘Kocho’ on her back for sale until I accommodate my first degree from the University.

Acknowledgments

First, I would like to thank **Almighty GOD** for his love, mercy, and his mother, holy virgin Mary help throughout my life's success.

Next to the almighty God, I would like to extend my heartfelt gratitude to my Advisor **Tesfaye Semela (Professor)** for his guidance, understanding & valuable comments to keep me on track throughout the research process. Thank you Professor Tesfaye for your commitment, tolerance, and making me love structural equation modeling!!

My profound and deep appreciation goes to my Co-advisor, **Abraham Tulu (Associate Professor**), for his credible support to shape the dissertation to be in this form, and for his comments on every elements of the work, especially in the proposal phase, and to my internal examiner of the proposal of this disserttion, **Adamu Assefa (Associate Professor)** for his valuable comments on this dissertation starting from proposal phase and for his being focus on quality writing and rigorous research.

I am greatly indebted to **college deans, and department heads, and students of Natural and Computational science, Education, Engineering, and Health, and students in Hawassa University, Addis Ababa University, Jimma University who helped me in collecting primary data, and all others who have contributed directly or indirectly** to the success of this dissertation work.

Great credit also forwarded to **my families**. Especially I'm grateful to thank my beloved mother Abaynesh Woldemariam, my spouse Tesfanesh Temesgen, my sister Dinknesh Bekele, my sister Aregash Bekele, Yibabe Mekonnin, my descendant Betselot Belay, my brother Zwudie Beyene, Yordanos Yibabe, Tigist Yibabe and Meron Yibabe for their endless encouragement and moral support to realize my dream.

Finally, I extend my appreciation to the **College of Education**, School **of Teacher Education of Hawassa** University for designing and implementing such a wonderful and value adding Ph.D. program in Educational Measurement and Evaluation on which I am engaged in .

Belay Bekele

Janury 2024

Table of Contents

List of Tables

Table **Page**

List of Figures

Figure **Page**

Acronyms

AAUW	American Association of University Women
ANCOVA	Analysis of Covariance
CFI	Comparative Fit Index
EFA	Exploratory Factor Analysis
EGMA	Early Grade Mathematics Assessment
EVT	Expectancy Value Theory
GTP	Growth and Transformation Plan
IAEEA	International Association for Evaluation of Educational Achievement
IRT	Item Response Theory
LCT	Latent Construct Theory
MANCOVA	Multiple Analysis of Covariance
MLM	Mathematics Learning Motivation
RMSEA	Root Mean Square Error of Approximation
SEM	Structural Equation Modeling
SDT	Self Determination Theory
STEM	Science, Technology, Engineering and Mathematics
TIMSS	Trend in International Mathematics and Science Study
TLI	Tucker- Lewis Index

Abstract

This study aimed at developing and validating MLM instruments in the context of Ethiopia and accordingly exploring the influence of MLM on mathematics achievement and academic achievement of university undergraduates in Ethiopia. Quantitative approach was employed and data was obtained on a random sample of 400 undergraduate students (M=245 and F=155) from three Ethiopian public Universities by using self-reported questionnaire and Math achievement test. The instrument, which was adapted from Butler (2016), Al Mutawah (2015), Vallerand and Blssonnette (1992), Lubienski, Robinson, Crane and Ganley (2013), and Ayodele(2011) consists of measures of self-efficacy, self-concept, self-determination, expectancy-value, anxieity, attribution, and achievemen-goal related motivation. In addition, a 25-item Mathematics Achievement Test (MAT) was developed and validated to measure mathematics achievement. The internal consistency reliability of the MAT was found to be high (alpha =0.84). Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM) were employed to assess systematic relationship between math self-beliefs and math achievement. Univariate Analysisis of Covariance (ANCOVA) and Multivariate Analysis of Covariance(MANCOVA) were also employed. Results reveal that self-concept, anxiety, and achievement-goal theories contribute to the valid 22-items MLM instrument in the case of Ethiopia; mathematics self-concept, and anxiety have a significant influence on mathematics achievement, whereas achievement goal have no significant influence on mathematics achievement. There is significant main effect and pair-wise interaction effect of self-concept, anxiety, and achievement-goal on math achievement. Mthematics achievement significantly predicts the academic achievements of university underaduates in Ethiopia. In conclusion, the self-concept, anxiety and achievement-gaol are the dominant determints of MLM in the case of selected Public Univerisites of Ethiopia. Finally, the study delineates the inferences for teaching and learning, and research.

Key Words: Self-concept, Expectancy-value, Achievement- Goal, Anxiety, Mathematics Achievement; university undergraduates, Ethiopia

Chapter 1: Introduction

Learning mathematics needs concerted effort for students, and this need for effort has led to many researches on constructs concerning motivation and on motivational relationships associated with mathematics instruction. Some of these researches have involved the use of various psychometric scales for measuring disparate constructs associated with mathematics (McAuley, Duncan, & Tammen, 1987; Pintrich et al. 1992; Midgley, Kaplan, Middleton, Maehr, Urdan, Anderman, & Roeser, 1998; Miller, DeBacker, & Greene, 1999; Pelletier, Fortier, Vallerand, Tuson, Briere, & Blais, 1995; Usher & Pajares, 2009; Butler, 2016). Several of these scales have been used extensively, and several have been shown to be internally valid and consistent for the populations being measured. But little or no research has been performed in relation of combination of self-determination theory, self-efficacy theory, self-concept theory, Attribution theory, Achievement goal theory, and expectancy value theory. Moreover, little or no study has been conducted to deliver validated mathematics learning Motivation instrument in the context of Ethiopia and in relation to academic achievement. Thus the need for this study is to re-develop and validate the instrument measuring Mathematics Learning Motivation (MLM) and to check the effect of MLM on academic achievement by combining different theories of learning motivation. The developed tool will serves as a measure of MLM in the context of Ethiopia in such a way that Mathematics teachers will use the tool to diagnose the gage or level of the motivation level of their students in class during teaching learning process; education leaders can use the tool to evaluate the level of motivation of students in the class, in the campus or throughout the Universities; researcher can use the validated tool for studies concerning mathematics learning motivation with different contexts.

1.1 Background

Mathematics is one of the branches of science that contributed greatly to the advancement of science and technology. The important role of mathematics recognized Cockcroft (1986), for example, he writes: “It would be very difficult – perhaps impossible – to live a normal life in very many parts of the world in the twentieth century without making use of mathematics of some kind.” It would be very difficult or not possible for a person to live on the earth in the 21th century without the slightest utilize mathematics. That is why currently, there is a strong political focus in Ethiopia on science, engineering, and mathematics. But according to Hembree (1990), when students avoid the study of mathematics, it erodes the country’s resources base in science and

technology, since it is a base for science and technological fields. If Ethiopians were able to use the application of mathematics to build the Lalibela Temple (Rock Hwan churches in the northern Ethiopia) from top to down by using the techniques of reverse engineering, that is thinking together how the doors, the windows and the walls can be constructed, being in the converse direction, before 800 years ago, the reason why they are unable to do more in 21th centenary is a big concern and this implies that the motivation to learn Mathematics and its application is under question. Thus it is very important to have a measure of Mathematics learning motivation in the context of Ethiopia and identify the level that student are motivated to learn Mathematics.

The field of motivation is a cornerstone in the science of human behavior. Motivational theories ask a fundamental question, namely: what moves a person. They are concerned with the prime force at work in human nature and human culture (Ryan 1998).The study of motivation is central to the science of human behavior in general, and Ryan's (1998) statement is also relevant to educational science. By motivation, we mean the reasons, purposes, intentions, goals, feelings, intuitions, values, beliefs, and attitudes that humans use to explain why they do the things they do (Mercier & Sperber 2017). Simply put, "a person who feels no impetus or inspiration to act is thus characterized as unmotivated, whereas someone who is energized or activated toward an end is considered motivated" (Ryan & Deci 2000). While environmental and genetic factors may shape human behavior, individual motivation contributes to behavior and outcomes.

In educational settings, the study of student motivation is central, because this interacts with educational choices and achievement behavior in important ways (Bandura 1997; Deci & Ryan 1985; Hattie 2009; Wigfield & Eccles 2002.).Students who enjoy in learning are more likely to show interest, value, and effort toward achievement, perform well (Miserandino, 1996), and persist in school (e.g., Vallerand et al. 1989). Students do not enjoy in learning are less likely to show interest, value in, and effort toward achievement, and more likely to perform poorly and drop out of school (Deci, 1995; Vallerand et al. 1993). Students need to learn the skills and competencies expected of them and, to do so, they need the will to learn and perform well in educational assessment settings (Eklof 2010). Learning science has gone further and pointed to the need for students to gain skills, the will to learn, and experience a motivating thrill in learning that enables them to persist when learning becomes difficult (Hattie & Donoghue 2016). Motivation is not a static characteristic, but malleable, and differs between and within individuals across different domains, activities, and contexts (Ryan & Deci 2000). Some students learn to achieve extrinsic rewards, while others learn for more intrinsic reasons. The strength of these goal motivations can vary across time, according to the context, and by a student's level of maturity, culture, and

individual background demographic characteristics. Thus, motivation matters because, unlike societal habitus or genetic inheritance, individuals seem to be able to select from a range of options, as well as monitor the efficacy of motivation and exercise control over their motives.

In international large-scale assessments (ILSAs) for example, student motivation, self-efficacy, and self-concept in academic subjects are consistent predictors of student performance across almost all participating countries (Marsh et al. 2006, 2013). These predictors are important, because it is possible to support, coach, or develop students' adaptive beliefs about the purpose of assessment (Brown 2011), interest in school subjects (Alexander 2003), confidence in their own abilities (Bandura 1977), goals (Ryan & Deci 2000) and motives (Eccles & Wigfield 2002) for learning, and so on.

Gender is mainly used conventionally to describe how the society gives certain roles to boys and girls. Gender has to do with behaviors that have become associated with masculinity and feminity, and with how people see their roles as male or female (Kauffman, 1997). Therefore, gender is related with how individuals perceive themselves in such a way that most people of the same sex identify themselves with certain attributes. These attributes affect children as they develop. Without doubt, the environment in which a child finds himself or herself has a lot of impact on the child. According to Berk (2010), girls and boys are treated differently at birth. Girls are dressed with pink, and parents tend to be gentle with the girl child. On the other hand, boys are dressed with blue materials, while parents are harder with them. In the process of treating children differently, girls are offered more sex stereotyped toys, and without doubt, these children grow up looking and acting differently. This is in line with Kauchak and Eggen (2011) who stated that male children are regarded as handsome and seen as tougher and harder, and parents are rougher with their sons and involve them in more physical stimulation than their female children. It was along this direction that the American Association of University Women (AAUW; 2006) argued that the differential treatment given to boys and girls by teachers and the society dangerously hampered the educational progress, self-esteem, and career choices of girls. If this is so, there are the indications that self-concept and academic achievement of male and female children could be affected by stereotyping.

According to Aboud (1988) and Durkin (1995), stereotypic views may reflect cognitive developmental changes and have impact on the way children understand the meaning of categories, attributes, and changes in role-taking skills. Therefore, stereotypes testify individuals' orientation and past experiences, which could manifest positively or negatively as individuals interact with others within and outside their immediate environment. It is believed that stereotypic

views might affect individuals' self-cognitive development, as well as their feelings, actions, and attitudes. According to Allen (2000), stereotype is associated with the development of beliefs concerning the traits supposedly possessed by most members of a society. It is an exaggerated belief that members of a group have certain traits that are peculiar to them. This implies that the impact of stereotype tends to change the individual's perception of reality over a period of time. Stereotypes are widely held beliefs about the character and behavior of all members of a group. Stereotyping is the perception, clarification, and assessment of social objects (events) on the basis of specific notion (Ramalingam, 2006). A stereotype is a rigid, simplistic caricature of a particular group of people, which in one way or the other can affect individuals by limiting them on their academic achievement (Kauchak & Eggen, 2011). From this evidence, it is possible that stereotype might limit children from pursuing their career choices. Stereotype becomes a problem when forces in schools and the society limit the academic potential of either male or female. According to Francis and Skelton (2005) and Wessel (2005), gender stereotypic views create negative influence on children in their choice of career decision, and females are less likely to study engineering and computer sciences than males. Therefore, there are some indications that gender stereotype can influence individuals' academic perceptions and achievement.

In the case of Ethiopia, however, while each of these individual psychological and affective factors such as self-confidence/self-efficacy (Aboma, 2009; Mulugeta, 1998; Tamire, 1997; Tsige, 2001; Yalew, 2003), motivation (Daniel, 1992; Girma, 1997; Mulugeta, 1998; Tesfaye, 2007), academic self-concept (Demewez, Mehadi, & Tesfaye, 2005), anxiety (Tamire, 1997; Yalew, 2003) have been studied as predictors of performance, they are less often studied as combination of patterns in the case of Ethiopia and in the case of mathematics learning motivation. Is it true that only students who consistently and systematically score highly on all factors will achieve the best academic performance? Is it possible that there are combinations of factors that generally support good academic achievement, and certain factors are less critical? The International Association for the Evaluation of Educational Achievement (IAEEA) Trends in International Mathematics and Science Study (TIMSS) has included self-report measures of student attitudes and motivation in mathematics and science in the student background questionnaires administered together with the achievement tests since 1995. But these measures have not been about MLM in the case of Ethiopia. Thus developing new valid and MLM tool based on theories and checking the effect of MLM on academic achievement is important. Moreover, the Educational and Training Policy of Ethiopia(1994), The growth and transformation plan - GTP2 (2016, P.189) of Ethiopia, Ethiopian Education Development Road Map (2018-30), and the 70:30 admission policy at higher education

institutions gives emphasis on improving the achievements in mathematics and science subjects but there is gap of awareness that the achievement is related with learning motivation, and there is a gap that no valid instrument in Ethiopia that can numerically measure the Mathematics Learning motivation of students and the study was not concerning scale validation. Hence, the need arises for this study.

1.2 Statement of the problem

Mathematics learning Motivation is the impetus for and maintenance of mathematical activity(Moddleton, 2020). Motivation is important in many contexts: in school, at home, and in the world at large (Eccles & Wigfeld, 2002). The key reason that motivation is important to teachers is the well-documented relationship between motivation to learn and academic achievement (Alderman, 2007). Students who are motivated tend to achieve more in school; they stay in school longer, learn more, and perform better on tests. Teachers must foster motivation for learning before they can expect students to profit from instruction or from school in general (Daniels, Kalkman, & McCombs, 2001; Dembo, 2000; Dembo & Eaton, 2000; Dembo & Sel, 2004; McCombs, 1996, 1998). But student motivation for school is a complex and dynamic phenomenon, marked by distinct academic and social goals (Covington, 2000; Dowson & McInerney, 2003). Motivation has a pivotal role in mathematics education (Hannula, 2006; Walter & Hart, 2009). Numerous studies have shown that mathematics performance is strongly related to students' motivation towards mathematics learning (Schiefele & Csikszentmihalyi, 1995; Kim, Park, & Cozart, 2014; OECD, 2014a; Mullis, Martin, Foy, & Arora, 2012), but this need to be checked how it works in the context of working Ethiopian education Policy.

Maslow's Hierarchy is directly related to learning through motivation. In order for students to succeed in the classroom, they must be motivated to learn. When all levels of Maslow's Hierarchy of Needs are met, students are at their full potential for learning (McLeod, 2007). For example, a student would not be able to enter a classroom with an empty stomach and the fear of dying from starvation and successfully learn. Each student has needs that must be met in order to maximize learning. The higher up in the hierarchy a student is, the more levels that are met, the better the motivation and therefore the more learning that the student will experience. All students have basic needs to be met for learning to occur. The more needs that are met, the more students will learn. Maslow's hierarchy, developed by Abraham Maslow in 1954, is a way of organizing the basic needs of students on different levels (McLeod, 2007). The more levels that are met, the more a student will learn. Maslow's hierarchy of needs applies especially to students with exceptionalities,

because many times students' with exceptionalities needs are more difficult to meet. The first level must be met in order to move onto any other levels in the hierarchy. Physiological needs include the basic necessities of life (Gorman, 2010). These needs may include food, water, and shelter. Once physiological needs are met, students will then need the second level of Maslow's hierarchy. The second level is safety needs. Students need to feel safe in the environment in which they are learning with no outside threats. If a student feels like they could potentially be harmed, this level of safety will not be met. After physiological needs and safety needs are met, students will reach the third level of the hierarchy. In the third level of the hierarchy, students need to feel a feeling of belongingness and love. At this level, students will want to feel a sense of belonging with other people in their environment (Maslow, 1943). In this level, students need to identify with a group or groups of other students and need to feel that they do fit in. In the fourth level of the hierarchy, which can only be reached after levels one, two, and three are met, students now have to face esteem needs. In the fourth level, students want to have good esteem through recognition and achievement (Maslow, 1943). By getting recognition from others, students feel confident in their ability to learn. At the fifth level, self-actualization becomes important. At the fifth level, the student looks for ways to fulfill their personal potential for learning, and seek fulfillment in their learning. At this level students will strive for certain learning goals and seek to achieve them (Gorman, 2010). For example, at this level, students may want to receive an "A" on their test or may seek to read a certain number of books. In the final and sixth level of the hierarchy, which can only be reached if all levels are previously met, students now are motivated through self-transcendence. At this level, students have already met many of their personal goals and are now motivated to improve the people around them (Gorman, 2010). By motivating and helping those around them, they in turn can have a better sense of understanding and can improve their personal experience. At this level students are concerned about the learning of other students. For example, a student who is particularly good at math, may sign up to be a math tutor. But no educational policy or Curriculum documents of Ethiopia incorporate these levels students' needs and motivation.

As per educational and training policy of Ethiopia(2022), the basic education will focus on literacy, numeracy, environment, agriculture, crafts, home science, health services and ethics, practice oriented learning, the use of technology in education, and industry linked education, education which take into account the current condition of the country, education which take into account the indigenous knowledge of the country, and the higher education at diploma, first degree and graduate levels, will be research oriented, enabling students become problem-solving

professional leaders in their fields of study and in overall societal needs. According to Ethiopian Education Development Road Map (2018-30), the curriculum should introduce higher order thinking skills through teaching science, technology, engineering and mathematics (STEM) subjects appropriate for the level. The growth and transformation plan - GTP2 (2016, P.189) of Ethiopia also suggests that the number of public higher education institutions and their admission capacity will be increased and in order to improve the achievement of preparatory secondary school students admitted to higher education, universities and preparatory secondary schools will work in collaboration mainly with emphasis on improving the achievements in mathematics and science subjects. But the numeracy, literacy and problem solving skills will be enabled in mathematics and the emphases in improving achievement in mathematics and science needs further detail including making checking students' learning motivation for mathematics. Thus the validated instrument to check students' Mathematics learning motivation (MLM) in the context of Ethiopia will be much more important to give the emphases mentioned by the GTP 2 document for mathematics learning. GTP 2 also mentioned that Special emphasize will be given to training highly skilled manpower to enable capacity building of technology transformation. Supporting and encouraging activities will be made to the revitalization and reinforcement of maintaining initiatives for applying the 70:30 admission policy at higher education institutions and the promotion of initiatives and attitude among primary and secondary schools students for mathematics and natural Science. This 70: 30 program makes the enrollment natural and computational science students in university to be massive than that of social science students. The majority of mathematics curricula available today do not incorporate the results of the best and most recent research on how children actually learn, and do not evaluate design and revisions based on student classroom performance (Clements, 2004b). In response, empirical research is available that suggests valid mathematics instruments that can help teachers and systems learn quite specifically where students need support (Gersten, Jordan, & Flojo, 2005). As it has been seen from EGMA(2009) report, there were differences in skill levels among students in early grade level throughout the countries. This implies there will be differences in level of motivation in learning mathematics among students and thus in the higher grade level also it is not expected that all the 70% of students accepted to be science learners in Universities of Ethiopia are high achievers in mathematics and highly motivated to learn mathematics. Thus to check students' level of Mathematics motivation the need of validated mathematics learning instrument in the context of Ethiopia will be un questionable. In addition to this, checking the students' level mathematics achievement and the level of academic achievement in relation to their mathematics

learning motivation will be important. According to Ethiopian Education Development Road Map (2018-30), the curriculum should introduce higher order thinking skills through teaching science, technology, engineering and mathematics (STEM) subjects appropriate for the level.

Moreover, various factors influence students' academic achievement in higher institutions of Ethiopia. Prior studiess distinguish some of possible reasons of poor academic achievements as organizational factors, such as admission type (Fentaw, 2001), enrollment of department (Adem, 2005), community adjustment and adaptation (Tamire, 1997; Tsige, 2001; Yalew, 2003), boarding and library facility (Habte, 1988; Tsige, 2001, 2006; Yalew, 2003), reference materials (Tamire, 1997; Yalew, 2003); counseling services (Tesfaye, 2007; Tsige, 2006), teachers' teaching and evaluation techniques (Tamire, 1997; Tsige, 2006), and grading problems of instructors (Yalew, 2003). Other practical researches have also recognized students' individual characteristics, such as past ability (Aboma, 2009; Adem, 2005; Fentaw, 1991; Habte, 1988; King & King, 1972; Mezgebo, 2008; Tamire, 1997; Tsige, 2006; Yalew, 2003), English language skill (Fentaw, 1991; King & King, 1972; Tsige, 2006), self-confidence/self-efficacy (Aboma, 2009; Mulugeta, 1998; Tamire, 1997; Tsige, 2001; Yalew, 2003), motivation (Daniel, 1992; Girma, 1997; Mulugeta, 1998; Tesfaye, 2007), academic self-concept (Demewez, Mehadi, & Tesfaye, 2005), anxiety (Tamire, 1997; Yalew, 2003), study skills (Adem, 2005; Yalew, 2003), homesickness (Yalew, 2003), loneliness (Tsige, 2001), and gender (Demewez, Mehadi, & Tesfaye, 2005; Fentaw, 1991; Habte, 1988; Hedija, 2002; Mulugeta, 1998; Tsige, 1991; Wudu & Getahun, 2009), are possible factors that affect the academic achievement of university or college students. Moreover, factors connected to family, such as family education, have been recognized as vital factors in hindering for academic result of students in higher education institutions *(*Adem, 2005).

Despite all these factors, little is known about students' academic achievement in relation to the motivation of learning mathematics in the case university students of Ethiopia hence, the need for the study. Thus this study is aimed at verifying mathematics motivation scale and accordingly to identify the relationship of students academic performance with these constructs in Ethiopian context. The study also investigates the multivariate main effect of motivation on university students. Gender stereotypic beliefs concerning Mathematics learning motivation and achievement are the other issue that will be blended in this study.

In addition to this, measuring Mathematics Learning Motivation will give numerical result in such a way that to what extent a student is motivated in learning mathematics. The absence of such psychometric tool will result the issue of Mathematics learning Motivation to be remaining vague and to have spotty measurement instruments. By such spotty instruments, government or any other

stake-holder who need to identify to what extent a student is motivated in learning mathematics cannot get full information because of lack of unique measure. If it is not clear to assess how much a student is motivated, it is difficult to monitor the student. If it is difficult to monitor or evaluate his/her motivation, it is impossible to say there is Motivational practices such Maslow's hierarchy in method of teaching and it is impossible to identify which student is more motivated in learning Mathematics and which is not. This in turn has impact on Education as well as country's prosperity in general. Having unique construct to measure MLM and having unique items to measure the constructs will narrow such gaps. Thus this impels the researcher to undertake this study and the purpose of this study is to fix the dimension and to develop and validate instrument which measure MLM in the context of Ethiopia.

1.3 Research questions

The study aimed to answer the following questions:

1. To what Extent do items in the instrument of Mathematics Learning Motivation (MLM) valid in the case of undergraduate students in Selected Public Universities of Ethiopia?
2. Is there a multivariate main effect of Mathematics Learning Motivation on students' Achievement in the case of undergraduate public university students of Ethiopia?
3. Is there a relationship between Mathematics Learning Motivation and Students' Achievement in the case of undergraduate students in Ethiopian Public Universities?
4. What motivational factors dominantly affect academic-achievement of undergraduate students of Ethiopian Public Universities?
5. Is there effect of mathematics achievement on academic achievement in the case of undergraduate students in Ethiopian Public Universities?

1.4 Objectives

The general of objective of this dissertation is to develop and validate an instrument of Mathematics Learning Motivation and to check its effect on academic achievement of university students in Ethiopia, and the specific objectives are:

1. To develop MLM instrument and validate it by using three phases and nine steps of Boateng, Neilands, Frongillo, Melgar-Quiñonez, & Young (2018) in the context of Ethiopia.
2. To observe whether there is multivariate main effect Mathematics Learning Motivation on Academic Achievement in undergraduate students in Selected Public Universities of Ethiopia.
3. To identify the relationship between Mathematics Learning Motivation and Students' Achievement in the case of undergraduate students in Ethiopian Public Universities.

4. To recognize which motivational factor(s) dominantly affect academic-achievement of undergraduate Ethiopian Public Universities?

5. To determine whether there is an effect of mathematics achievement on academic achievement in the case of undergraduate public university students of Ethiopia.

1.5 Purpose of the study

This study has explanatory purpose in such a way that it is aimed at: the development of MLM measurement scale and examine the effect of mathematics learning motivation on academic achievement of university students in Ethiopia; validation of the tools of mathematics learning motivation in case of university students of Ethiopia; identification of the relationship between mathematics learning motivation constructs and academic achievements; recognition of motivational construct(s) which dominantly affect academic success of university students of Ethiopia.

1.6 Significance of the study

The study provided valid instrument of mathematics learning motivation which will be applicable for university students of Ethiopia. The study also filled the research gap that little is known concerning the relationship between academic achievement of Univesit y students of Ethiopia and Mathematics Learning Motivation. This in turn brings an alarm for every stake holders that is, students, parents, teachers, principals, educational administrators and ministry of educations etc. to take possible measures on quality of education concerning mathematics learning motivation. Moreover, the findings of this study provides information and valid the instrument of Mathematics Learning Motivation (MLM) in the case of undergraduate students Ethiopian Selected Public Univesit ies and this benefits to measure MLM for further researchers to conduct similar study. The findings on the gender stereotypic believes, mathematics learning motivation, and academic achievement will benefit all students who were disadvantaged by the gender stereotypic believes in such a way that the result provides clue for every stake holders(students, teachers, parents, educational leaders and policy workers, etc.) that how the gender stereotypic believes related with and influenced on academic achievement and how much this gender stereotypic believes contribute in MLM in relation to academic achievement. The motivational factor(s) which dominantly affect academic-achievement will get high focus on every educational stake-holder. MLM instrument in general will serve in the field of Measurement and Evaluation in such a way that educators and researchers will use this instrument which will pass all psychometric steps of validation rather than using spotty measurement instruments which are not unique and which are

not developed based on theories. This instrument will serve the country in such a way that teachers can measure the level motivation in learning mathematics, educational leaders can diagnose their students motivation on mathematics learning, and policy makers can use the tools as a mother document to elaborate vague ideas concerning teaching mathematics in the policy and curriculum and take a corrective action to increase the motivation of students in learning mathematics.

1.7 Delimitation of the Study

This study is delimited to Develop and Validate instrument to measure Ethiopia Univesit y students' Learning Motivation towards Mathematics and to examine the effect of learning Motivation on Academic achievement in general and on Mathematics achievement in particular. First year Public Univesit y students who are taking introductory Mathematics course are the target respondents in this study. According to the reason that Univesit ies in Ethiopia are parallel which are guided by Ministry of Education, these respondents was randomly selected from 3 Univesit ies of Ethiopia. According to their being first generation Universities, and convenience in relation to Cost and time for the researcher, Addis Ababa University, Jimma University, and Hawassa University, was purposely included in the sample.

1.8 Operational definition of key Terms

Motivation: is internal psychic energy or as a mental force that helps a person achieve a goal. The drive which propels and influences students to learn, set aspirations, realize full potential, perform well academically, and succeed (Adegboyega, 2018; Alivernini et al., 2015; lanskova, 2014; Lee, 2017). In education, motivation is the impetus, energy, tendency, direction, persistence, and desire for an individual to excel in a momentous objective(Adegboyega, 2018; Balanescu, 2015; Saki & Nadari, 2018).

Learning Motivation: Driving influences from internal (intrinsic) or external (extrinsic) forces that give students power to learn effectively. (Adegboyega, 2018; Balanescu, 2015; Saki & Nadari, 2018).

Extrinsic motivation: Desire to do something so as to achieve rewards from an external source. The usefulness and the instrumentality which compel people to do something for achieving a goal (Alivernini et al., 2015; Ryan & Deci, 2000a). Extrinsic motivation is a tendency for students to engage in activities for rewards such as money from parents, praise from others, and grades from teachers (Asif et al., 2018).

Intrinsic motivation: Desire to do something simply for the reward of doing it, rather than for the sake of external rewards. The human inherent proclivity toward learning and resourcefulness,

novelty and challenges, and increasing and exercising one's capabilities (Lemos & Verissimo, 2014; Ryan & Deci, 2000a; Sini, Muzzulini, Schmidt, & Tinti, 2018). An intrinsic motivation naturally moves a person to do something which is of personal interest, satisfaction, and pleasure (Alivernini et al., 2015; Ryan & Deci, 2000a). When a student is intrinsically motivated, the person takes part in school activities for personal ends.

Mathematics Learning Motivation: *Mathematics Learning* Motivation is an internal state that arouses, directs, and maintains behavior of Learning Mathematics(Adegboyega, 2018; Balanescu, 2015; Saki & Nadari, 2018).

Academic achievement: *Academic achievement describes academic outcomes that indicate the extent to which students have achieved their learning goals.* (Ezema &Ogunshola, 2013).

The term "Achivement" and" academic success" was used interchangebily to define mathematics achichievment and academic achievement collectively.

Public University:- *is a government University in Ethiopia which is open for all members of community who fulfill the entrance criteria and primarily funded by the state government. (Lacobucci , Touhy &Touhy, 2005).*

1.9 Limitation

Due their abundance of experience, the homogeneous nature of students enrolled in Ethiopian public Universities and their being economic and convenient for the researcher for collecting relevant data, only three top ranked first generation Universities were considered in this study, which might be the limitation of this study.

Though there are different measures of academic achievement, this study considers respondents' self-reported cumulative grade point average as a measure of this construct, which might be the other limitation of this study.

Chapter 2: Review of Literature

Math academic achievement includes a large of cognitive skills, knowledge, problem-solving abilities, and the application of mathematical theories, principles, and concepts to real-world contexts, which set out further than rote memorization (Kessler et al., 2019; Opstad, 2018). It replicates a student's competence and proficiency in mathematical operations, including arithmetic, algebraic manipulation, and geometry. Within an educational context, math academic achievement is typically assessed through various means, such as grades and scores earned from tests, exams, assignments, projects, and classroom participation. Studies assert that grades and scores above average, aligned with a student's goals, signify the attainment of math achievement (Tayyaba, 2010; Williams et al., 2016). Furthermore, the ability to solve complex mathematical problems, interpret, and analyse mathematical information presented in diverse formats such as graphs, charts, tables, and written explanations constitutes a significant aspect of math academic achievement (Zientek et al., 2019; Opstad, 2018). Principally, proficient math students engage in critical thinking, logical reasoning, and creative strategies to tackle a variety of mathematical challenges. Additionally, Bezzina (2010) noted that the capability to perform accurate and efficient calculations, as well as completing math assignments and tasks in time, is a foundational skill of math achievement. Challenges can arise from individual students, learning environments, teaching methods, and societal influences that hinder math academic achievement among secondary students. These include math anxiety, the unique needs of individual students, gaps in foundational math concepts, and learning environments that do not foster supportive, collaborative teaching methods (Abidin et al., 2018; Asad et al., 2022). Furthermore, the endeavour to balance academic demands with other commitments, such as socio-economic activities at home, can result in insufficient time for studying and practising math (Dennis, 2022; Lent et al., 2018).

According to Cresswell and Speelman (2020), learning and mastery of mathematics can make easy logical, analytical, critical, and abstract thinking among students. Mathematics put forward fundamental skills such as thinking in life, ascertaining relationships between events, reasoning, estimating, problem-solving apart from ahead calculation skills and teaching numbers and mathematical operation (Onal, Inan, & Bozkurt, 2017). Besides that, mathematics also provides a supportive role in understanding and mastering other sciences and art subjects. Hence, it is crucial for educators to understand the learners' barriers in learning mathematics, as it is common for students to have negative perceptions towards mathematics (Ashcraft, 2002). Mathematics anxiety is known to be one of the major factors that hinder the students' proficiency and mastery in mathematics.

This chapter deals with related literature on the concept of motivation, theories of motivation, gender and academic motivation, and the theoretical framework of the study.

2.1 The Concept of Motivation

Motivation refers to "a student's willingness, need, desire and compulsion to participate in, and be successful in the learning process" (Bomia et al., 1997). Middleton and Spanias (1999) viewed motivation as reasons individuals have for behaving in a given situation. A more comprehensive definition was provided by Ames (1992) who stated that motivation exists as part of one's goal structures, one's beliefs about what is important and it determines whether or not one will engage in a given pursuit. Skinner and Belmont (1991) explained that students who are motivated to engage in school "select tasks at the border of their competencies, initiate action when given the opportunity, and exert intense effort and concentration in the implementation of learning tasks; they show generally positive emotions during ongoing action, including enthusiasm, optimism, curiosity, and interest" (p. 3). Motivation contributes to the ability to solve problems. Based on several problem solving models, O'Neil & Schacter (1997) developed the CRESST model of problem solving that incorporates four elements; content understanding, problem solving strategies, meta-cognition and motivation. In their model, motivation comprises of three components; self efficacy, effort and worry. Several researches showed that high worry is associated with low cognitive performance (Hembree, 1988, 1990; Pajares & Urdan, 1996; Seipp, 1991). On the other hand, studies such as Wigfield and Meece (1988) showed that there is no relationship between worry and achievement. Although worry can trigger negative effects on learning, depending on the degree of worry, it could also contribute to positive antecedent to high achievement. It may trigger positive outcomes, in terms that it will drive students to work harder if their worries drive as a challenge to exhibit better performance.

Thus, this study focuses on mathematics learning motivation which is closely related to the models of learning mathematics listed above and which in turn related to the capacity to remember and forget when leaning mathematics and performing tasks. This task related and memory related theories of motivations were listed below; and in the case of this study, the theories will be contextualized to mathematics learning motivation and performing mathematics tasks.

2.2 Theory of Motivation

2.2.1 Self-determination theory

One of the more influential motivational theories is self-determination theory (SDT). In this theory, a distinction is made between different types of motivation based on the different kinds of reasons or goals that give rise to motivated action. SDT is concerned with people's inherent growth tendencies and innate psychological needs (i.e., competence, autonomy, and psychological relatedness) that evolve in interaction with the surrounding social context. SDT focuses on the degree to which an individual's behavior is self-motivated and self-determined. Although rather complex in detail (see Ryan and Deci 2002, 2017), a basic distinction is often made between extrinsic and intrinsic motivation (Ryan and Deci 2000).

Extrinsic motivation refers to goals or reasons related to reaching an external reward (e.g., money, praise from others, good grades) or avoiding negative consequences (e.g., embarrassment upon getting a poor test result, or not being allowed to visit a friend unless homework has been completed as expected).

According to Deci and Ryan (1985), extrinsic motivation can become more or less internalized and is not, as often described, antithetical to intrinsic motivation. In other words, it can be intrinsic to the self to aspire to external rewards. Intrinsic motivation, in contrast, is when an action is performed "for its own sake," without expectation of external rewards. It can concern things such as personal development, enjoyment of exploring that leads to feelings of "internal rewards," reaching personal goals, mental satisfaction, physical well-being, or enjoyment in the moment. The focus can be on the process more than the result, though the result itself may be invisible to external parties. Intrinsic and internalized (self-determined) motivation is often linked to stronger devotion, greater persistence, and deeper processing. In practice, motivated behavior is often guided by both internal and external factors. However, individuals will differ in the balance between internal and external motivations, and the degree of internalization of extrinsically-focused motivating factors may appear to differ even within social contexts. TIMSS has measured attitudes and motivation towards learning and achieving in mathematics and science from 1995 and onwards (Hooper et al. 2017). However, it is not clear if and how operationalization of SDT into TIMSS survey items has been guided by theory. In the recent assessment frameworks, there was reference to SDT when motivational constructs were described (Hooper et al. 2013, 2017). Enjoyment, confidence, and value for mathematics and science are constructs operationalized and

measured in the TIMSS background questionnaires. Inspection of the scales indicates that enjoyment items relate to intrinsic motivation and some value items relate to extrinsic motivation.

After childhood, social pressures force most people to do activities they do not find interesting; thus, most student motivations are extrinsic (Ryan & Deci, 2000). When these uninteresting activities are modeled and valued by role models, students are more likely to engage in the activity, when students receive positive feedback concerning an activity they are more likely to internalize the activity, and when students are given choices in how they engage in these uninteresting activities they are more likely to integrate the activity into their self-concepts. Thus, to move students' regulation from external or introjected to being identified or integrated the three innate psychological needs become crucial. When student role models discuss the value of mathematics, model mathematical engagement, and encourage students to engage in authentic –self-authored– mathematics; then student motivation for mathematics may move towards the integrated end of the extrinsic spectrum. However, when role models state mathematics is not needed, they do not personally engage in mathematics, and they control how their students engage in mathematics; then student motivation for mathematics may lend itself towards the externally regulated end of the extrinsic spectrum (Ryan & Deci, 2000).

In this study, students' intrinsic and extrinsic mathematics learning motivation will be checked under Self-determination theory. Extrinsic motivation is students' motivation to learn mathematics fearing to fail exam in mathematics and expecting good results in mathematics. Intrinsic motivation is students' motivation to learn mathematics for their own personal goals, mental satisfaction, physical well-being, or enjoyment in the moment and so on.

2.2.2 Expectancy-Value theory

Previous research has shown that it is possible to interpret the motivational scales used in TIMSS within an expectancy-value framework (Eklof 2007). The expectancy-value theory (EVT) of achievement motivation originates from the first half of the 20th century (Atkinson 1957; Weiner 1992), but the most widely used expectancy-value model derives from the more recent work of Eccles and Wigfield (Eccles and Wigfield 2002; Wigfield 1994; Wigfield and Eccles 2002). This model focuses on the role of students' expectancies for academic success and their perceived value for academic tasks; it is based on personality, social, and developmental psychology (Pintrich and Schunk 2002). EVT has two core components: an expectancy component that corresponds to the question "Can I do this task?" (namely, student perceptions of their abilities), and a value component that corresponds to the question "Do I want to do this task and why?" The

expectancy component in the model refers to the individual's beliefs and judgments about his or her capabilities to do a task and succeed at it, with obvious correspondence with constructs from other theoretical traditions such as self-schemata, self-concept, or self-efficacy. The value component in the model refers to the various reasons individuals have for engaging in a task or not, and the strength of those values. Both of these components have been shown to be important predictors of achievement behavior (Wigfield and Eccles 1992).

The different value components in the model are attainment value (perceived importance of doing well on a task), intrinsic value (interest/enjoyment in doing a task), utility value (usefulness in terms of the individual's future goals), and cost (perceived amount of effort required for a task). Intrinsic value is conceptually similar to intrinsic interest in SDT (Deci and Ryan 1985), while utility value resembles the extrinsic motivation component in SDT. Expectancy beliefs, including self-concept, ability perceptions, and expectancy for success, predict actual achievement in terms of grades and performance on standardized tests. Values have been shown to correlate positively with actual achievement, but when both expectancy beliefs and values are used simultaneously to predict achievement, expectancy beliefs remain significant predictors, while values become not significant predictors. However, in terms of intentions to take future courses and actual enrollment in those courses, value beliefs are actually better predictors than expectancy beliefs (Eccles 1983; Meece et al. 1990; Wigfield and Eccles 1992). Confidence and enjoyment for mathematics and science have been measured in TIMSS questionnaires using several items in the past, although more recently, they have been measured as separate, multi-item scales; grade eight students are asked to report how much they value the two subjects.

Eklof (2007) uses expectancy-value model to discuss the constructs of self-concept and valuing of mathematics using a Swedish sample from TIMSS 2003. Results from exploratory factor analysis indicate that the factors of mathematics self-concept and valuing math are different and could be extracted. Confirmatory factor analysis, however, shows that mathematics self-concept is a unitary construct but valuing mathematics might have different dimensions (Eklof, 2007).

The achievement behaviors in the expectancy-value model of achievement motivation include persistence, choice, quantity of effort, cognitive engagement and actual performance. Studies have shown that children's beliefs about their ability and expectancies for success are the strongest predictors of grades in math while children's subjective task values are the stronger predictors of children's intentions to keep taking math and actual decisions to do so (Wigfield & Eccles, 2000).

In this study, self expectancy value is interpreted by the task of mathematics and students ask themselves on the perceptions of their abilities whether they Can I do the task of mathematics and they value the component whether they want to do the task and why they want.

2.2.3 Self-efficacy Theory

Self-efficacy can be understood as the individual's conviction that he or she is capable of successfully performing a given task (Bandura 1997). This is analogous to "Can I do this task?" in the terminology of EVT. Self-efficacy theory is grounded in a larger theoretical framework known as social cognitive theory, which assumes that human achievement depends on interactions between an individual's behaviors, personal factors (e.g., thoughts and behaviors), and environmental conditions. TIMSS does not measure self-efficacy, although we found references to Bandura's work in the theoretical frameworks (e.g., see Hooper et al. 2013).

Research findings have demonstrated that self-efficacy is a better predicator than any other cognitive or affective processes (Schunk, 1991) and it is a valid predictor for students' motivation and performance (Hodges, 2008). Chan and Lam (2008) conducted a study with 71 seventh-graders in Hong Kong and found that student self-efficacy might be threatened when they are engaged in vicarious learning in a competitive classroom. Pajares (1997) points out that self-efficacy beliefs have received increasing attention in educational research, primarily in studies of academic motivation and of self-regulation (Pintrich & Schunk, 1995). Klee, Miller, and Buehl (2022) conducted a study on self-efficacy, self-concept, and anxiety related to mathematics. The result pointed out that least mathematics self-concept and least mathematics self-efficacy frequently exhibit elevated mathematics anxiety. Apart from self-efficacy beliefs, literature regard teachers as the pivotal figures in shaping students' educational experiences (Berkovich and Eyal, 2019; Rezaei et al., 2019; Zadok and Benoliel, 2023). Teachers' personalities encompass a range of individual attributes, behavioural patterns, and attitudes that shape their instructional approaches, classroom climate, and interactions with students. Their teaching methods, interpersonal interactions, and individual characteristics contribute to the classroom climate and students' perceptions of their own capabilities. Traits such as extraversion, agreeableness, conscientiousness, openness, and emotional stability not only define teachers' interpersonal styles but also potentially affect students' perceptions of their own abilities (Berkovich and Eyal 2019; Kessler et al., 2019; Aarti and Kadian, 2022). Although every student is unique, and factors such as learning disabilities, health issues, and personal circumstances can affect academic achievement, tailoring educational approaches to individual needs is important. It has been revealed that teachers who

create an inclusive and stimulating supportive learning classroom environment often inspire students to perform at their best (Agyemang et al., 2016; Shaninah and Noor, 2023; Zadok and Benoliel, 2023).

In this study, self- efficacy is interpreted by the task of mathematics and students ask themselves whether they are cable of fully performing given task in the process of learning mathematics.

2.2.4 Self-concept

Related to self-efficacy, and not always easy to separate empirically, is the theoretically different and broader construct of self-concept. Self-concept can be defined as an individual's "collective self-perceptions that are formed through experiences with and interpretations of the environment" (Wigfield and Eccles 2002). Self-concept then is how individuals perceive and evaluate themselves: questions such as "Who am I?" and "What kind of person am I?" are the foci of self-concept (Hattie 1992). Self-concept is heavily influenced by reinforcements and evaluations by significant others (Shavelson and Bolus 1982) and it is multidimensional in the sense that self-concept differs according to context; an individual's self-concept could differ for mathematics, reading, or academics in general (Marsh 1990). Self-concept differs from self-efficacy both in specificity and content (Michaelides 2008); the former focuses on "Who I am," while the latter focuses on "How sure am I that I can do something?" Aspects of self-concept and self-efficacy are also incorporated as parts of other models of motivation, such as EVT. In recent cycles of TIMSS, the measure of student confidence in mathematics and science included items that could be related to aspects of self-concept. Self-esteem refers to the value a person places on himself or herself. Self-esteem is related to self-concept, or one's ideas about one's attributes and abilities. According to research by Harter (1990; Harter & Whitesell, 2003), people's self-concepts became increasingly differentiated as they explore their abilities and learn more skills. They may think highly of themselves in one of these dierentiated areas, but not in another. Between the ages of four and seven, children can make reliable judgments about themselves in four personal domains: cognitive competence, physical ability, social ability, and behavioral conduct (Harter & Pike, 1984). By adulthood, people can rate themselves within 11 different domains of competency: intelligence, sense of humor, job competence, morality, athletic ability, physical appearance, sociability, intimacy, nurturance, adequacy as a provider, and household management (Messer & Harter, 1985).

Byrne (1984) noted that much of the interest in the relation between self-concept and achievement stemmed from the belief that academic self-concept has motivational properties such that changes

in academic self-concept will lead to changes in subsequent academic achievement. Marsh (1990a) conducted a longitudinal study about the relationship between academic self-concept and academic achievement and tested two models. The self-enhancement model was based on the assumption that prior academic self-concept affects subsequent academic achievement and was used implicitly to justify many educational programs designed to enhance self-concept; and the skill development model was based on the assumption that academic self-concept merely reflected academic skills so that the best way to enhance academic self-concept is to improve academic skills (Marsh, 1990a). In reality, the relationship between academic self-concept and academic achievement is likely to be reciprocal, that is, prior academic achievement affects subsequent academic self-concept and prior academic self-concept also affects academic achievement. Marsh (1990b) later tested the academic self-concept portion of the Shave son et al. (1976) model and concluded that the model was supported when it was limited to self-concepts in academic core subjects such as English and mathematics. As per Arens, Frenzel, and Goetz (2022), past self-concept related to math was positively connected to a following self-efficacy related to math whereas past self-efficacy related to math was not connected to a succeeding math-self-concept. In view of math grades, reverse relations might be establishing for math self-concept. Math self-efficacy and math grades indicated a one directional relationship with previous math grades being associated to a following math self-efficacy.

In this study, self concept will be used as a measure of students confidence and the value that students place on themselves as whether they are good in mathematics or not.

2.2.5 Achievement Goal Theory

Achievement goal theory (Ames 1992; Dweck and Leggett 1988; Elliott and Dweck 1988; Pintrich 2000) assumes that students have different reasons for engaging or not engaging in learning and school work. These reasons affect what, how, and why students learn (Patrick et al. 2011) and how they subsequently perform. Typically, two different sets of achievement goals are identified: (1) task and ego goals (Nicholls 1984) or (2) mastery and performance goals **(**Dweck and Leggett 1988). The primary goal of a mastery-oriented person is the learning and mastery of the task for its own sake (similar to intrinsic motivation in SDT and intrinsic value in EVT). Mastery goals reflect a desire to achieve competence in terms of set criteria or task- mastery. They rely on comparisons with the explicit requirements of the task and/or internal comparisons with an individual's past or potential attainment. Performance goals, in contrast, reflect a desire to achieve competence to a degree that is relative to the performance of others. The goal here is to do well and gain the

rewards associated with high performance. The desire to attain high performance sometimes leads to strategic behaviors that can involve making learning more difficult for competitors (Murdock et al. 2016). These two goal orientations are associated with different consequences in achievement context, with mastery being associated with higher performance than performance orientation.

A mastery goal (also referred to as a learning goal, task goal, or intrinsic goal) is one in which the student's aim is to gain knowledge or skills. A performance goal (also referred to as an ego goal, ability focused goal, or extrinsic goal) is a competitive goal in which the aim is to look good compared to others (Pintrich, 2000, 2003; S. Ross, 2008). The choice between mastery goals and performance goals rests on a number of factors, including feelings of self worth, theories of personal intelligence, fear of failure, and fear of looking "bad" in front of others (S. Ross, 2008).

Performance goals can be further subdivided into performance-approach and performance-avoidance goals, based on students' beliefs that they will do well, or conversely, on a fear of failure (Berger, 2009; Van Yperen, Blaga, & Postmes, 2014). Elliot, Murayama, and Pekrun (2013) propose further subdivisions of goals based on three potential orientations: task-based, related to the demands of the task; self-based, with an internal metric of the value of the activity; and other-based, with an external interpersonal metric. Each of these orientations is then assigned a valence of approach or avoidance. Thus, this model can be represented by a 3x2 matrix describing six goal orientations, each of which may vary depending on a given situation; the goal orientation may lie in any of the six cells, and this position could be different in another situation, or even change during the performance of the task (Elliot et al., 2013).

Performance-approach goals are positively correlated to self-efficacy, task value, and use of cognitive and self-regulatory strategies (Shunk & Pajares, 2005). Performance-avoidance goals have not been found to be predictive of positive achievement (Elliott & McGregor, 2001; Elliott & Thrash, 2001). Mastery goals are positively correlated with self-efficacy, task value, cognitive strategy use, and self-regulated learning (S. Ross, 2008). Ryan and Deci (2000a, 2000b) found that mastery goals are correlated with intrinsic motivation, whereas both performance approach and avoidance goals are correlated with extrinsic motivation. Thus, students with a high degree of intrinsic motivation tend to demonstrate mastery goals, and students with high levels of extrinsic motivation demonstrate performance goals. The converse is also true; students with a mastery goal orientation tended to have greater levels of intrinsic motivation, while students with a performance goal orientation tended to have lower levels of intrinsic motivation, and higher levels of extrinsic motivation (Spinath & Steinmayr, 2012). These findings are not surprising, given the direct relationship between having an internal metric (mastery goals, intrinsic motivation) or an

external metric (performance goals, extrinsic motivation). Goal orientation was found to be correlated with self-efficacy beliefs, task enjoyment, and interest (Spinath & Steinmayr, 2012).

Goal orientation is a strong predictor of achievement. Students with a mastery goal orientation outperform students with a performance goal orientation (Middleton & Spanias, 1999). Middleton and Spanias (1999) found that students tend to adopt their teachers' goal orientations; therefore, if teachers demonstrate that they value mastery-goals, this should impact students' goal orientations and thus increase students' intrinsic motivation. One way to accomplish this is to emphasize criterion- rather than norm-referenced assessments (Wolters & Daugherty, 2007).

In this study, achievement goal theory is interpreted as students' different reasons for engaging or not engaging in learning Mathematics.

2.2.6. Attribution Theories of Motivation

In elementary school, boys and girls typically show similar levels of interest in math (Eccles, Wigfield, Harold, & Blumenfeld, 1993; Wigfield et al., 1997); however, by middle school girls are less interested in math than boys (Linver & DavisKean, 2004; Watt, 2004). Researchers have also found gender differences in math achievement, with boys showing higher achievement in math beginning as early as first grade (Penner & Paret, 2008). However, recent research indicates the difference in mean math achievement scores between girls and boys has been drastically reduced (Hyde, 2005; Hyde, Lindberg, Linn, Ellis, & Williams, 2008; Hyde & Linn, 2006) and achievement scores at the low end of the distribution are now essentially equal between the two genders (Hyde & Mertz, 2009).

During the 1970s and early 1980s, attribution theory was the predominant theory of motivation, and it was utilized to understand gender differences in achievement motivation (Dweck, 1986; Eccles et al., 1983; Frieze, 1975; Meece, Parsons, Kaczala, Goff, & Futterman, 1982). Research using an attribution framework identified gender differences in the ways that children and adults interpret their successes and failures. Early studies indicated that women were more likely to exhibit what has been labeled as a low-expectancy attribution pattern, and their achievement behavior has been found to suffer as a consequence. Specifically, men attributed their successes to internal stable causes (ability), whereas women attributed their failures, but not their successes, to these causes (Bar-Tal, 1978; Crandall, Katkowsky, & Crandall, 1965; Frieze, 1975; McMahan, 1973).

These patterns were not consistently found across all studies and findings appeared to be more

marked for achievement areas that were sex-typed as masculine or feminine domains (Frieze, Whitley, Hanusa, & McHugh, 1982). In mathematics, for example, girls were less likely than boys to attribute their successes to ability. Instead, girls attributed their successes to effort and hard work, which may undermine their expectations for success as mathematics increases in difficulty (Eccles et al., 1983; Parsons, Meece, Adler, & Kaczala, 1982; Wolleat, Pedro, Becker, & Fennema, 1980).

In this study, attribution theory is interpreted as students' perception on gender differences in achievement motivation during Mathematics Learning.

2.2. 7 Anxiety

Mathematics anxiety is described as a multidimensional psychological construct that involves complex factors, such as feelings of pressure, performance inadequacy, test anxiety that interfere with the manipulation of numbers and solving mathematical problems in a wide variety of ordinary life and academic situations (Kazelskis, 1998). Researchers define anxiety as a state of arousal in which people feel unsafe through physical, emotional and cognitive changes. There are different types of anxiety, such as examination anxiety, test anxiety, teaching anxiety and Mathematics anxiety. Mathematics anxiety is among the types specified in educational studies (Perker& Ertekin, 2011). Mathematics anxiety is commonly defined as a feeling of tension, anxiety and fear towards Mathematics problems in both academic situations and ordinary life. As defined by Ashcraft and Moore (2009), Mathematics anxiety is one's negative reactions while coming across manipulation of numbers, Mathematics calculations and any other situations related to Mathematics. Mathematics anxiety indicates the student's negative response to mathematical circumstance, including numbers, Mathematics and Mathematics calculations (Ashcraft& Moore, 2009). It is defined that Mathematics anxiety is "*a feeling of tension and anxiety that interferes with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations*" (Richardson& Suinn 1972, p.551). According to previous research, it is indicated that Mathematics anxiety is one of the problems in Mathematics education and it prevents students from pursuing advanced courses in Mathematics or other science subjects. Mathematics anxiety has negative influence on students' Mathematics achievement regardless of their true level of mastering Mathematics (Ashcraft& Moore, 2009). It is related to bad performance on Mathematics achievements (Hembree, 1990). Students who feel more of anxiety towards Mathematics achieve worse results in Mathematics (OECD 2012). The one who has a high level of Mathematics anxiety, achieves a lower score in Mathematics tests and has poorer attitudes

towards Mathematics (Abu-Hilal, 2000; Ashcraft, 2002; Luo, Wang&Luo, 2009). In China, "We've found that Mathematics performance is statistically significant correlated to Mathematics anxiety" (Luo, Wang&Luo, 2009).

As one of the special subjects of anxiety, mathematics anxiety is the tension and anxiety that interferes with mathematics teaching and solving mathematics problems. The sixth-grade students at primary school face the pressure of entering junior high school. If they are not intervened in time, they may develop into mathematics avoidance and mathematics fear. It has obvious adverse effects on mathematics achievement and students' actual development (Gierl & Bisanz, 1995).

He & Qi (2018) found a negative correlation between mathematics anxiety and mathematics achievement in primary and secondary school students. The research of Ramirez et al (2016) also showed that mathematics anxiety is not conducive to the development of students' mathematics achievement. Some studies have pointed out that mathematics anxiety is usually caused by the inability to objectively self-evaluate and lack of self-confidence when studying or working in a mathematics environment, and anxiety is highly positively correlated with negative self-concept and self-efficacy (Morony, 2013).

Researchers stated negative significant correlation between mathematics performance and anxiety parallel to the other research studies in the literature (Devine, Fawcett, Szucs, Dowker, 2012; Hembree, 1990; Ma, 1999). According to Perry (2004), much like a novice golfer on the first tee, the mathematics students can seriously hamper her or his performance by being nervous and insecure towards mathematics. Many students who suffer from math anxiety have little confidence in their ability to do mathematics and tend to take minimum number of required mathematics courses, greatly limiting their career choice options. This is unfortunate especially as society becomes more reliant on mathematical literacy (Scarpello,2005). According to Sherman and Wither (2003), a five-year study conducted on students from the age of 6 to the age of 10 revealed that the level of mathematics anxiety in students is strongly related to student achievement. The results conform to the findings of Khatoon and Mahmood (2010); Yuksel-Şahin (2008) and Satake and Amato (1995). Students will often feel worried, tired and afraid or feel that mathematics is not important and will generally refuse to learn mathematics, even though it is the primary gateway to engineering, science and technology. According to Arem (2009), students with high mathematics anxiety levels engage in negative thinking about their self-ability. These students will exhibit less confidence in working with numbers and mathematical concepts through a problem-solving process. Self-efficacy and self-concept in their negative form are highly related to anxiety (Stankov, Morony, Kleitman & Lee, 2012). Poulou (2022) investigated that anxiety and self-

efficacy related to mathematics are high forecasters of mathematics achievement. The result of a study conducted by Du, Qin, Wang, and Xin (2021) revealed that there are reciprocal relations amongst mathematics interest (MI), mathematics anxiety (MA), mathematics self-efficacy (MSE) and mathematics achievement of primary school students. Zhang, Zhao, and Kong (2019) conducted a meta-analytic study on the relationship between math anxiety and math performance. The outcome of this study signifies that a negative relationship arises between math performance and mathematics anxiety. The relationship was strong in investigations that concerned students in Asia whereas the relationship was weak in investigations which engage European students. Moreover, the connection was strong in investigations concerning a senior-high-school grouping, while it was weakest in the studies within an elementary group. According to Yeo, Tan and Lew (2015), anxiety in mathematics is one of the categories of uneasiness and may have a negative impact on students as it is continually presented within mathematical problems. Mathematics anxiety occurs within all levels of education and continues to rise as the year progresses (Yurtcu & Dogan, 2015). The level of mathematics anxiety in students can also be an honest indicator of students' academic success (Karimi & Venkatesh, 2010). A study by Sheffield and Hunt (2006) found that students with high mathematics anxiety levels generally performed low in their mathematics assessments. Understanding the nature of mathematics anxiety and its effects on students' behavior may provide an insight on how to minimize and manage mathematics anxiety among students.

Summary

To situate the research insight of the existing knowledge, both theoretical and empirical review of related literature was carried out concerning self-efficacy, anxiety, self-concept, self-determination, and achievement-goal, expectancy-value, attribution theory of mathematics learning motivation. The literature focus was on the basis research questions: the extent of validity of items in the instrument of Mathematics Learning Motivation (MLM) in the case of undergraduate students in Public Universities of Ethiopia; the existence of multivariate main effect Mathematics Learning Motivation on students' Achievement in the case of undergraduate public university students of Ethiopia; the existence of relationship between Mathematics Learning Motivation and Students' Achievement in the case of undergraduate students in Ethiopian Public Universities; the discovery of dominant factor which affect academic-achievement of undergraduate students of Ethiopian Public Universities; the existence effect mathematics achievement on academic achievement.

With regard of validity of items in the instrument of Mathematics Learning Motivation (MLM), the items were developed in the context of Ethiopia by using the self-efficacy, anxiety, self-concept, self-determination, and achievement-goal, expectancy-value, attribution theory of mathematics learning motivation. The application each theory was delighted in the setting of undergraduate university students in Ethiopia. As different literatures suggest different types of relationships of each motivational constructs with academic achievement, the research result supports some literatures and conflicts with the others. Concerning the existence of multivariate main effect Mathematics Learning Motivation on students' Achievement in the case of undergraduate public university students of Ethiopia, the primary data collected by survey displayed the effect of MLM on academic achievement. The use of reviewed literature in this regard was to see different debating issues in relation of the effect of MLM on academic achieving and to relate the results of current literature with the findings. Moreover, the literature in this respect was supported to device the MLM scale and accordingly to measure extent to which MLM influences academic achievement. The existence of relationship between Mathematics Learning Motivation and Students' Achievement in the case of undergraduate students in Ethiopian Public Universities was also supported by related litratures. The dominant factor which affects academic-achievement of undergraduate students of Ethiopian Public Universities was also depicted from the data and supports by literatures.The literature also supported to frame the existence effect mathematics achievement on academic achievement. Overall, the review of related literatures were undertaken by the researcher to gather the information and to find the research gap and hence to develop the conceptual framework of the current research, which portrays academic achievement as a linear combination different constructs of mathematics learning motivation.

2.3 The theoretical framework

Various theoretical frameworks have posited the link between motivation to learn and academic success (e.g., Bandura 1997; Deci and Ryan 1985; Wigfield and Eccles 2000). Confidence perceptions as indicators of self-concept are thought to relate to engagement with purposeful behavior and success in academic tasks, and increased self-confidence is more likely to lead to successful outcomes. Ascribing value to a task and its outcome is another factor linked to academic performance that includes intrinsic characteristics like enjoyment, interest, and self-perceived importance, as well as costs and perceptions of usefulness. Moreover, these affective and motivational attributes are considered to be important, not just as predictors of achievement but also as valued schooling outcomes.

Hattie (2009) reported that attitudes toward mathematics and science correlated with student achievement in both subjects. While this relationship has been characterized as positive and strong (Mullis et al. 2012), empirical evidence suggests a less pronounced network of associations. For example, in their multinational analyses of data from TIMSS and the Organization for Economic Cooperation and Development's Program for International Student Assessment (OECD's PISA), Lee and Stankov (2018), and Marsh et al. (2006, 2013) found weak correlations between value and affect for the subject with achievement for both mathematics and science; the only moderate to strong relationship was that between self-concept in the subject and achievement.

The explanation and prediction of achievement is important to most educational motivation theories (Meece et al. 2006). A vast number of studies have explored components of student motivation and their relationships with performance, and meta-analyses have shown a positive (but often modest) relationship between student motivation (measured in different ways, using different theoretical frameworks) and scholastic achievement (Hattie 2009; Karadag 2017; Lee and Stankov 2018; Osborne et al. 2003). Throughout most of the theoretical and empirical work, the main message is that adaptive and high levels of motivation positively correlate with better learning and achievement. Research shows that one of the most prominent academic problems plaguing today's teenage youth is lack of motivation towards academic activities. Desai (1979), Hirunval (1980), Krishnamurthy (2000) found that there is a positive and significant relationship between achievement and academic motivation. Koseoglu (2013) found that there is a statistically significant difference between male and female students in academic motivation. It has been found that female students are more intrinsically and extrinsically motivated than the males overall. A review of the literature shows that most of studies are done on motivation in general, on a small sample and had contradictory findings. Hence, in the present study Mathematics learning motivation in relation to academic achievement will be investigated by using larger sample.

In this regard, the following Structural equation paths were solved by using structural equation modeling and empirical data were collected from selected Universities of Ethiopia.

I) Mathematics- Achievement$_i$ = β_{0i} + β_{1i} Self- determination + β_{2i}Self-efficacy +

β_{3i} self- concept + β_{4i} expectancy-value +

β_{5i} goal-achievement + β_{6i} attribution+ ε_i, for

i^{th} individual.

II) Academic-achievement$_i$ = α_{0i} + α_{1i} Self- determination + α_{2i}Self-efficacy +

α_{3i} self-concept + α_{4i} expectancy-value +

α_{5i} goal-achievement+ α_{6i} attribution + μ_i, for

i^{th} individual.

III) Academic-achievement = γ_i + γ_{1i} Mathematics- achievement + ν_i

Here, students' academic achievement is the cumulative grade point of the student at the end of the semester and mathematics achievement was obtained by administering standardized mathematics achievement test. Data on self efficacy, self-concept, self-determination, expectancy-value, goal-achievement, and attribution were obtained by self administered Mathematics Learning Motivation (MLM) questionnaire which includes these constructs and structured interview. Gender stereotypic beliefs data were obtained by using self administered questionnaire based on *Attribution Theories of Motivation.*

Chapter 3: Methodology

3.1 Introduction

This chapter deals with settings of the study area, research design, research method, Data analysis methods and ethical considerations.

3.2 Setting of the study areas

This study has been conducted on Selected Public Universities of Ethiopia. Undergraduate Students in public Universities of Ethiopia who were enrolled for basic Mathematics course were the target population of the study. Addis Ababa, Hawassa, and Jima Universities were purposively included in the sample. The reasons for inclusion of these Universities were their being first generation Universities, having rich experience, and their being convenient for the researcher for collecting relevant data. Moreover, the homogenous nature of enrollments of students in public Universities of Ethiopia by Ministry of Education enables the researcher to consider considering only the first generation Universities. The three Universities from the 10 first generation Public Universities was chosen based on their Experience, and Convenient nature for data collection for the researcher.

3.3 Research Philosophy

Research is a way in which knowledge and understanding of the world is discovered and turned into acceptable knowledge in a discipline. This knowledge and understanding influence how researchers comprehend the world (Ryan, Scapens & Theobald, 2003). Therefore, research philosophy plays an important role to develop knowledge and assumptions about the way in which researchers view the world. The importance of assumptions and knowledge is due to their effect on the research strategy and the research method. They also have a significant impact on how researchers understand social phenomena. Furthermore, the relationship between knowledge and process is another important issue that influences the researchers' philosophical view (Saunders, Lewis & Thornhill, 2009). Consequently, it is essential to explain how the researcher relates his philosophical choices to this research, how the researcher shapes his position towards knowledge, and why the researcher has a specific philosophical stance among the alternatives. According to literature, there are two major stances, which are ontology and epistemology. Both of them provide different views about the research process and on how the researcher treats knowledge.

Epistemological considerations pertain to what is acceptable knowledge and whether social studies and natural studies can have the same methods and principles to study reality or not.

(Bryman & Bell, 2007). First, let us begin with explaining epistemological consideration, which has three different stances: positivism, realism, and interpretivism.

Positivism claims that methods of natural sciences can be used for the study of social reality. Researchers observe, investigate social reality and generalize results, which is very similar to the way natural scientists operate. This process also creates reliable and credible data. Therefore, researchers collect data, utilize existing theories, develop and test hypothesis (or model). After testing the hypothesis (or model), (if it is confirmed), it will lead to the development of existing theories and generate new knowledge that comes from, "the gathering of facts and providing the basis for laws" (Bryman & Bell, 2007; Saunders et al., 2009).

The second stance is realism, in which there are many ways to interpret social reality. "The essence of realism is that what the senses show us as reality is the truth (Saunders et al., 2009)." This stance also advocates that the same kind of approach can be used for both natural and social sciences. Therefore, this approach should include collecting, explaining, analyzing, and evaluating the data. The view of this epistemological consideration is that the world exists independently of our knowledge of it. Social phenomena such as actions, text, and institutions are concept-dependent. Therefore, the researcher has to not only explain their production and material effects but also to understand, read and interpret what they mean (Bryman & Bell, 2007).

The third stance is interpretivism, which is a crucial factor regarding positivism. It asserts that social sciences are fundamentally different from natural sciences and social phenomena are dependent on social actors. Therefore, researchers need to have different methods and procedures for social studies and cannot use natural science methods (Bryman & Bell, 2007). In other words, as the subject matter of social science – people, institutions – is fundamentally different from that of the natural sciences, researchers need to interpret the reality.

When it comes to the researcher's epistemological stance, the researcher adopts positivism for several reasons. First, the researcher utilized existent theories to develop models about Mathematical learning Motivation and students academic performance of selected university students in Ethiopia. Furthermore, the researcher collected the data from selected Universities of Ethiopia, the researcher validated the instrument, and the researcher investigated the relationships between Mathematical Learning Motivation (MLM) and students' academic performance which cannot be influenced by social actors or others. My model was also tested by the data, which has

been seen as credible knowledge. Hence, it is obvious that my aim was to validate MLM instrument, to develop models in light of theories, and to test them empirically by the data. This approach leads me to use a natural science method, which is applicable for my research. Second, let us continue to explain ontological considerations, which pertain to the nature of realities and social entities. It considers whether social reality and phenomena build up from social actors' perceptions and actions or not. There are two main stances regarding ontological considerations: objectivism and constructivism.

Objectivism is an ontological consideration that asserts social reality and phenomena are independent of social actors. Therefore, they are external facts and cannot be reached and influenced (Bryman & Bell, 2007). Constructivism is also another ontological consideration that implies social reality and phenomena are dependent and constantly accomplished by social actors. Therefore, it is agreed that there is interaction among social phenomena, realities, and social actors and they are in a, "constant state of revision" (Bryman & Bell, 2007).

The researcher used objectivism as an ontological consideration since Motivation and performance are independent phenomena and cannot be influenced by social actors. Motivation and performance does not require any subjective interpretation. Furthermore, the resaecher analyzed the data that were obtained from randomly selected undergraduate students of purposively selected Public Universities, it is expected that a single social actor cannot change the selected listed students' motivation, academic performance and relationship between them because of size effects. As objectivists, the researcher validated MLM instrument and found the relationship between Mathematics Learning Motivation and academic performance. Therefore, the researcher deployed the natural science methods.

3.4 Research Design

Creswell (2018) defines research designs as plans and procedures for research that span the decisions from broad assumptions to detailed methods of data collection and analysis. He says the selection of a research design is based on the nature of the research problem, the researchers' personal experiences and the audiences for the study. A mixed research design is a procedure for collecting, analyzing, and "mixing" both quantitative and qualitative methods in a single study or a series of studies to understand a research problem (Creswell & Plano Clark, 2011). The basic

assumption is that the uses of both quantitative and qualitative methods, in combination, provide a better and deep understanding of the research problem and question than either method by itself.

A framework for data collection and analysis is provided by research design. A choice of research design reflects the priority of a researcher about the dimensions of the research process and methods. The main types of research designs are case study, experimental, longitudinal design, and cross-sectional design. Experimental design is mostly used in the natural sciences but researchers have also started using it for social science research. The purpose of an experiment is to find casual links and relationships between variables. It is interested in links between variables by making experiments, which are more useful in exploratory research in order to answer 'how and why' questions (Saunders et al., 2009). The most important difference of experimental design is that there are many phases for data collection, which may take days, weeks, or even years (Bryman & Bell, 2007). In experimental research, two groups are very important, one is the experimental group and one is the control group in order to find and compare the difference between these two (Saunders et al., 2009). In cross-sectional design, data is collected and analyzed for more than one case at a single point in time. The aim is to gather quantitative and quantifiable data in connection with two or more variables to detect patterns of association (Bryman & Bell, 2007). Case study entails a strategy for undertaking research, which involves an empirical investigation and intensive analysis of a single case. This case is generally "contemporary phenomenon within its real life context using multiple sources of evidence" (Saunders et al., 2009; Bryman & Bell, 2007). Longitudinal design is used for providing casual influences over time and investigating changes in phenomena. It is little used in business and management because it is time consuming and costly (Bryman & Bell, 2007).

Last but not the least, "with a cross-sectional design, it is only possible to examine relationship between variables" (Bryman & Bell, 2007). After validation step, to find the relationship between students' mathematics learning motivation and their academic performance, cross-sectional design was the most suitable for study. Since the researcher investigated the relationships between variables which are motivational variables and students academic performance, which in turn employ quantitative strategy, and which subject the data to statistical tests, the researcher adopted an explanatory research design. Furthermore, the research objectives clearly indicate that the aim of the study was to validate MLM instrument and accordingly to explain the relationship between students mathematics learning motivation and their academic performance.

3.4.1 The Purpose of Research

Research purpose provides a guideline to researchers in order to execute an effective and successful study. Research objectives also give a clue to how research is designed and what aim the research has (such as exploration, description, or explanation) (Kent, 2007). According to Saunders, Lewis & Thornhill (2009), there are three research purposes, which are exploratory, descriptive, and explanatory. Exploratory study aims to seek fresh insights and assess phenomena in a new light. Therefore, it is useful to generate ideas, theories, and to discover insights. A descriptive study aims to measure the "sizes, quantities, or frequencies." Variables are presented one at a time and there is no effort to explain relationships between them. Explanatory study aims to investigate social phenomena and display relationships between variables. It is useful to apply quantitative strategy and make statistical tests for this kind of study (Saunders et al., 2009; Kent, 2007). Thus, as the relationships among variables were explained in detail this study, the study has explanatory purposes.

3.4.2 Research Approach

There are three types of research approaches, which determine the design of research based on the relationship between research and theory. The first one is a deductive approach, which explains the relationship between theory and research. The way of deductive research is from a general law to a specific case. Researchers transform concepts into researchable entities. They should know how to collect data in relation to concepts and how to create hypothesis in light of concepts. According to what is known about the research area and related theoretical consideration, the researcher deduces a hypothesis, which is tested by empirical findings. The next step is to evaluate the outcome of tests and confirm or reject the hypothesis. Finally, the theory should be revised in the light of the findings. The aim of deductive research is to utilize existing theories to create new research areas. Therefore, it is very important for the researcher to be independent of what is being observed and get enough data to generalize findings (Bryman & Bell, 2007; Saunders et al., 2009).

The second is an inductive approach, which does not follow the same sequence as the deductive approach. Inductive research uses a different scientific approach, which begins with a collection of observations and ends with general laws. Therefore, theory is created as an outcome of research and this is another point of view towards a scientific approach. In this method, theory or some conclusions about social phenomena are drawn in light of the data

and observations. Furthermore, an inductive approach lets researcher's present alternative explanations about social phenomena.

Researchers can also mix up both inductive and deductive approaches according to their research design. The mixed approach is called an abductive approach, which does not completely follow the pattern of pure deduction or of pure induction. An abductive approach is generally seen as systematized creativity or intuition in order to generate new knowledge. This approach is preferred due to breaking out of the limitations of deduction and induction. Unsurprisingly, the abductive approach has a unique research process. In abductive reasoning, an empirical event or a phenomenon is investigated according to a rule, which allows the researchers to gain new insight about the event or phenomenon. As long as the case is plausible according to correct anticipated rules, it does not need to have a logically necessary conclusion. The abductive approach focuses on specific situations, which "deviate from the general structure of such kinds of situations." Furthermore, interpreting or re-contextualizing individual phenomena is the way that abduction investigates individual phenomena within a contextual framework. The aim is to understand something in a new way, from the perspective of a new conceptual framework (Kovács & Spens, 2005).

According to the nature of this research, the researcher learned about the existing scientific knowledge regarding Motivation and academic performance in the first place. In light of previous knowledge, the researcher formulated the model/hypothesis. Afterwards the researcher collected the empirical data from selected university students in Ethiopia. Finally, the researcher tested model by the help of the data in order to confirm or reject them. Furthermore, the researcher searched many previous studies about motivation or students performance that help to extend knowledge. In addition, the researcher tried to get benefit from previous studies and apply them to the Ethiopia context since there is no previous study topic for Ethiopia regarding this research area. Therefore, it is obvious that a deductive approach is most suitable for this study. Hence the study adopted deductive approach.

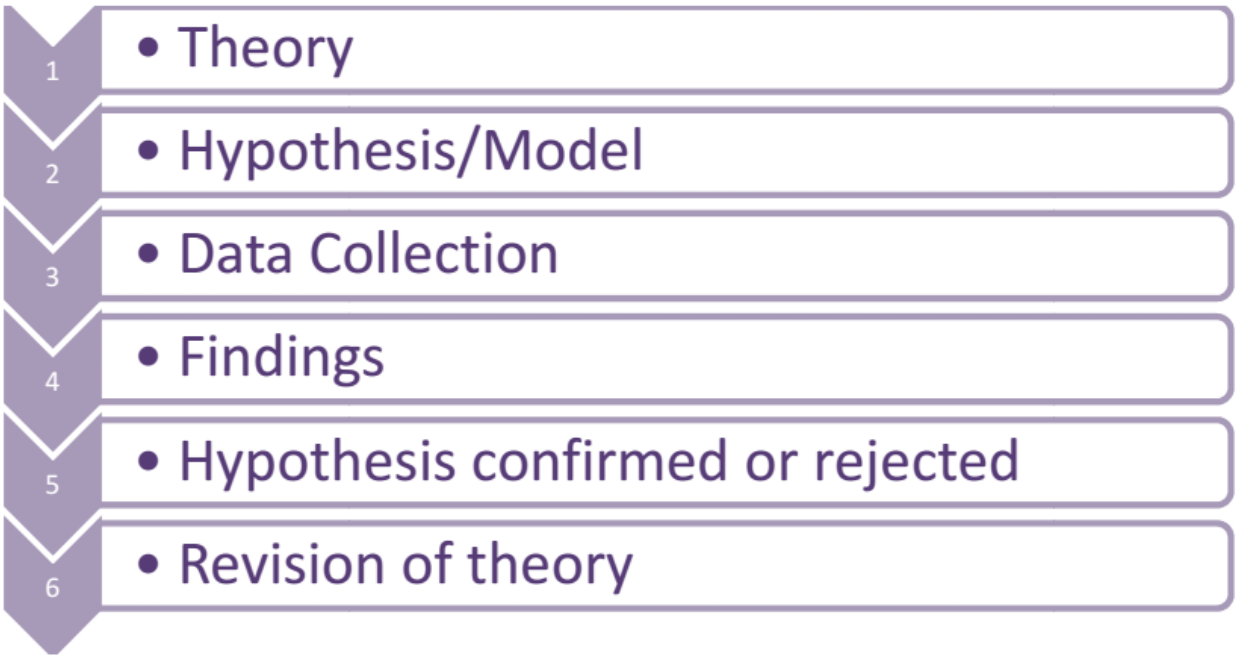


Fig. 1: The process of Deduction (Source: Bryman and Bell, 2007, p. 11)

3.4.3 Research strategy

Quantitative and qualitative strategies are regarded as Bryman and Bell (2007) even though some writers consider that they are not useful any longer. However, the researcher believes that they should be clarified for the sake of my research since there are some important differences between them. The main difference is that quantitative strategy uses measurement and quantification whilst qualitative strategy does not. Additionally, many writers claim that these strategies differ in terms of epistemological consideration (Bryman & Bell, 2007).

Quantitative research should use a research strategy which utilizes quantification in terms of data collection and analysis and;

- entails a deductive approach to the relationship between theory and research
- has incorporated the practices and norms of the natural scientific model and of positivism in particular
- embodies a view of social reality as an external, objective reality." (Bryman & Bell, 2007)

Despite that, qualitative research should use a research strategy, which utilizes words instead of quantification in terms of data collection and analysis, and:

- predominantly emphasizes an inductive approach to the relationship between theory and research.

- has rejected the practices and norms of the natural scientific model and of positivism in particular in preference for an emphasis on the ways in which individuals interpret their social world.
- embodies a view of social reality as a, "constantly shifting emergent property of individuals' creation." (Bryman & Bell, 2007).

In quantitative research, an investigator relies on numerical data (Charles & Mertler, 2002). He uses positivist claims for developing knowledge, such as cause and effect thinking, reduction to specific variables, hypotheses and questions, use of measurement and observation, and the test of theories. A researcher isolates variables and causally relates them to determine the magnitude and frequency of relationships. In addition, a researcher himself/herself determines which variables to investigate and chooses instruments, which will yield highly reliable and valid scores.

Alternatively, qualitative research is "an inquiry process of understanding" where the researcher develops a "complex, holistic picture, analyzes words, reports detailed views of informants, and conducts the study in a natural setting" (Creswell, 1998, p. 15).In this approach, the researcher makes knowledge claims based on the constructivist (Guba & Lincoln, 1982) or advocacy/participatory (Mertens, 2003,) perspectives.

In a mixed methods approach, the researchers build the knowledge on pragmatic grounds (Creswell, 2003; Maxcy, 2003) asserting truth is "what works" (Howe, 1988). They choose approaches, as well as variables and units of analysis, which are most appropriate for finding an answer to their research question (Tashakkori & Teddlie, 1998). A major tenet of pragmatism is that quantitative and qualitative methods are compatible. Thus, both numerical and text data, collected sequentially or concurrently, can help better understand the research problem. While designing a mixed methods study, three issues need consideration: priority, implementation, and integration (Creswell, Plano Clark, Guttman, & Hanson, 2003). Priority refers to which method, either quantitative or qualitative, is given more emphasis in the study. Implementation refers to whether the quantitative and qualitative data collection and analysis comes in sequence or in chronological stages, one following another, or in parallel or concurrently. Integration refers to the phase in the research process where the mixing or connecting of quantitative and qualitative data occurs.

Thus, in this dissertation, the researcher adopted primarily the quantitative strategies because of several reasons. First, the researcher emphasize quantification in the collection and analysis of data. Second, the researcher's positivistic epistemological consideration leads to employ this research strategy. Third, according to the researcher's ontological consideration, the researcher see

that social phenomena and reality are independent of social actors. Therefore, the researcher needs to use measurement and quantification in this research. Fourth, the researcher uses a deductive research approach, which is suitable for quantification in the collection and analysis of data. Lastly, the scale development and validation studies primarily depend on coefficients, factor loadings, significance of the model, relationships which are fully numerical in nature which leads to the quantitative strategy.

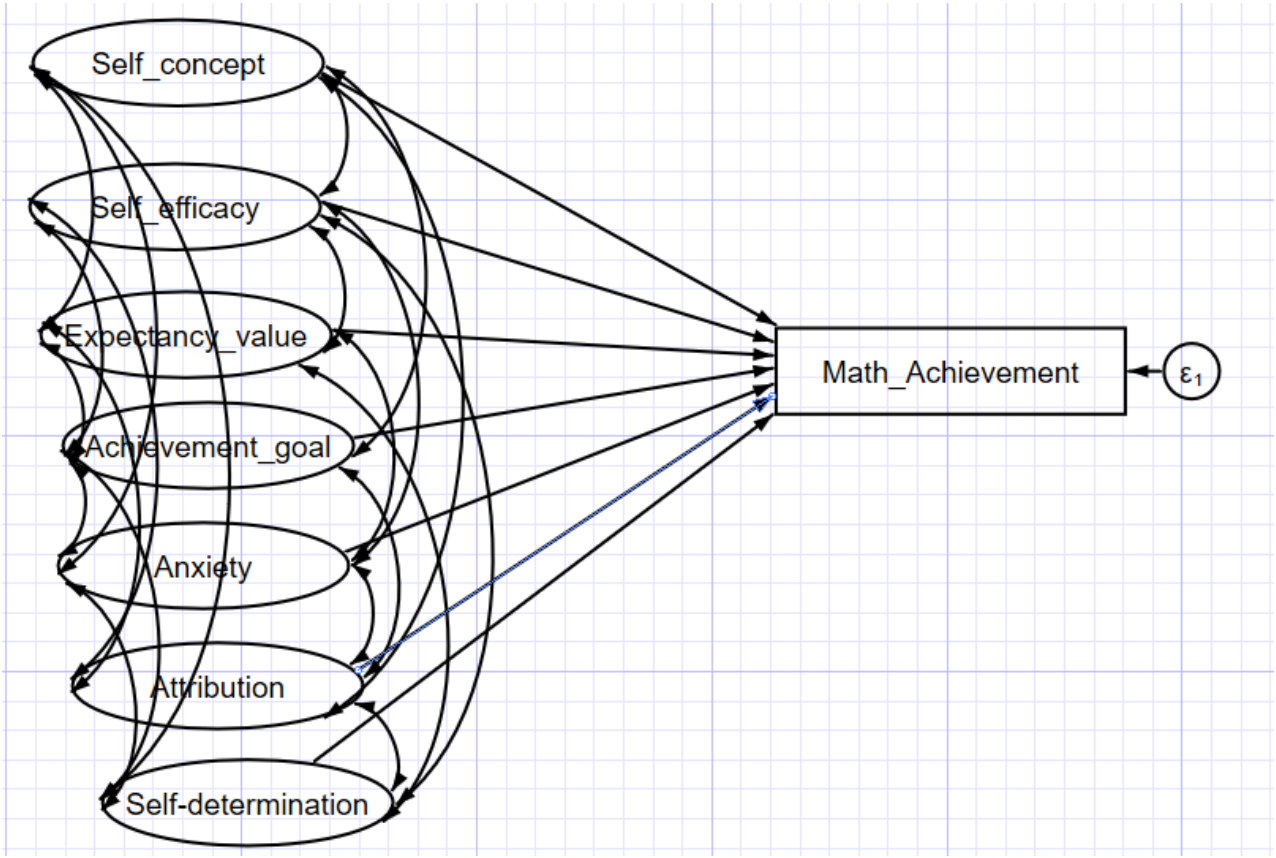


Fig 2 : Hypothesized model showing the constructs relation ships with math achievement (source: own design)

3.5 Research Method

3. 5.1 Data Sources

The source of data was primarily from the primary sources. The primary data were collected by using self developed- questioner, Mathematics Achievement Test and interviews. The structured interview was used to collect primary data from experts. This interview was employed for experts for items validation.

3.5.2 Measurement of Variables

Independent variables:

Self -determination- is a latent variable measured by developed scales based on self determination theory.

Expectancy value - is a latent variable measured by developed scales based on Expectancy value theory.

Self efficacy- is a latent variable measured by scales developed based on self efficacy theory.

Self concept – is a latent variable which is measured by scales developed based on self concept theory.

Goal achievement- is a latent variable which is measured by using scales developed based on achievement goal theory.

Attribution – is a latent variable on gender stereotypic beliefs which can be measured in terms of scales developed by using attribution theory.

Anxiety: is a latent construct which is measured by using scale developed based on Anxiety theory.

Dependent variable:

Academic achievement: is a measurable variable which can be measured in terms of achievement test or achievement results obtained from students' current grade report.

3.5.3 Target Population, Sample and sampling Techniques

The population of the study was undergraduate university students of Ethiopia. The reason to consider the undergraduate student is that most undergraduate students were taking mathematics as a common course and these students were believed to provide relevant data. The study sample was 400 randomly selected undergraduate university students who attend mathematics course as a common course from Addis Aaba University, from Hawassa University and from Jimma University. Purposive sampling technique was used to select the three universities, while stratified random sampling technique was used to select participants from each University and each College and each Department. The reason for inclusion of the three Universities were the homogeneous nature of students enrolled in Ethiopian public Universities, their being first generation Universities, the plenty of experiences of these Universities, and their being budget saving, convenient, and ease for the researcher for collecting relevant data.

There reason to have only 400 respondents is as follows:

As per the Morgan(2013) formula of sample size determination, n = $\frac{N}{1+\varepsilon^2 N}$, and as N becomes very large (goes to infinity), this formula for the significance level being 0.05 is 400 (that is, $\lim_{N\to\infty} \frac{N}{1+\varepsilon^2 N}$ = 400 for $\varepsilon = 0.05$). Thus for large (infinite) population, a sample size 400 is sufficient, provided that the sample selection technique is correct.

Moreover, Israel(1992) and Singh & Masuku (2014), and Fox, Hunn and Mathers (2009) confirmed that for 95% confidence interval, and for the large size of population more than 100, 000, the sample size n=400 is sufficient. Hence, the researcher took, 400 samples from the large population of undergraduate university students in Ethiopia.

3.5.4 Data Collection tools

The instrument, which was initially adapted and then redeveveloped in the context of Ethiopia from Butler (2016), Al Mutawah (2015), Vallerand and Blssonnette (1992), Lubienski, Robinson, Crane and Ganley (2013), and Ayodele(2011) consists of measures of self-efficacy, self-concept, self-determination, expectancy-value, anxiety, attribution, and achievement-goal related motivation. In addition, a 25-item Mathematics Achievement Test (MAT) was developed and validated to measure mathematics achievement.

Undergraduate students in Addis Ababa, Hawassa and Jimma Universities were the respondents of this study. Four instruments were used for data collection. The first was the experts' interview concerning items of Mathematics Learning Motivation(MLM); the second was self-report questionnaire entitled, "Mathematics learning motivation (MLM)" in which the students were asked to rate how they think, feel, act, value and evaluate themselves in Mathematics on a five-point scale, namely: Strongly Agree=5, Agree=4, Undecided=3, Disagree=2 and Strongly Disagree=1. The self developed questionnaire was pilot tested. Thirdly, Cognitive interview of type group debriefing was employed to identify items with confusing meaning and which needs modification and deletion. Finally standardized Mathematics achievement test was given on mathematics course to check students' mathematics achievement in relation to their mathematics learning motivation. Students' current cumulative grade point was included in the demographic characteristics of respondents.

3.5.5 Data Collection Procedures

Students were selected based on stratified sampling techniques. The strata were based on the colleges of students. Students who took basics mathematics during the freshman course were

randomly selected from appropriate Colleges of the three universities, namely Addis Ababa, Jima and Hawassa Universities. The randomization process is in such a way that once the Universities and the colleges of students are selected purposively, participant selection was randomly from each college by not bothering on inclusion all students in each department and in each class and section of students. Accordingly, the College of Natural Science, the College of Education, the College of Engineering, and the College of Health science were the strata from which sample was randomly selected. The questionnaire distributed in paper form. The researcher distributed the questionnaire and administered the test. In average one week of time were spent the questionnaire to be filled and the test to be administered in one university. Participants first filled MLM questioner and then they took MAT as the same time after completion of responding to the questionnaire. In average one and half hour was given to each participant to respond on the questionnaire and administer the test.

The standardized MAT was administered to undergraduate students taking the mathematics course to tap students' mathematics achievement. In addition, students' current cumulative GPA (Grade Point Average) was also tapped as along with the demographic characteristics of respondents.

3.6 Method of Data Analysis

Three phase (item development, scale development, and scale evaluation) with nine steps of item development and validation was employed in this study. (see Fig. 3).

The first phase is the Item development concerned with the initial set of questions for an eventual scale, which consists of : (1) identification of the domain(s) and item generation, and (2) consideration of content validity. The second phase is the scale development that is turning individual items into a harmonious and measuring construct, consists of (3) pre-testing questions, (4) sampling and survey administration, (5) item reduction, and (6) extraction of latent factors. The last phase is the scale evaluation, which consists of: (7) tests of dimensionality, (8) tests of reliability, and (9) tests of validity. For these, the Structural equation modeling and Explanatory analysis (EFA) was employed. Item Response Theory (IRT) and Latent Construct Theory (LCT) were used. The software SPSS 23, and STATA 15 were used for data analysis.

To answer the research question,(To what Extent do items in the instrument of Mathematics Learning Motivation (MLM) valid in the case of undergraduate students in Selected Public Universities of Ethiopia?), domain identification and item pool development was employed; experts' interview was analyzed; the Confrmatory factor analysis was employed and the validity

and reliability of final scale was checked. (See the Psychometric steps of item development and validation in fig. 3)

Multiple analysis of Covariance (MANCOVA) was used to answer the question,(Is there a multivariate main effect Mathematics Learning Motivation on Academic Achievement in undergraduate students in Selected Public Universities of Ethiopia?). The factors such as students' gender, year, and college that alter the mathematics learning motivation of students were used as covariates. That is, the information on these covariates were selected separately and used as part of the analysis.

To answer the research question (Is there a relationship between Mathematics Learning Motivation and students' achievement in the case of undergraduate students in Ethiopian Public Universities?), and to answer the research question "which motivational factor(s) dominantly affect academic-achievement of undergraduate Ethiopian Public Universities?", the factor analysis through STATA 15 mapped and confirmed the relationship among each learning motivation constructs and the academic achievement or mathematics achievement. The factor(s) which is (are) contributing highly for the academic achievement or mathematics achievement was identified from the model that was built by structural equation modeling. Univariate analysis of covariance(ANCOVA) was used to observe the effect of mathematics achievement on the academic achievement in the case of undergraduate public university students of Ethiopia,

In this regard, the confirmatory factor analysis was applied, that is the commonly used analysis of goodness of fit was applicable to check the validity and fitness of the tools in relation to the academic achievement. That is, the results of commonly used goodness-of-fit indices namely, Tucker-Lewis index (TLI), comparative fit index (CFI), root mean square error of approximation(RMSEA), and chi-square (X^2) were used to indicate that whether the model fit to the data exactly or not. In case the fit of a model is not adequate, it has become common practice to modify the model, by deleting parameters that are not significant, and adding parameters that improve the fit. Thus, in this study, modification indices of the model was checked exhaustively.

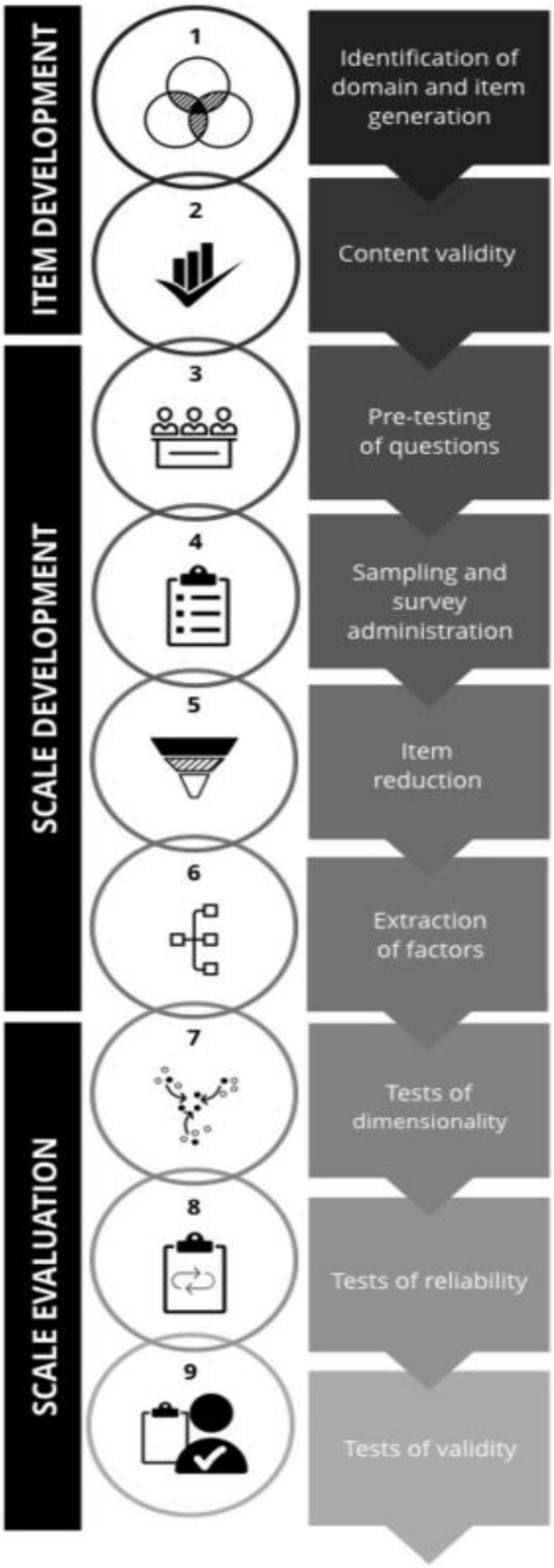


Fig. 3 : An overview of the three phases and nine steps of scale development and validation. (source: *Boateng etal. 2018, p. 2).*

3.7 Ethical Considerations

Protecting the rights of participants by safeguarding their privacy is the most important concern in guiding the relationship between the researcher and respondents. Accordingly, the researcher has taken responsibility in protecting respondents' confidentiality, and respecting the codes of ethics developed. To avoid ambiguity, the interview questions and questionnaires were prepared to include explanation about the study purpose, briefing on respondents' rights and protection, and consent to obtain information.

Moreover, the study was conducted following the approval of the PhD dissertation proposal and obtaining ethical clearance by the Office of Vice President for Research and Technology Transfer (VPRTT), Hawassa University. In this regard, the approval was given from College of Education with Reference number: ጦትት/17/2014 and date October 19/2021. The respondents were free to participate or not to participate in the study at any point in time; Respondents were aware of the aims, reward, risks, and financial support following the study and had the opportunity to refuse to participate; In person identifiable information was not assembled; Bodily, societal, mental and all other types of hurt are kept to an absolute bare minimum. I also ensure that my work is free of plagiarism or research misconduct, and I accurately represent my results.

Consent of participants

The author affirms that: written consent was obtained from participants; all respondents were told about how their data would be used and published; participants did not object to participate in this research and to be published in the journal article; participants provided informed consent for publication of the data in the journal. The consent form can be found in the data repository as Consent of participants.docx (Woldemichael, 2023).

Data availability

Underlying data:

OSF: Mathematics Learning MotivationMLM).

https://doi.org/10.17605/OSF.IO/F67KR(Woldemichael, B. B., 2023)

This project contains the following underlying data:

Main data_12SPSS.sav

Satata data-2.dta

Extended data:

This project contains the following extended data:

Consent of participants.docx

approval Screenshot_20231006-070539.jpg

Data collection permission.pdf

Chapter 4: RESULTS

4.1 Introduction

The development and validation of MLM instrument consists of three phases - nine steps of Boateng, Neilands, Frongillo, Melgar-Quiñonez, & Young (2018) procedures. Phase1: ITEM DEVELOPMENT, PHASE 2: SCALE DEVELOPMENT, and PHASE 3: SCALE EVALUATION. Phase 1 includes: Step 1: Identification of the Domain(s) and Item Generation and Step 2: Content Validity. Phase 2 includes Step 3: Pre-testing Questions, Step 4: Survey Administration and Sample Size, Step 5: Item Reduction Analysis, and Step 6: Extraction of Factors. Phase 3: Scale Evaluation includes Step 7: Tests of Dimensionality, Step 8: Tests of Reliability and Step 9: Tests of Validity. Analyis by using multiple analysis of covariance (MANCOVA) provides the multivirate main and interaction effect of MLM on math and academic achievement; Strucural Equation Modelling (SEM) was employe to designate the MLM factors which highly bring influence on students' math and academic success; univariate analysis of covariance (ANCOVA) was implemented to assess the effect of math achievement on Academic achievement.

Table 4.1 Demographic information

		College				
		Natural Science	Engineering	Education	Health Science	Total
Gender	Female	50	35	45	25	155
	Male	58	58	93	36	245
University	Jimma	59	13	2	61	135
	Hawassa	0	0	131	0	131
	Addis Ababa	49	80	5	0	134
Department	Bio Educ.	0	0	5	0	5
	Bio Medical Eng	0	50	0	0	50
	Chemistry	9	0	0	0	9
	CiVilEnG	0	9	0	0	9
	Computer Science	40	0	0	0	40
	Dental medicine	0	0	0	61	61
	Other	59	0	133	0	192
	Pre- Eng.	0	34	0	0	34
Year	First year	58	0	133	0	191
	second year	9	34	0	61	104
	Third year	41	37	5	0	83
	4th year and above	0	22	0	0	22
Total		108	93	138	61	400

Table 4.1 indicates that undergraduate students of different year, different department, and different universities were included in the study.

Objective 1: to identify to what extent do the MLM scale is Valid

4.2 Scale for Mathematics Learning Motivation (MLM)

4.2.1 Phase I: Item Development

In this section identification of the domains and item generation, and the content validity was assessed.

4.2.1.1 Identification of the Domain(s) and Item Generation

A domain or construct refers to the concept, attribute, or unobserved behavior that is the target of the study. A well-defined domain will provide a working knowledge of the phenomenon under study, specify the boundaries of the domain, and ease the process of item generation and content validation. According to Haynes SN et al. (1995), the first step is to articulate the domain(s) that you are endeavoring to measure. Raykov T & Marcoulides GA (2011) articulated that the domain being examined should be decided upon and defined before any item activity. McCoach et al.(2013) outline a number of steps in scale development; The first five to be suitable for the identification of domain were given. These are all based on thorough literature review and include (a) specifying the purpose of the domain or construct you seek to develop, and (b), confirming that there are no existing instruments that will adequately serve the same purpose. Where there is a similar instrument in existence, you need to justify why the development of a new instrument is appropriate and how it will differ from existing instruments. Then, (c) describe the domain and provide a preliminary conceptual definition and (d) specify, if any, the dimensions of the domain. Alternatively, you can let the number of dimensions forming the domain to be determined through statistical computation. Domains are determined *a priori* if there is an established framework or theory guiding the study, but *a posteriori* if none exist. Finally, if domains are identified *a priori*, (e) the final conceptual definition for each domain should be specified.

In this regard, as the main purpose was to bring a scale that can serve to measure the mathematics learning motivation, MLM, in the context of Ethiopia. The first phase in the research included the development of the initial instrument. In order to create this instrument, a comprehensive review of literature was completed in order to identify gaps in the current research and identify the core elements of MLM. There was also a review of existing instruments and it has been identified that there is no such scale developed in the context of Ethiopia. Hence, based on different literatures, the researcher identified the twelve possible domains for learning motivation, namely:

achievement goal theory (mastery approach, performance approach, mastery avoidance, and performance avoidance) , self determination theory(intrinsic motivation, and extrinsic motivation), Self-efficacy theory , Expectancy value theory(Expectancy, and Task-value), theory of self-concept, anxiety, and attribution theory. Accordingly the items were developed and translated in Amharic language by using related literatures. (see appendix -1 A and B).

Three groups of language instructors from Bonga Education College and Bonga University, with 3 members of each group, one group involved in translation English questionnaire to Amharic, the second group in back translation, and the third group in checking the equivalence between the original items and the back translated items. All language instructors have 5-10 years of experience and all of them have MA degree and above in language and related fields. Finally the raters average point obtained was 3.75 which is under category of "superior" based on rubric adopted from Samir and Tabatabaee-Yazdi(2020). (see appendix 10). Thus the equivalency has been obtained between the original items and the back translated items. This in turn indicates that the Amharic version items are equivalent of the English version items.

Once the domain is delineated, the item pool can then be identified. This process is also called "question development" as per Kline (1993). or "item generation" as per Hinkin (1995). According to Hinkin(1995), there are two ways to identify appropriate questions: deductive and inductive methods. The deductive method, also known as "logical partitioning" or "classification from above" is based on the description of the relevant domain and the identification of items. This can be done through literature review and assessment of existing scales and indicators of that domain. The inductive method, also known as "grouping" or "classification from below" involves the generation of items from the responses of individuals. Qualitative data obtained through direct observations and exploratory research methodologies, such as focus groups and individual interviews, can be used to inductively identify domain items (Morgado et al., 2018). According to Loevinger (1957), it is considered best practice to combine both deductive and inductive methods to both define the domain and identify the questions to assess it. It is recommended that the items identified using deductive and inductive approaches should be broader and more comprehensive than one's own theoretical view of the target.

According to Kline(1993) and Schinka et al(2012), the initial pool of items developed should be at minimum twice as long as the desired final scale. Thus 160 items were developed by considering the 12 variables namely: Performance approach, Mastery approach, Performance avoidance, mastery avoidance, intrinsic motivation, extrinsic motivation, Self-efficacy, Expectancy, Task-value, self concept, anxiety, and Gender stereotype. Furthermore, in the development of items, the

form of the items, the wording of the items, and the types of *responses* that the question is designed to induce should be taken into account. It also means questions should capture the lived experiences of the phenomenon by target population (Schinka et al, 2012). Further, items should be worded simply and unambiguously. Items should not be offensive or potentially biased in terms of social identity, i.e., gender, religion, ethnicity, race, economic status, or sexual orientation (Schinka et al, 2012) .Accordingly, in this study, the researcher used the inductive and deductive approach to develop and translate the 160- items. (appendix-1 A). The deductive step was that items were obtained from different surveys of domain indicators, and then in the inductive process the responses of individual experts were also included.

Table 4.2 : Items numbers constructs, theory and description

Item number	**Sub category**	**Description**	**Theory**
1-11	Mastery-approach	Learners desire to understand the content and showing less concern for grades or comparisons to others.	Achievement of Goal Theory
12-21	Performance-Approach	Learners desire to do well on assessments and to be compared favorably with others.	
22-33	Mastery-Avoidance	Learners do not desire to understand the content and also showing less concern for grades or comparisons to others.	
34-41	Performance-Avoidance	Learners avoiding situations where they feel incompetent because of a desire not to be compared unfavorably with others.	
42-63	Intrinsic Motivation	Motivation to learn mathematics sake of internal rewards such as personal development, enjoyment of exploring that leads to feelings of "internal rewards," reaching personal goals, mental satisfaction, physical well-being, or enjoyment in the moment.	Self-Determination Theory
64-74	Extrinsic Motivation	Motivation to learn mathematics for the sake of external rewards such as money, praise from others, good grades etc.	
75-91	Self-Efficacy	Can I do specific tasks of mathematics like linear equation, quadratic equations, logarithms etc?	Self-Efficacy Theory
92-98	Anxiety	A feeling of tension on operating mathematics	Anxiety
99-110	Expectancy	Student perceptions of their abilities by asking themselves questions, "Can I do this task?"	Expectancy-Value Theory
111-121	Task-Value	The individual's beliefs and judgments about his or her capabilities to do a task and succeed at it by asking question "Do I want to do this task and why?"	
122-146	Self-Concept	Answering self questions such as who am I,	Self-Concept

		what kind of person am I, how sure am I that I can do mathematics. Am I good at mathematics?	Theory
147- 160	Attribution	How students attribute success and failure in mathematics based on their gender.	Attribution Theory

4.2.1.2 Face and Content Validity

Expert review was conducted on the 160 items instrument in order to establish face and content validity. Face validity is defined as how well an instrument appears to measure what it is intended to measure, or its face value (Kucuk & Walters, 2009). The definition of content validity takes analysis one step farther and refers to whether the items in the instrument actually measure what they are stated to measure (Delgado-Rico, CarreteroDios, & Ruch, 2012) . As per Haynes, Richard & Kubany (1995) Content validity is defined as the degree to which elements of an assessment instrument are relevant to and representative of the targeted construct for a particular assessment purpose. According to Hinkin (1995), Content validity refers to the "adequacy with which a measure assesses the domain of interest". According to DeVellis (2012), the need for content adequacy is vital if the items are to measure what they are presumed to measure. Guion(1977) has proposed five conditions that must be satisfied in order for one to claim any form of content validity. These include that (a) the behavioral content has a generally accepted meaning or definition; (b) the domain is unambiguously defined; (c) the content domain is relevant to the purposes of measurement; (d) qualified judges agree that the domain has been adequately sampled based on consensus; and (e) the response content must be reliably observed and evaluated. Therefore, content validity requires evidence of content relevance, representativeness, and technical quality. Content validity is mainly assessed through evaluation by expert and target population judges. The face and content validity in this study was assessed by review of the items by experts.

Evaluation by Experts

Expert judges are highly knowledgeable about the domain of interest and/or scale development; target population judges are potential users of the scale (DeVellis,2012,, Morgado, 2018). *Boateng etal. (2018)* recommend that expert judges seem to be used more often than target-population judges in scale development work to date; Ideally, one should combine expert and target population judgment; When resources are constrained, however, we recommend *at least* the use of expert judges(*Boateng, etal., 2018).*As per Haynes (1995), expert judges evaluate each of the items to determine whether they represent the domain of interest. These expert judges should be

independent of those who developed the item pool. Expert judgment can be done systematically to avoid bias in the assessment of items.

Despite the two aspects of content validity (i.e., relevant and representativeness of an assessment tool), the relevant of an assessment tool has been frequently used to measure the content validity Polit & Beck (2006, 2007). It is important to note that establishing the content validity is vital to support the validity of an assessment tool such as questionnaires, especially for research purpose. Haynes, Richard & Kubany (1995) suggest that, "Inferences from assessment instruments with unsatisfactory content validity will be suspect, even when other indices of validity are satisfactory."

In this study, nine experts, three from the psychology field, three from the measurement and evaluation field and three from the mathematics fields were made to fill the content validation form. (see appendix 2 A). The experts were chosen by the researcher from Bong Education College and from Bonga University. As Yusoff(2019) suggests, the content validity evidence can be represented by the content validity index (CVI). Moreover, as per Yusoff(2019) there are two forms of CVI, in which CVI for item (I-CVI) and CVI for scale (S-CVI). Two methods for calculating S-CVI, in which the average of the I-CVI scores for all items on the scale (S-CVI/Ave) and the proportion of items on the scale that achieve a relevance scale of 4 or 5 by all experts (S-CVI/UA). The calculation of CVI, the relevance rating must be recorded as 1 (relevance scale of 4 or 5) or 0 (relevance scale of 1, 2 or 3) as shown in appendix 2B.

In this study items with all the experts agreed up on as relevant, which are items with I-CVI = 1 and universal agreement (UA=1), were accepted for the next step (see appendix 2 C). Accordingly, 59 items were accepted to fit the content.(see appendix 2D)

4.2.2 Phase II: Scale Development

In this phase, the pretesting of questions and the cognitive interview part was employed in this study.

4.2.2.1 Pre-testing Questions

Pre-testing helps to ensure that items are meaningful to the target population before the survey is actually administered, i.e., it minimizes misunderstanding and subsequent measurement error. Because pre-testing eliminates poorly worded items and facilitates revision of phrasing to be maximally understood, it also serves to reduce the cognitive burden on research participants. Saunders et al., (2007) state that prior to using the questionnaire to collect data it should be pilot tested. Saunders et al., (2007) point out the purpose of the pilot test is to refine the questionnaire so

that the respondents will have no problems in answering the questions and also there will be no problems in recording the data. In this study, 150(male=86, female =64) respondents from Bonga University were participated in the pilot testing.

Item-total correlation

According to Field (2009), the Corrected Item-Total Correlation value indicates the correlation between each item and the total score for the questionnaire, and item-to-total correlation values that are less than 0.30 are deemed unacceptable. As per Baker, etal.(2015), values between 0 and 0.19 may indicate that the question is not discriminating well values between 0.2 and 0.39 indicate good discrimination; values 0.4 and above indicate very good discrimination.

In this study, the discrimination index of the items is calculated by using the point-biserial correlation or the item total correlation (see Appendix 5).

Items contributing negatively to the item total correlation and items contributing less than 0.4 to the item total contribution were supposed to be suppressed. We observe from table in appendix 5, that three items item namely q143, q159, and q160 are contributing less to the item-total correlation. Accordingly the items: q143, q159, and q160 were suppressed from the list.

Cognitive interview

Cognitive interview of type group debriefing was employed to identify items with confusing meaning and which needs modification and deletion. According to Vogt, King, and King (2004), in group debriefing, the respondents were asked in focus group discussion to remark about what they believe they are being asked and if they found confusing or misleading about the survey question. Accordingly focus group of five members were selected and read the individual questions aloud and assess test participants reactions. The group debriefing approach allow to assess the magnitude of confusion for certain items, so that they do not over or under react to issue raised by any one individual respondent. The group debriefing identified nine items namely, q29,q34, q63, q78, q99, q110, q143, q149, and q155. But one the items, q143, were already suppressed from the former steps(by item-total correlation). In this regard, the cognitive interview of the type group debriefing approach was employed on the items, and this process excludes seven items whose meanings are not match with the intended meaning to measure the construct and which are confusing from the list. That is, the items: q29, q34, q63, q78, q99, q110, q149, and q155 were supposed to be excluded on needs modification by using the cognitive interview. (See appendix -3). But, to get at least four items under each predictor, q149 and q155 were included in the items list with a little modification. Total of nine items (three items: q143, q159, and q160 from item-total correlation, and five items: q29, q34, q63, q78, q99, and q110 from goup

debriefing) were suppressed from list of 59 items. Finally, 50 items namely: q7, q 9, q 10, q 19, q 25, q 26, q 30 , q 31, q 35, q38, q 39, q 43, q 44, q 48, q 49, q50, q 51, q56, q57, q61, q64, q66, q67, q73, q76, q77, q81, q82, q87, q90, q91, q95, q96, q101, q111, q115, q116, q120, q121, q125, q131, q133, q135, q140, q144, q145, q149, q150, q154, and q155 were retained to be included in the questionnaire. (see appendix 6 A and B). These questionnaires were used to collect the main data from 400 participants of Jimma University, Hawassa University and Addis Ababa University. Both English and Amharic version questionnaire were used for data collection. Students who prefer to use Amharic version was given Amharic version questionnaire and other who need the English version used the English version questionnaire.

4.2.3 PHASE III: SCALE EVALUATION

4.2.3.1 Tests of Dimensionality

As per Brown (2014), the test of dimensionality is a test in which the hypothesized factors or factor structure extracted from a previous model is tested at a different time point in a longitudinal study or, ideally, on a new sample. Tests of dimensionality determine whether the measurement of items, their factors, and function are the same across two independent samples or within the same sample at different time points. Such tests can be conducted using independent cluster model (ICM)-confirmatory factor analysis, bi-factor modeling, or measurement invariance.

Confirmatory* factor *Analysis* (*CFA)

In this study Confirmatory Factor Analysis was employed to test the dimensionality. According to Morin, Arens & Marsh(2016), Confirmatory Factor Analysis is a form of psychometric assessment that allows for the systematic comparison of an alternative a priori factor structure based on systematic fit assessment procedures and estimates the relationship between latent constructs, which have been corrected for measurement errors. The systematic fit assessment procedures are determined by meaningful satisfactory thresholds; These techniques include the chi-square test of exact fit, Root Mean Square Error of Approximation (RMSEA ≤ 0.06), Tucker Lewis Index (TLI ≥ 0.95), Comparative Fit Index (CFI ≥ 0.95), Standardized Root Mean Square Residual (SRMR ≤ 0.08), and Weighted Root Mean Square Residual (WRMR ≤ 1.0).

Table 4.3 : KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.874

Bartlett's Test of Sphericity	Approx. Chi-Square	8508.248
	Df	1225
	Sig.	.000

According to Field (2009), the KMO statistics provide information about whether the data is sufficient to run the factor analysis or not. The value of KMO statistic should be at least equal to 0.5 the values between 0.5 and 0.7 are mediocre, values between 0.7 and 0.8 are good, values between 0.8 and 0.9 are great and values above 0.9 are superb. In the table 2 we observe the KMO and Bartlett's Test . As observed in table 4.3, the KMO statistic is 0.874 which is greater than 0.5, and which falls into the range of being great, showing that the sample size is adequate for factor analysis. The Bartlett's test of sphericity is significant (the value of *Sig*.=0.000 which is less than .05) also showing that Bartlett's test is highly significant ($p < .001$), and therefore factor analysis is appropriate.

Table 4.4 Communalities

	Initial	Extraction
q7	1.000	.446
q9	1.000	.537
q10	1.000	.515
q19	1.000	.183
q25	1.000	.536
q26	1.000	.542
q30	1.000	.401
q31	1.000	.417
q35	1.000	.449
q38	1.000	.465
q39	1.000	.393
q43	1.000	.398
q44	1.000	.458
q48	1.000	.728
q49	1.000	.331
q50	1.000	.281
q51	1.000	.446
q56	1.000	.601
q57	1.000	.617
q61	1.000	.275
q64	1.000	.250
q66	1.000	.463
q67	1.000	.360

q73	1.000	.419
q76	1.000	.503
q77	1.000	.387
q81	1.000	.483
q82	1.000	.501
q87	1.000	.321
q90	1.000	.413
q91	1.000	.753
q95	1.000	.597
q96	1.000	.586
q101	1.000	.367
q111	1.000	.510
q115	1.000	.286
q116	1.000	.495
q120	1.000	.818
q121	1.000	.499
q125	1.000	.595
q131	1.000	.121
q133	1.000	.473
q135	1.000	.563
q140	1.000	.556
q144	1.000	.367
q145	1.000	.571
q149	1.000	.446
q150	1.000	.249
q154	1.000	.553
q155	1.000	.386

Extraction Method: Principal Component Analysis.

Table 4.4 shows "communality"—is a definition of common variance that ranges between 0 and 1. When the values close 1, it suggests that the extracted factor explain more of the variance of an individual item. The communality table described the values as initial and extraction. As per Hair et at (2011), the extraction values needs to be equal or greater than 0.50 because variables whose communalities are less than 0.50 are not having sufficient explanation and excluded from analysis. In addition to this, Comrey and Lee (1992) recommended that variables with communality values of 0.45are tolerable and fair. Thus, of 50 items, 20 of them were suppressed due to their communality value less than the tolerable and fair value= .45. Accordingly items: q19, q30, q31, q39, q43, q49, q50, q61, q64, q67, q73, q77, q87, q90, q101, q115, q131, q144, q150, and q155 were suppressed

and excluded from further analysis. Only the 30 items namely; q7, q9, q10, q25, q26, q35, q38, q44, q48, q51, q56, q57, q66, q76, q81, q82, q91, q95, q96, q111, q116, q120, q121, q125, q133, q135, q140, q145, q149, q154 were included for further analysis. Factor analysis was employed by using these 30 items. (see table 4.5)

Table 4.5 Pattern Matrix[a]

	Component		
	1	2	3
q7		.603	
q9		.636	
q10		.660	
q25		.653	
q26		.770	
q35		.632	
q38		.614	
q44			
q48			.763
q51			
q56	.661		
q57	.684		
q66			.408
q76	.629		
q81		.440	
q82		.435	
q91			.801
q95	-.491		.443
q96			.467
q111			
q116	.638		
q120			.649
q121	.503		
q125	.799		
q133	.659		
q135	.786		
q140	.686		
q149	.720		
q154	.777		
q145	.607		

Extraction Method: Principal Component Analysis.

Rotation Method: Promax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

Since dimensions are *theoretically dependent*, Oblique (Promax) rotation has been performed. The results from the oblique rotation in table 4.5 suggested the factors to three.

Table 4.6 Structure Matrix

	Component		
	1	2	3
q7		.639	
q9	.420	.689	
q10	.433	.713	
q25		.547	
q26		.656	
q35		.542	
q38		.588	
q44	.537	.504	
q48			.793
q51	.571	.532	
q56	.704	.440	
q57	.743	.483	
q66			.425
q76	.602		
q81		.497	
q82	.448	.550	
q91			.827
q95	-.403		
q96			
q111	.511	.422	
q116	.662		
q120			.697
q121	.609	.416	
q125	.747		
q133	.684		
q135	.725		
q140	.668		
q149	.673		
q154	.655		
q145	.584		

Extraction Method: Principal Component Analysis.
Rotation Method: Promax with Kaiser Normalization.

The structure matrix in table 4.6 differs from table 4.5 in that shared variance is not ignored. Several questions load onto more than one factor. This has occurred because of the relationship between factors 1, 2 and 3. This clarifies our assumption that the factors are correlated.

Table 4.7 Component Correlation Matrix

Component	1	2	3
1	1.000	.493	.266
2	.493	1.000	.123
3	.266	.123	1.000

Extraction Method: Principal Component Analysis.
Rotation Method: Promax with Kaiser Normalization.

The correlation matrix between the factors in table 4.7 contains the correlation coefficients between factors. We observe from table 4.7 that each factor has moderate correlation with the other factor. The fact that these correlations exist tell us that the constructs measured can be interrelated. If the constructs were independent then we would expect oblique rotation to provide an identical solution to an orthogonal rotation and the component correlation matrix should be an identity matrix (i.e. all factors have correlation coefficients of 0). Therefore, this final matrix in table 4.7 gives us a guide that we cannot assume independence. Therefore, the results of the orthogonal rotation should not be trusted: the obliquely rotated solution is probably more meaningful.

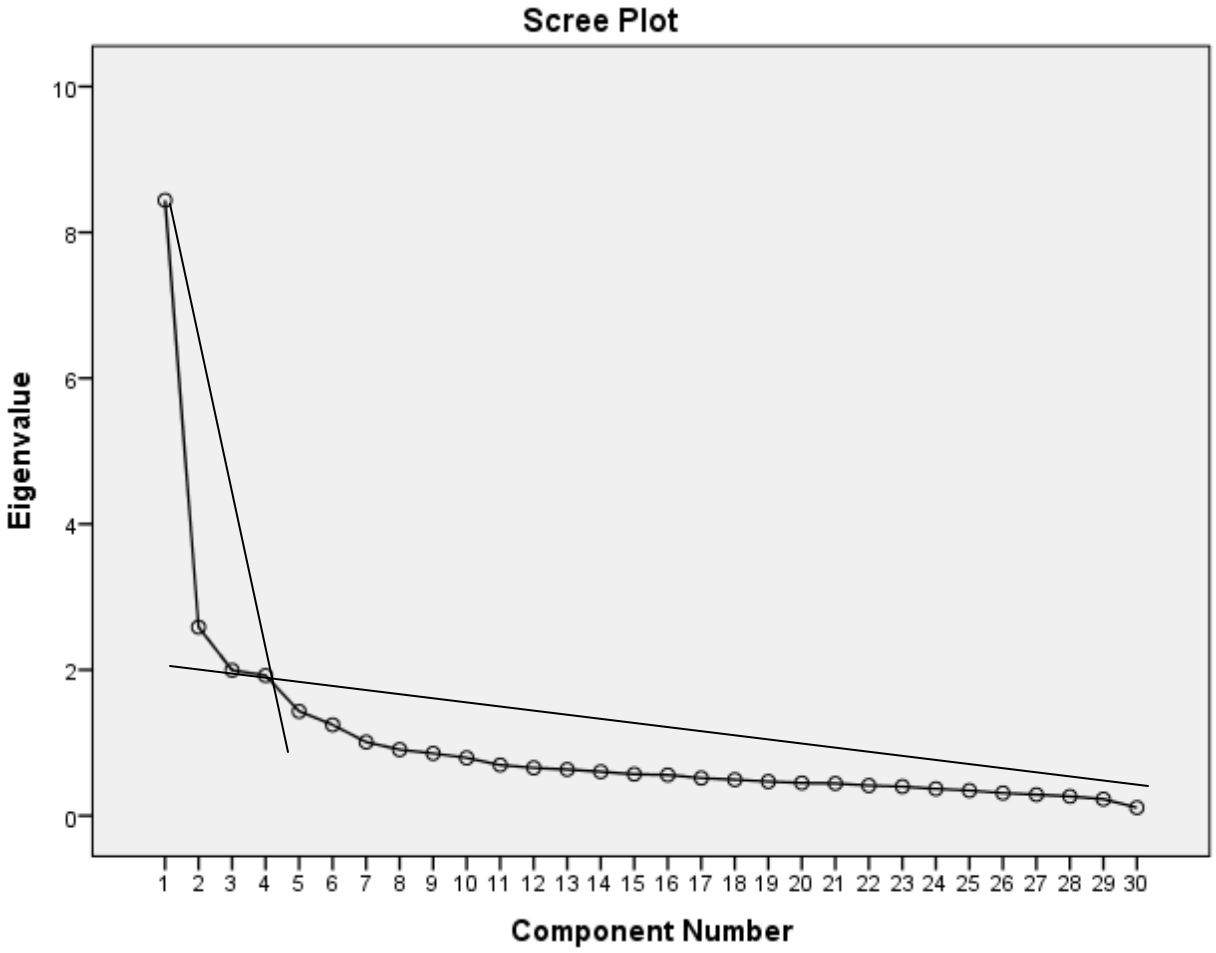


Fig4: The Scree plot

Moreover, the sree plot in Fig4, confirmed that the factors to be extracted is three. We see from the patten matrix that q44, and q111 are suppressed due to their less contribution or less load and q95 is suppressd due to the negative loading. Therfore, only 27 items go to the next step. Hence by using the pattern and structure matrix we admit the following items for each factor.

Factor1: q56, q57, q76, q116, q121, q125, q133, q135, q140, q145, q149, and q154 which is more related to Self-concept

Factor 2: q7, q9, q10, q25, q26, q35, q38, q81, and q82 which is related to Achievement-goal and

Factor3: q48, q66, q91, q95, q96, and q120 which is related to Anxiety.

The structural equation model employing these items was given in Fig 2 below.

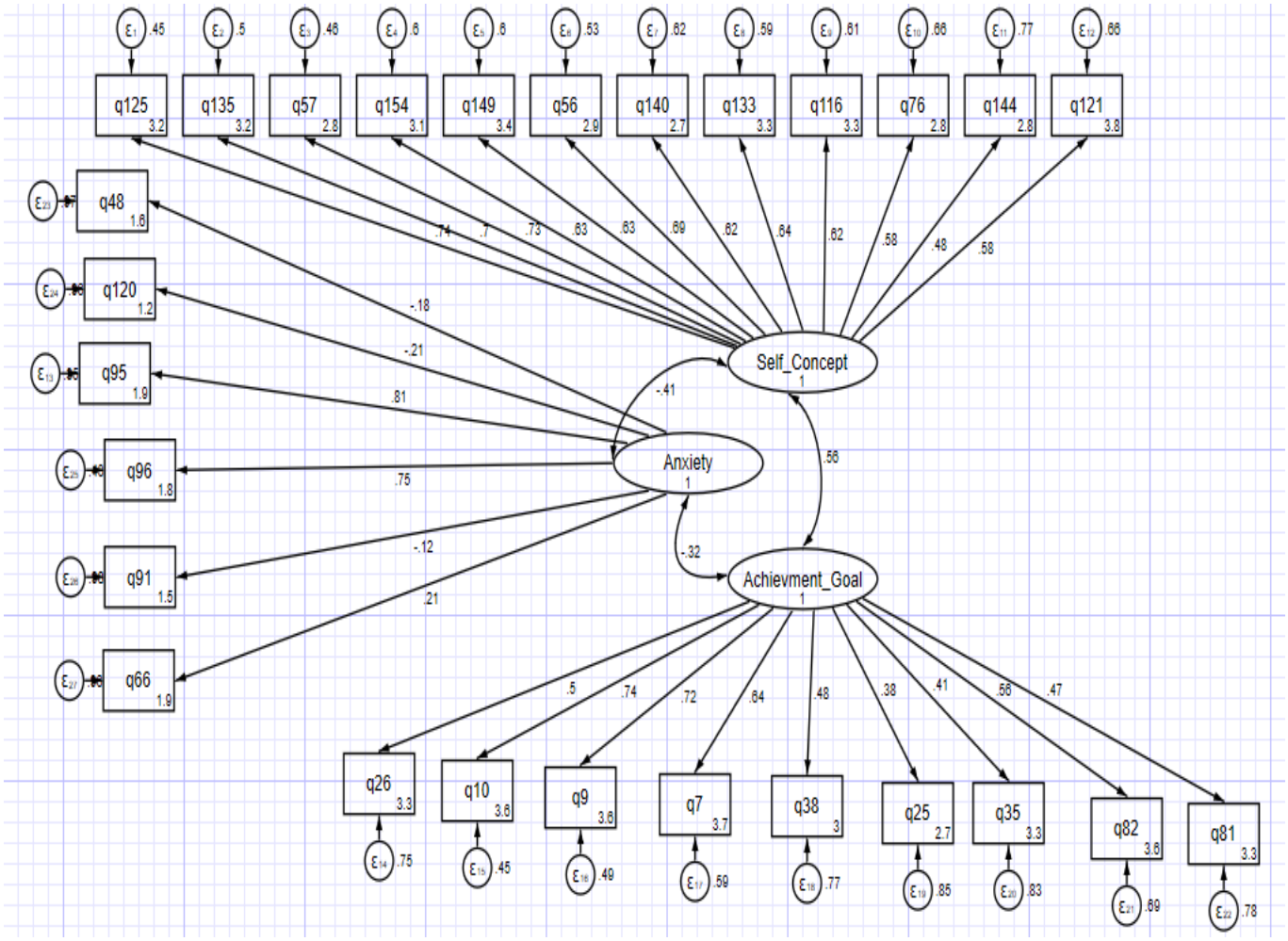


Fig 5: Structural Equation model estimates

As we observed from Fig 5, item 48, 91 and 120 have negative contribution to the corresponding construct. Thus these items will be suppressed from the list. Thus only 24 items pass to the next step.

Measurement Model Estimates

Table 4.8: Estimates and their significance of Self-concept items

	Standardized	OIM Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Measurement							
q125							
	Self_Concept	.7389957	.0260164	28.40	0.000	.6880045	.7899869
	_cons	3.177394	.1229626	25.84	0.000	2.936392	3.418396
q135							
	Self_Concept	.7035243	.0284791	24.70	0.000	.6477062	.7593423
	_cons	3.24788	.1252434	25.93	0.000	3.002408	3.493353
q57							
	Self_Concept	.7316054	.0269067	27.19	0.000	.6788693	.7843416
	_cons	2.840049	.1121711	25.32	0.000	2.620198	3.059901
q154							
	Self_Concept	.6343707	.033227	19.09	0.000	.569247	.6994943
	_cons	3.0909	.1201752	25.72	0.000	2.855361	3.326439
q149							
	Self_Concept	.6315891	.0330489	19.11	0.000	.5668145	.6963637
	_cons	3.364721	.1290414	26.07	0.000	3.111805	3.617638
q56							
	Self_Concept	.6854153	.0300325	22.82	0.000	.6265526	.7442779
	_cons	2.872036	.1131845	25.37	0.000	2.650198	3.093874
q140							
	Self_Concept	.620502	.0340119	18.24	0.000	.5538399	.6871642
	_cons	2.72541	.1085579	25.11	0.000	2.51264	2.938179
q133							
	Self_Concept	.64186	.0323998	19.81	0.000	.5783576	.7053625
	_cons	3.328897	.1278747	26.03	0.000	3.078267	3.579527
q116							
	Self_Concept	.622246	.0337869	18.42	0.000	.556025	.6884671
	_cons	3.303139	.1270371	26.00	0.000	3.054151	3.552127
q76							
	Self_Concept	.5802786	.0361558	16.05	0.000	.5094145	.6511427
	_cons	2.816344	.1114215	25.28	0.000	2.597962	3.034727
q144							
	Self_Concept	.4817796	.0413183	11.66	0.000	.4007972	.562762
	_cons	2.835671	.1120325	25.31	0.000	2.616091	3.055251
q121							
	Self_Concept	.5817416	.0361237	16.10	0.000	.5109404	.6525428
	_cons	3.759743	.1420197	26.47	0.000	3.48139	4.038097

We observe from table 4.8 that all items of self-concept contributed to the construct self-concept significant positively, $p < 0.05$.

Table 4.9 Estimates and significance of Achievement Goal items

	Standardized	OIM Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
q26							
	Achievment_Goal	.4949674	.0438021	11.30	0.000	.409117	.5808179
	_cons	3.253441	.1254234	25.94	0.000	3.007615	3.499266
q10							
	Achievment_Goal	.7446842	.0290974	25.59	0.000	.6876544	.8017141
	_cons	3.643798	.1381902	26.37	0.000	3.37295	3.914646
q9							
	Achievment_Goal	.7172497	.0307327	23.34	0.000	.6570146	.7774847
	_cons	3.559111	.1354033	26.29	0.000	3.293726	3.824497
q7							
	Achievment_Goal	.6369122	.0354047	17.99	0.000	.5675203	.7063041
	_cons	3.743407	.1414791	26.46	0.000	3.466113	4.020701
q38							
	Achievment_Goal	.4755299	.0443117	10.73	0.000	.3886806	.5623791
	_cons	2.954695	.1158135	25.51	0.000	2.727704	3.181685
q25							
	Achievment_Goal	.3830124	.0487141	7.86	0.000	.2875345	.4784902
	_cons	2.657318	.1064268	24.97	0.000	2.448726	2.865911
q35							
	Achievment_Goal	.4121261	.0469323	8.78	0.000	.3201405	.5041117
	_cons	3.328177	.1278512	26.03	0.000	3.077593	3.578761
q82							
	Achievment_Goal	.5580747	.0404712	13.79	0.000	.4787525	.6373968
	_cons	3.635491	.1379165	26.36	0.000	3.365179	3.905802
q81							
	Achievment_Goal	.4674512	.0448584	10.42	0.000	.3795304	.555372
	_cons	3.317758	.1275123	26.02	0.000	3.067839	3.567678

It was also depicted in table 4.9 that all the achievement goal items are significantly contributed to the achievement goal factor.

Table 4.10 Estimates and significance of Anxiety items

	Standardized	OIM Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
q95							
	Anxiety	.819485	.0682183	12.01	0.000	.6857796	.9531904
	_cons	1.936699	.0847851	22.84	0.000	1.770524	2.102875
q66							
	Anxiety	.2401737	.0575237	4.18	0.000	.1274292	.3529181
	_cons	1.867933	.082834	22.55	0.000	1.705581	2.030285

We observe from table 4.10 that the items of anxiety are the significant estimators of the construct anxiety. All item loaded and contributed to the construct positively and $p < 0.05$.

Table 4.11 Overall goodness of Fit before Modification indices

Fit statistic	Value	Description
Likelihood ratio		
chi2_ms(321)	1825.185	model vs. saturated
p > chi2	0.000	
chi2_bs(351)	4618.705	baseline vs. saturated
p > chi2	0.000	
Population error		
RMSEA	0.108	Root mean squared error of approximation
90% CI, lower bound	0.103	
upper bound	0.113	
pclose	0.000	Probability RMSEA <= 0.05
Information criteria		
AIC	32866.241	Akaike's information criterion
BIC	33201.524	Bayesian information criterion
Baseline comparison		
CFI	0.648	Comparative fit index
TLI	0.615	Tucker-Lewis index
Size of residuals		
SRMR	0.111	Standardized root mean squared residual
CD	0.994	Coefficient of determination

We observe from table 4.11 that (RMSEA = .108>0.06), Tucker Lewis Index (TLI =.615 < 0.95), Comparative Fit Index (CFI =.648 < 0.95), and Standardized Root Mean Square Residual (SRMR =.111> 0.08), which needs certain modification indices.

Modification Index

The modification index results indicate that deletion of Item 66 will decrease the value of chi square by 30.784, cov(140,144) will decrease the will decrease the value of chi square by 40.777, Cov (81,82) will decrease the value of chi square by 81.168, Cov(56, 57) will decrease the value of chi square by 83.836, and Cov (25,26) will decrease the will decrease the value of chi square by 99.731. (See Appendix 8). Thus after applying the best three of these modification indices we have the following overall goodness of fit.

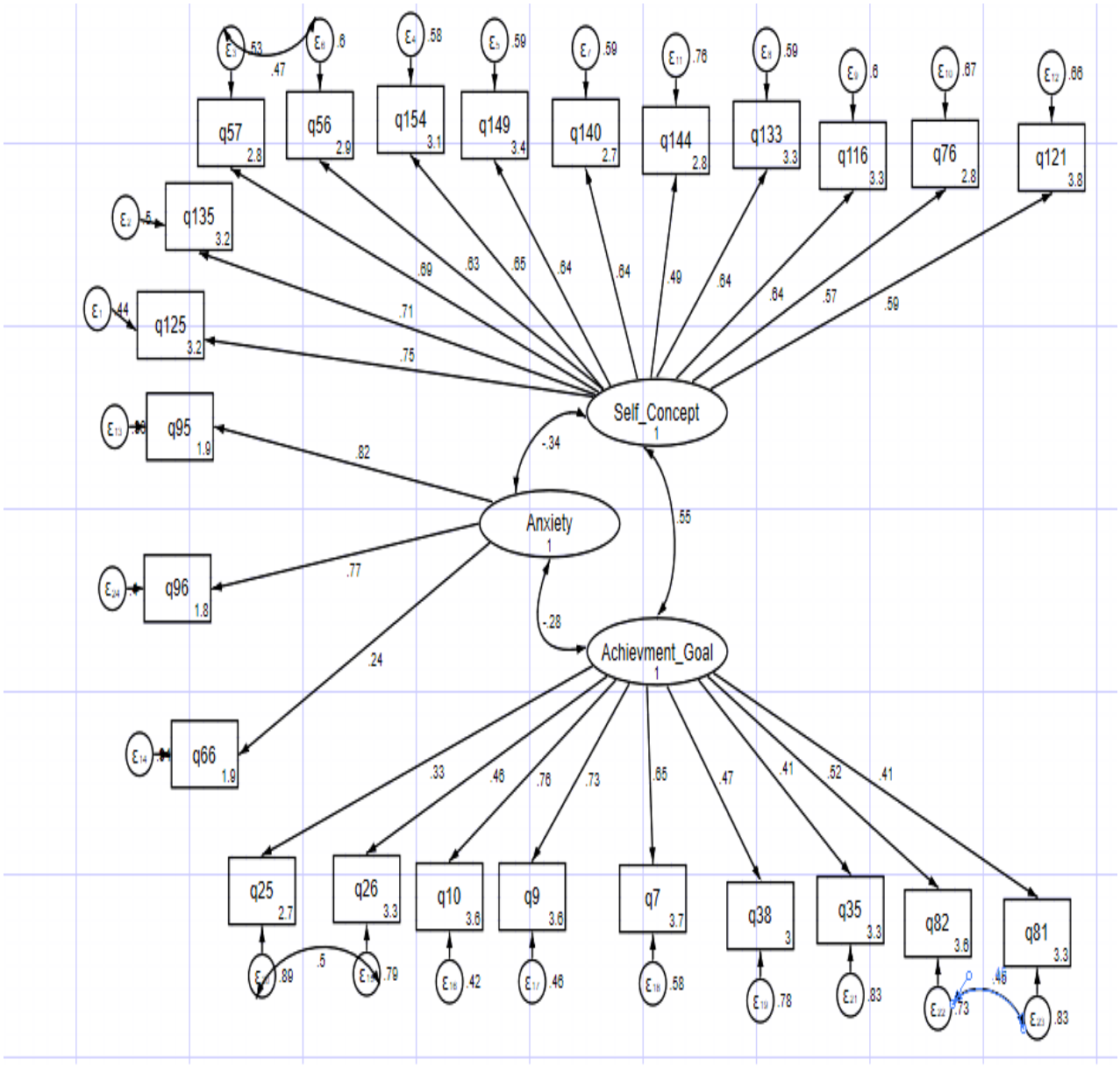


Fig 6: The model estimation after modification indices

Table 4.12 Overall goodness of Fit after Modification indices

Fit statistic	Value	Description
Likelihood ratio		
chi2_ms(246)	710.190	model vs. saturated
p > chi2	0.000	
chi2_bs(276)	3763.269	baseline vs. saturated
p > chi2	0.000	
Population error		
RMSEA	0.069	Root mean squared error of approximation
90% CI, lower bound	0.063	
upper bound	0.075	
pclose	0.000	Probability RMSEA <= 0.05
Information criteria		
AIC	26852.572	Akaike's information criterion
BIC	27163.906	Bayesian information criterion
Baseline comparison		
CFI	0.867	Comparative fit index
TLI	0.851	Tucker-Lewis index
Size of residuals		
SRMR	0.073	Standardized root mean squared residual
CD	0.994	Coefficient of determination

As depicted in table 4.12, we get the modified model goodness-of-fit statistics, with relative Chi-Square = 710.190; CFI = .867, RMSEA = .069, SRMR = .073, and p = .000, which indicate that the model is considerably fit the data.

Fully fledged Model

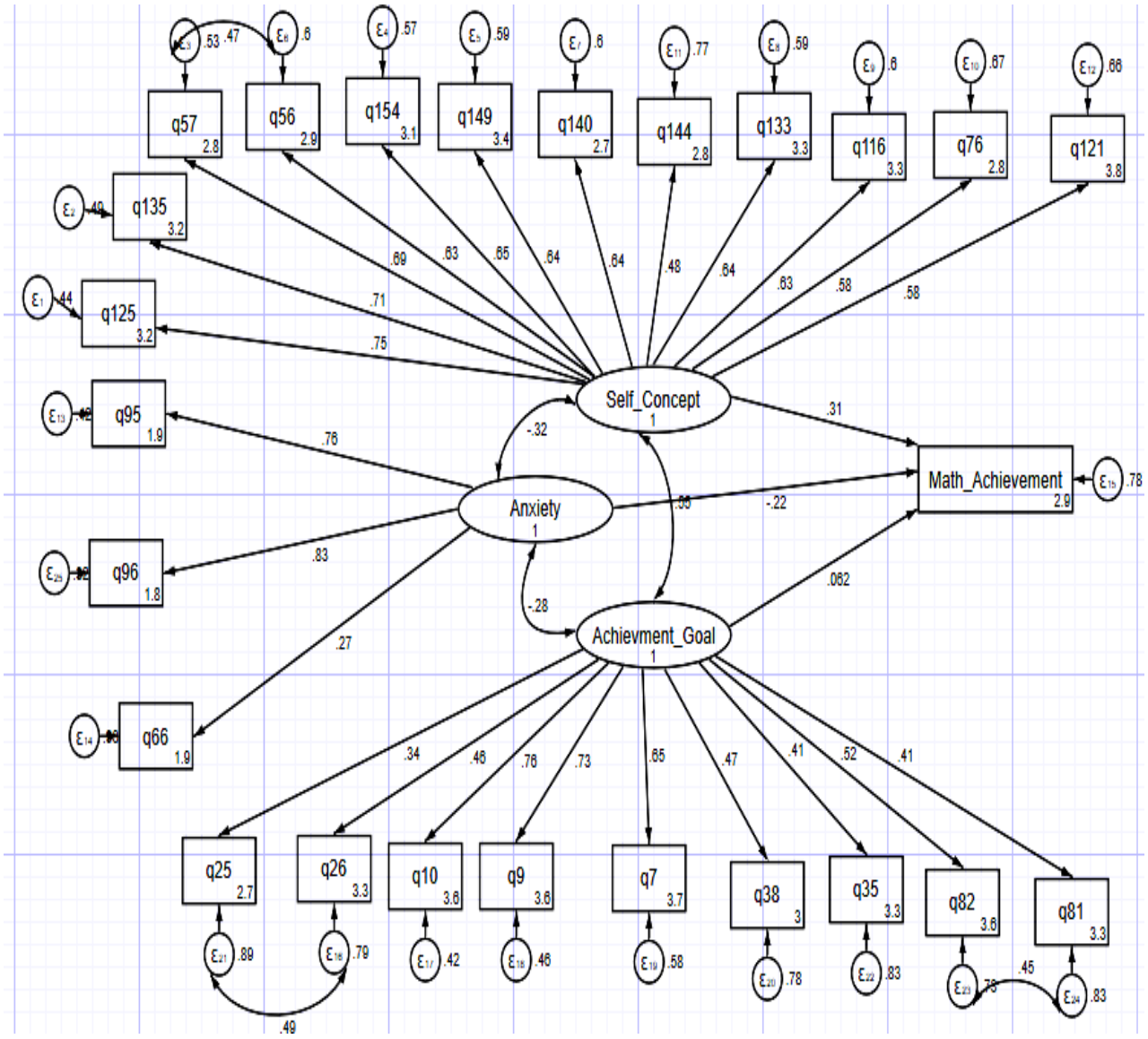


Fig 7: fully fledged model with respect to mathematics achievement

Fig 7 indicate the full fledged modified model and the standardized estimates of each item load to its corresponding construct, and the estimates of each construct with respect to the dependent variable, mathematics achievement.

Table 4.13: Structural level Model estimates and significance

Standardized	OIM Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Math_Achievement						
Self_Concept	.3080708	.0613621	5.02	0.000	.1878033	.4283383
Achievment_Goal	.0616962	.0656104	0.94	0.347	-.0668978	.1902902
Anxiety	-.2181593	.0544716	-4.01	0.000	-.3249216	-.111397
_cons	2.908867	.114361	25.44	0.000	2.684724	3.133011

As depicted in table 4. 13 above, the two predictors, namely the Self concept (β =.31, P=.000 <.05) and Anxiety (β =-.218, p=.000 <.05), of math achievement are significant estimators of mathematics achievement. The anxiety is negatively related and significant estimator of math achievement and Self-Concept is positively related and significant estimator. Where as one of the estimators namely the Achievement Goal (β =.062, p=.347 >.05) related positively with mathematics achievement but not a significant estimator of mathematics achievement.

4.2.3.2 Test of Reliability

Table 4.14 : Reliability Statistics

Cronbach's Alpha	N of Items
.844	24

From table 4.14 we see that overall, the 24 items has reliability of .844, which is considered to be high reliability.

Table 4.15 : Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
q95	80.1050	171.182	-.227	.862
q96	80.1325	170.025	-.185	.862
q66	80.1750	158.721	.163	.847
q135	79.0125	149.792	.549	.833
q125	79.0475	148.266	.602	.831
q140	79.2575	147.991	.552	.832
q144	79.3150	152.592	.415	.838
q57	78.9250	144.907	.623	.829
q56	78.9300	146.341	.581	.831

q154	79.1050	151.187	.480	.835
q149	78.9600	150.760	.523	.834
q121	78.6300	150.068	.565	.833
q133	78.9250	149.473	.561	.832
q76	79.3000	151.243	.459	.836
q116	78.9225	149.500	.555	.833
q7	78.5700	152.226	.465	.836
q9	78.5850	150.710	.498	.835
q10	78.6100	149.873	.549	.833
q25	79.0050	155.098	.261	.844
q26	78.6400	155.479	.287	.842
q35	78.7425	155.781	.295	.842
q38	78.9300	152.672	.376	.839
q81	78.8275	153.522	.387	.839
q82	78.7325	152.302	.469	.836

The item- total statistics in table 4.15 indicates that deleting item q95 and q96 will the overall reliability statistics from .844 to .862. Also deleting item 66 will result to increase of reliability from .844 to .847. But because of the change on the overall reliability is not considerably high and the deletion might reduce construct-wise reliability, the items q5 and q96 were not to be suppressed from the list. But items q25 and q66 were suppressed by their fewer loads to the model and deletion of them increases the overall reliability. Thus only 22 items were retained.

As per Roldán & Sánchez-Franco(2012), a measure of internal consistency reliability, the composite reliability(C R) developed by Werts, Linn, and Jöreskog (1974) fulfills the same task as Cronbach's alpha. However, composite reliability is more suitable since it does not assume that all indicators are equally weighted (Chin, 1998b). Since the Cromach's Alpha estimates for reliability does not provide the reliability level of each item, and since individual item reliability is assessed by analyzing the standardized loadings (λ), the researcher considered the standardized item loading to its corresponding construct as a measure of reliability of each item and composite reliability was calculated.(See table 4.16). Carmines and Zeller (1979) suggest that to accept an indicator as a constituent of a construct, the manifest variable should have a loading of 0.707 or more.

Table 4.16 Composite Reliability (CR) and Average Variance Extracted (AVE)

Construct	Item no.	Item	Load(λ)	Error (E) $(1-\lambda^2)$	λ^2	CR $\frac{(\sum\lambda)^2}{(\sum\lambda)^2+\sum(1-\lambda^2)}$	AVE $\frac{\sum\lambda^2}{n}$
Self-concept	q125	I feel esteem for myself (dignity, achievement, mastery, independence) in math subject.	0.739	0.453879	0.54612		
	q135	I am good at Mathematics as a subject	0.704	0.504384	0.49562		
	q57	I would describe mathematics as very interesting.	0.7316	0.46476144	0.53524		
	q154	I believe that I have better mathematical Proficiency.	0.634	0.598044	0.40196		
	q149	I have more positive perceptions of my abilities and expectations for success in mathematics than others	0.63158	0.601106704	0.39889	**0.892**	**0.638**
	q56	I enjoy doing mathematics very much. Mathematics is fun to do.	0.6854	0.53022684	0.46977		
	q140	Mathematics encourages me to apply detailed steps to solving my personal Problems	0.6205	0.61497975	0.38502		
	q133	Mathematics improves my understanding of other subjects	0.6418	0.58809276	0.41191		
	q116	I think I will be able to use the mathematics I learn.	0.622	0.613116	0.38688		
	q76	I have always been successful with math.	0.58	0.6636	0.3364		
	q144	I do extra work to learn Mathematics	0.4817	0.76796511	0.23203		
	q121	Understanding mathematics is very important to me.	0.5817	0.66162511	0.33837		

		Sum	**7.65328**	**7.061780714**	**7.65328**		
Anxiety	q95	I start to feel stressed-out as soon as I begin my math work.	0.9	0.19	0.81		
	q96	My mind goes blank and I am unable to think clearly when doing math work.	0.7	0.51	0.49	**0.785**	**0.65**
		Sum	**1.6**	**0.7**	**1.3**		
Achievement Goal	q10	I try very hard to understand as deep as possible in mathematics subject matter.	0.74468	0.445451698	0.55455		
	q9	My goal is to learn mathematics as much as I can	0.71724	0.485566782	0.51443		
	q7	My goal is to fully understand the mathematics contents taught in class	0.6369	0.59435839	0.40564	**0.791**	**0.331**
	q26	My goal is to avoid learning less in mathematics than what it should be	0.49497	0.755007669	0.24499		
	q38	My goal is to avoid getting negative feedback concerning mathematics	0.47553	0.773871219	0.22613		
	q35	I try hard to avoid producing worse work than others concerning mathematics.	0.41213	0.83015216	0.16985		
	q82	When I see how my math teacher solves a problem, I can picture myself solving the problem in the same way.	0.55808	0.688552294	0.31145		
	q81	Seeing adults do well in my math pushes me to do better.	0.4674	0.78153724	0.21846		
		Sum	**4.50692**	**5.354497453**	**2.6455**		

Accordingly items which are by far less than .7 loading were needed to be suppressed from the list. Hair et al. (2011) also indicate that weaker indicators can be sometimes retained on the basis of their contribution to content validity. Hair et al. (2011) suggests that variables with very low loadings (i.e., ≤ 0.4) should be removed. Thus all items satisfying standard load greater than .4 are considered to be reliable and were included to the item list is supposed to be deleted.

4.2. 3.3 Test of Validity

Raykov and Marcoulides (2011) stated that Scale validity is the extent to which "an instrument indeed measures the latent dimension or construct it was developed to evaluate". The validity of an instrument can be examined in numerous ways; the most common tests of validity are content validity (described in Step 2), which can be done prior to the instrument being administered to the target population, and criterion (predictive and concurrent) and construct validity (convergent, discriminant, differentiation by known groups, correlations), which occurs after survey administration.

4.2.3. 3. 1 **Criterion Validity**

Criterion validity is the "degree to which there is a relationship between a given test score and performance on another measure of particular relevance, typically referred to as criterion" (Raykov and Marcoulides, 2011).There is two forms of criterion validity: predictive (criterion) validity and concurrent (criterion) validity.

4.2.3.3.1.1 Predictive Validity

Predictive validity is "the extent to which a measure predicts the answers to some other question or a result to which it ought to be related with" (Fowler, 1995). Thus, the scale should be able to predict a behavior in the future. Predictive validity can be estimated by examining the association between the scale scores and the criterion in question. In this study the criterion validity was kept by relating the results with other researches. The items found to be predictive in similar manner that was presented in different literatures.

4.2.3.3. 1.2 Concurrent Validity

Concurrent criterion validity is the extent to which test scores have a stronger relationship with criterion (gold standard) measurement made at the time of test administration or shortly afterward (Raykov and Marcoulides, 2011). This can be estimated using Pearson product moment correlation or latent variable modeling.

A limitation of concurrent validity is that this strategy for validity does not work with small sample sizes because of their large sampling errors. Secondly, appropriate criterion variables or "gold standards" may not be available (Raykov and Marcoulides, 2011). This reason may account for its omission in most validation studies. Nothing was done in this study to the concurrent validity because of lack of gold standards.

4.2.3.3.2 Construct Validity

Construct validity is the "extent to which an instrument assesses a construct of concern and is associated with evidence that measures other constructs in that domain and measures specific real-world criteria" (Raykov and Marcoulides, 2011). Four indicators of construct validity are relevant to scale development: convergent validity, discriminant validity, differentiation by known groups, and correlation analysis. Construct reliability assessment allows the evaluation of the extent to which a variable or set of variables is consistent in what it intends to measure (Straub, Boudreau, & Gefen, 2004). As the construct validity is the aggregate of convergent and discriminant validity, the construct validity in this study was assessed in terms of convergent and discriminant validity as presented in 4.2.3.3.2.1 and 4.2.3.3.2.2.

4.2.3.3.2.1 Convergent validity

Convergent validity is the extent to which a construct measured in different ways yields similar results. Specifically, it is the "degree to which scores on a studied instrument are related to measures of other constructs that can be expected on theoretical grounds to be close to the one tapped into by this instrument" (Raykov and Marcoulides, 2011). This is best estimated through the multi-trait multi-method matrix (Raykov and Marcoulides, 2011), although in some cases researchers have used either latent variable modeling or Pearson product-moment correlation based on Fisher's Z transformation. Evidence of convergent validity of a construct can be provided by the extent to which the newly developed scale correlates highly with other variables designed to measure

the same construct (Raykov and Marcoulides, 2011). It can be invalidated by too low or weak correlations with other tests which are intended to measure the same construct. Convergent validity implies that "a set of indicators represents one and the same underlying construct, which can be demonstrated through their unidimensionality" (Henseler et al., 2009). Convergent validity is usually assessed by the average variance extracted (AVE) (Fornell & Larcker 1981). In this study, manual computation by using Microsoft Excel gives the average Variance extracted to be 0.638 for Self concept, 0.65 for Anxiety, and 0.331 for Achievement goal , all are considerabliy near 0.5 and hence acceptable. Thus we conclude that the convergent validity was achieved. (see table 4.16).

4.3.3.2.2 Discriminant validity

Discriminant validity is the extent to which a measure is novel and not simply a reflection of some other construct (Churchill, 1979; Raykov and Marcoulides, 2011). Specifically, it is the "degree to which scores on a studied instrument are differentiated from behavioral manifestations of other constructs, which on theoretical grounds can be expected not to be related to the construct underlying the instrument under investigation" (Raykov and Marcoulides, 2011). This is best estimated through the multi-trait multi method matrix (Raykov and Marcoulides, 2011). Discriminant validity is indicated by predictably low or weak correlations between the measure of interest and other measures that are supposedly not measuring the same variable or concept (Churchill, 1979). The newly developed construct can be invalidated by too high correlations with other tests which are intended to differ in their measurements (Campbell and Fiske, 1959). This approach is critical in differentiating the newly developed construct from other rival alternatives (Messick, 1995). Differentiation or comparison between known groups examines the distribution of a newly developed scale score over known binary items (Churchill, 1979).

The discriminant validity indicates the extent to which a given construct differs from other constructs. There are two approaches to assess discriminant validity; Fornell and Larcker (1981) suggest that the AVE should be greater than the variance between the construct and other constructs in the model (i.e., the squared correlation between two constructs). With the aim of facilitating this assessment, the square root of the AVE of each latent variable should be greater than its correlations with any other LV. On the other hand, the second approach suggests that no item should load more highly on another construct than it does on the construct it intends to measure (Barclay et al. 1995). In addition, each construct should load higher with its assigned indicators than other items. This

cross-loadings analysis is carried out calculating the correlations between the constructs' scores and the standardized data of indicators (Gefen & Straub, 2005).

For this study, we observe that no item highly loads to other sub-constructs (see table 4.6: The rotated component matrix). Moreover, the AVE for each sub-construct is greater than the maximum of the squared correlation between the sub-construct and other sub-constructs indicating acceptable discriminant validity. That is the square of the maximum of the correlation between the sub constructs at table 4.7, which is $(.493)^2 = .2430$, is less than each of the value of AVE at table 4.16. Hence the discriminant validity is obeyed.

In this regard we obtain the following valid MLM scale:

Self-Concept:

q125 I feel esteem for myself (dignity, achievement, mastery, independence) in math subject.

q135 I am good at Mathematics as a subject

q57 I would describe mathematics as very interesting.

q154 I believe that I have better mathematical Proficiency.

q149 I have more positive perceptions of my abilities and expectations for success in mathematics than others

q56 I enjoy doing mathematics very much. Mathematics is fun to do.

q140 Mathematics encourages me to apply detailed steps to solving my personal Problems

q133 Mathematics improves my understanding of other subjects

q116 I think I will be able to use the mathematics I learn.

q76 I have always been successful with math.

q144 I do extra work to learn Mathematics

q121 Understanding mathematics is very important to me.

Anxiety:

q95 I start to feel stressed-out as soon as I begin my math work.

q96 My mind goes blank and I am unable to think clearly when doing math work.

Achievement-Goal

q10 I try very hard to understand as deep as possible in mathematics subject matter.

q9 My goal is to learn mathematics as much as I can

q7 My goal is to fully understand the mathematics contents taught in class

q26 My goal is to avoid learning less in mathematics than what it should be

q38 My goal is to avoid getting negative feedback concerning mathematics

q35 I try hard to avoid producing worse work than others concerning mathematics.

q82 When I see how my math teacher solves a problem, I can picture myself solving the problem in the same way.

q81 Seeing adults do well in my math pushes me to do better.

4. 3 Mathematics Achievement Test (MAT)

31 multiple choice type achievement test were administered (see appendix-7.1). Nine experts were participated in reviewing this test. The experts were from the field of measurement and evaluation, Psychology, and Mathematics. Three experts were Psychometric experts, three experts were from Mathematics field and the remaining three were psychology experts. The reason to combine these experts from the three fields was to get the Psychometric experts as well as expert who have know-how on mathematical and psychological constructs. To analyze the discrimination index of items: the experts' review, cognitive interview, item characteristic curve(ICC), test information curve, difficulty and discrimination indices by using the application of IRT were used.

Accordingly, the nine experts in this study were asked to rate each item as either 1=Very weakly represents the Construct, 2= somewhat weakly represents the Construct, 3= Unsure, 4= Somewhat Strongly represents the Construct, 5= Very strongly represents the Construct. All the 31 Items have

acceptable level of content validity index with respect to the nine experts. (see Appendix 7.2 and 7.3). Five students who were taken the test were asked to determine items with confusing meaning and which needs modification and deletion. Students were responded that there is no such item whose meanings are not match with the intended meaning to measure the construct and which are confusing. Thus the cognitive interview result indicated that all the 31 items have to be retained. Two parameter IRT model was employed to determine items' difficulty and discrimination indices. The result indicate that all items except five items, item1, item3, item 5, item7, item19, and 1tem23, have acceptable degree of discrimination and difficulty indices. Thus only 25 items, namely: item2, item4, item6, item8, item9, item10, item11, item12, item13, item14, item15, item16, item17, item18, item20, item21, item22, item24, item25, item26, item27, item28, item29, item30, and item31 are retained for final data collection. (See table 1 in Appendix 7).

From the TCC we observe that individuals with any type of trait level can answer the questions correctly. (See Fig 1 in the IRT study at appendix 7)

The test information function curve is useful for illustrating the degree to which a test provides different quality of information at different trait levels. Since the curve was bell shaped, as depicted in Fig 2 in the IRT study at appendix 7, indicate that the test was differentiating well among people with different trait level. Accordingly, 25 items were retained to collect reliable data on mathematics achievement test. (See Appendix 7.4).

Objective 2: To observe whether there is a multivariate main (interaction) effect Mathematics Learning Motivation on Academic Achievement in undergraduate students in Public Universities of Ethiopia.

Multiple analysis of Covariance (MANCOVA) was applied to observe whether there is main effect of mathematics learning motivation on mathematics achievement as well as academic achievement. The interaction effect of MLM on Mathematics achievement and academic achievement was also depicted by the same analysis. The reason to use MANCOVA was to control different possible extraneous factors which might affect the result. Thus these possible confounding factors were purposively included in the analysis and took their own share in the analysis as covariates. Since covariates stand for a source of disparity that cannot been controlled in the research and assumed to have an effect on the dependent variable, the intend of MANCOVA is to eliminate the sound effects of such uncontrolled variation, in order to boost statistical power and to make certain and correct measurement of the factual relationship between the independent and dependent variables. These confounding variables include: Gender, university, college, year, Parental Education, Parental

Employment status, and Parental profession in science. The main MLM factors other than the aforementioned confounding variables are Self-Concept, Achievement-Goal and Anxiety are the fixed factors. The assumption of MANCOVA was also checked. (See Appendix 9)

Table 4.17 Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[d]
Intercept	Pillai's Trace	.000	.[b]	.000	.000	.	.	.	.
	Wilks' Lambda	1.000	.[b]	.000	24.500	.	.	.	.
	Hotelling's Trace	.000	.[b]	.000	2.000	.	.	.	.
	Roy's Largest Root	.000	.000[b]	2.000	23.000	1.000	.000	.000	.050
Age	Pillai's Trace	.000	.[b]	.000	.000	.	.	.	.
	Wilks' Lambda	1.000	.[b]	.000	24.500	.	.	.	.
	Hotelling's Trace	.000	.[b]	.000	2.000	.	.	.	.
	Roy's Largest Root	.000	.000[b]	2.000	23.000	1.000	.000	.000	.050
University	Pillai's Trace	.343	6.251[b]	2.000	24.000	.007	.343	12.503	.853
	Wilks' Lambda	.657	6.251[b]	2.000	24.000	.007	.343	12.503	.853
	Hotelling's Trace	.521	6.251[b]	2.000	24.000	.007	.343	12.503	.853
	Roy's Largest Root	.521	6.251[b]	2.000	24.000	.007	.343	12.503	.853
College	Pillai's Trace	.533	13.678[b]	2.000	24.000	.000	.533	27.356	.995
	Wilks' Lambda	.467	13.678[b]	2.000	24.000	.000	.533	27.356	.995
	Hotelling's Trace	1.140	13.678[b]	2.000	24.000	.000	.533	27.356	.995
	Roy's Largest Root	1.140	13.678[b]	2.000	24.000	.000	.533	27.356	.995
Year	Pillai's Trace	.229	3.573[b]	2.000	24.000	.044	.229	7.146	.606
	Wilks' Lambda	.771	3.573[b]	2.000	24.000	.044	.229	7.146	.606
	Hotelling's Trace	.298	3.573[b]	2.000	24.000	.044	.229	7.146	.606
	Roy's Largest Root	.298	3.573[b]	2.000	24.000	.044	.229	7.146	.606
Mother_Education	Pillai's Trace	.226	3.495[b]	2.000	24.000	.047	.226	6.989	.596
	Wilks' Lambda	.774	3.495[b]	2.000	24.000	.047	.226	6.989	.596
	Hotelling's Trace	.291	3.495[b]	2.000	24.000	.047	.226	6.989	.596
	Roy's Largest Root	.291	3.495[b]	2.000	24.000	.047	.226	6.989	.596
Father_Education	Pillai's Trace	.480	11.089[b]	2.000	24.000	.000	.480	22.179	.983
	Wilks' Lambda	.520	11.089[b]	2.000	24.000	.000	.480	22.179	.983
	Hotelling's Trace	.924	11.089[b]	2.000	24.000	.000	.480	22.179	.983
	Roy's Largest Root	.924	11.089[b]	2.000	24.000	.000	.480	22.179	.983
Father_Employement	Pillai's Trace	.268	4.404[b]	2.000	24.000	.023	.268	8.808	.703
	Wilks' Lambda	.732	4.404[b]	2.000	24.000	.023	.268	8.808	.703
	Hotelling's Trace	.367	4.404[b]	2.000	24.000	.023	.268	8.808	.703
	Roy's Largest Root	.367	4.404[b]	2.000	24.000	.023	.268	8.808	.703

Mother_Employment	Pillai's Trace	.067	.861[b]	2.000	24.000	.435	.067	1.723	.180
	Wilks' Lambda	.933	.861[b]	2.000	24.000	.435	.067	1.723	.180
	Hotelling's Trace	.072	.861[b]	2.000	24.000	.435	.067	1.723	.180
	Roy's Largest Root	.072	.861[b]	2.000	24.000	.435	.067	1.723	.180
Mother_Pofession_in_Science	Pillai's Trace	.509	12.435[b]	2.000	24.000	.000	.509	24.871	.991
	Wilks' Lambda	.491	12.435[b]	2.000	24.000	.000	.509	24.871	.991
	Hotelling's Trace	1.036	12.435[b]	2.000	24.000	.000	.509	24.871	.991
	Roy's Largest Root	1.036	12.435[b]	2.000	24.000	.000	.509	24.871	.991
Father_Profession_in_Science	Pillai's Trace	.306	5.285[b]	2.000	24.000	.013	.306	10.570	.785
	Wilks' Lambda	.694	5.285[b]	2.000	24.000	.013	.306	10.570	.785
	Hotelling's Trace	.440	5.285[b]	2.000	24.000	.013	.306	10.570	.785
	Roy's Largest Root	.440	5.285[b]	2.000	24.000	.013	.306	10.570	.785
Self_Concept	Pillai's Trace	1.500	1.827	82.000	50.000	.011	.750	149.804	.997
	Wilks' Lambda	.037	2.450[b]	82.000	48.000	.001	.807	200.895	1.000
	Hotelling's Trace	11.457	3.214	82.000	46.000	.000	.851	263.510	1.000
	Roy's Largest Root	10.016	6.107[c]	41.000	25.000	.000	.909	250.406	1.000
Achievement_Goal	Pillai's Trace	1.337	1.869	54.000	50.000	.013	.669	100.929	.993
	Wilks' Lambda	.098	1.949[b]	54.000	48.000	.010	.687	105.255	.994
	Hotelling's Trace	4.754	2.025	54.000	46.000	.008	.704	109.347	.995
	Roy's Largest Root	3.477	3.220[c]	27.000	25.000	.002	.777	86.937	.993
Anxiety	Pillai's Trace	.795	2.062	16.000	50.000	.026	.398	32.991	.924
	Wilks' Lambda	.297	2.506[b]	16.000	48.000	.007	.455	40.103	.969
	Hotelling's Trace	2.060	2.961	16.000	46.000	.002	.507	47.369	.988
	Roy's Largest Root	1.896	5.926[c]	8.000	25.000	.000	.655	47.407	.997
Self_Concept * Achievement_Goal	Pillai's Trace	1.661	1.549	158.00	50.000	.037	.830	244.798	.996
	Wilks' Lambda	.021	1.799[b]	158.00	48.000	.010	.856	284.225	.999
	Hotelling's Trace	14.250	2.074	158.00	46.000	.002	.877	327.755	1.000
	Roy's Largest Root	11.381	3.602[c]	79.000	25.000	.000	.919	284.523	1.000
Self_Concept * Anxiety	Pillai's Trace	1.284	1.495	60.000	50.000	.073	.642	89.719	.972
	Wilks' Lambda	.105	1.670[b]	60.000	48.000	.034	.676	100.212	.985
	Hotelling's Trace	4.824	1.849	60.000	46.000	.016	.707	110.948	.992
	Roy's Largest Root	3.863	3.220[c]	30.000	25.000	.002	.794	96.587	.995
Achievement_Goal * Anxiety	Pillai's Trace	1.023	2.180	24.000	50.000	.010	.511	52.312	.978
	Wilks' Lambda	.228	2.189[b]	24.000	48.000	.010	.523	52.528	.977
	Hotelling's Trace	2.287	2.192	24.000	46.000	.011	.533	52.603	.976
	Roy's Largest Root	1.600	3.334[c]	12.000	25.000	.005	.615	40.007	.962

a. Design: Intercept + Age + University + College + Year + Mother_Education + Father_Education + Father_Employement + Mother_Employment + Mother_Pofession_in_Science + Father_Profession_in_Science + Self_Concept + Achievement_Goal + Anxiety + Self_Concept * Achievement_Goal + Self_Concept * Anxiety + Achievement_Goal * Anxiety + Self_Concept * Achievement_Goal * Anxiety

b. Exact statistic

c. The statistic is an upper bound on F that yields a lower bound on the significance level.

d. Computed using alpha = .05

From table 4.17 we observe that:

Concerning the covariates, based on Roy's Largest Root, the university (Θ = .521, F (2, 24) = 6.251, p =.007< .05, partial eta squared = .343. Power to detect the effect was .853); the college (Θ = 1.140, F (2, 24) = 13.678, p =.000< .05, partial eta squared = .533. Power to detect the effect was .995); Students' year (Θ = .298, F (2, 24) = 3.573, p =.044< .05, partial eta squared = .229. Power to detect the effect was .606); Mother's Education (Θ = .291, F (2, 24) = 3.495, p =.047< .05, partial eta squared = .226. Power to detect the effect was .596); Father's Education (Θ = .924, F (2, 24) = 11.089, p =.000< .05, partial eta squared = .480. Power to detect the effect was .983); Father's Employment (Θ = .367, F (2, 24) = 4.404, p =.023< .05, partial eta squared = .268. Power to detect the effect was .703); Mather's Profession in science (Θ = 1.036, F (2, 24) = 12.435, p =.000< .05, partial eta squared = .509. Power to detect the effect was .991); Father's Education in science (Θ = .440, F (2, 24) = 5.285, p =.013< .05, partial eta squared = .306. Power to detect the effect was .785) are significant covariates.

According to Roy's Largest Root, the fixed factors namely:

Mathematics Self- concept has a significant main effect (Θ = 10.016, F (41, 25) = 6.107, p =.000< .05, partial eta squared = .909) on math and other academic achievement Undergraduate university students in Ethiopia. Power to detect the effect was 1.000); Mathematics Achievement Goal has a significant main effect (Θ = 3.477, F (27, 25) = 3.220, p =.002< .05, partial eta squared = .777. Power to detect the effect was .993) on math and other academic achievement undergraduate university students in Ethiopia; Mathematics Anxiety has a significant main effect (Θ = 1.896, F (8, 25) = 5.926, p =.000< .05, partial eta squared = .655. Power to detect the effect was .997) on math and other academic achievement of undergraduate university students in Ethiopia.

Moreover, based on Roy's Largest Root, the interaction of:

Math self-concept and math Achievement Goal has significant interaction effect (Θ = 11.381, F(79, 25) = 3.60, p =.000< .05, partial eta squared = .919, Power to detect the effect was 1.000) on math and other academic achievement of undergraduate university students in Ethiopia; Math self-concept and Anxiety has significant interaction effect (Θ = 3.863, F(30, 25) = 3.220, p =.002< .05, partial eta squared = .794, Power to detect the effect was .995) on math and other academic achievement of undergraduate university students in Ethiopia; Math Achievement Goal and Anxiety has significant interaction effect (Θ = 1.600, F(30, 25) = 3.334, p =.005< .05, partial eta squared = .615, Power to

detect the effect was .962) on math and other academic achievement of undergraduate university students in Ethiopia;

Table 4.18 Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Corrected Model	Math_Achievement	15242.502[a]	374	40.755	4.944	.000	.987	1848.957	1.000
	Academic_Acheievement	145.005[b]	374	.388	1.601	.078	.960	598.861	.944
Intercept	Math_Achievement	.000	0	.	.	.	.000	.000	.
	Academic_Acheievement	.000	0	.	.	.	.000	.000	.
Age	Math_Achievement	.000	0	.	.	.	.000	.000	.
	Academic_Acheievement	.000	0	.	.	.	.000	.000	.
University	Math_Achievement	90.705	1	90.705	11.003	.003	.306	11.003	.890
	Academic_Acheievement	.004	1	.004	.016	.900	.001	.016	.052
College	Math_Achievement	232.493	1	232.493	28.202	.000	.530	28.202	.999
	Academic_Acheievement	1.835	1	1.835	7.577	.011	.233	7.577	.754
Year	Math_Achievement	60.063	1	60.063	7.286	.012	.226	7.286	.737
	Academic_Acheievement	.151	1	.151	.624	.437	.024	.624	.118
Mother_Education	Math_Achievement	54.637	1	54.637	6.628	.016	.210	6.628	.697
	Academic_Acheievement	.032	1	.032	.134	.718	.005	.134	.064
Father_Education	Math_Achievement	183.550	1	183.550	22.265	.000	.471	22.265	.995
	Academic_Acheievement	.338	1	.338	1.397	.248	.053	1.397	.206
Father_Employement	Math_Achievement	50.482	1	50.482	6.124	.020	.197	6.124	.662
	Academic_Acheievement	.067	1	.067	.277	.603	.011	.277	.080
Mother_Employment	Math_Achievement	11.606	1	11.606	1.408	.247	.053	1.408	.207
	Academic_Acheievement	.276	1	.276	1.140	.296	.044	1.140	.177
Mother_Pofession_in_Science	Math_Achievement	211.364	1	211.364	25.639	.000	.506	25.639	.998
	Academic_Acheievement	1.669	1	1.669	6.893	.015	.216	6.893	.713
Father_Profession_in_Science	Math_Achievement	90.749	1	90.749	11.008	.003	.306	11.008	.890
	Academic_Acheievement	.510	1	.510	2.107	.159	.078	2.107	.287
Self_Concept	Math_Achievement	2034.126	41	49.613	6.018	.000	.908	246.745	1.000
	Academic_Acheievement	13.522	41	.330	1.362	.208	.691	55.844	.774
Achievement_Goal	Math_Achievement	686.332	27	25.420	3.083	.003	.769	83.254	.990
	Academic_Acheievement	8.148	27	.302	1.246	.291	.574	33.650	.667

Anxiety	Math_Achievement	383.580	8	47.947	5.816	.000	.650	46.529	.996
	Academic_Acheievement	4.166	8	.521	2.151	.069	.408	17.207	.723
Self_Concept * Achievement_Goal	Math_Achievement	2270.091	79	28.735	3.486	.000	.917	275.368	1.000
	Academic_Acheievement	20.072	79	.254	1.049	.464	.768	82.896	.687
Self_Concept * Anxiety	Math_Achievement	794.154	30	26.472	3.211	.002	.794	96.333	.995
	Academic_Acheievement	8.242	30	.275	1.135	.377	.577	34.040	.629
Achievement_Goal * Anxiety	Math_Achievement	327.055	12	27.255	3.306	.006	.613	39.673	.960
	Academic_Acheievement	4.701	12	.392	1.618	.150	.437	19.414	.663

a. R Squared = .987 (Adjusted R Squared = .787)

b. R Squared = .960 (Adjusted R Squared = .360)

c. Computed using alpha = .05

As depicted in table 4.18, the covarites and the fixed factors indicate their corresponding effect on each of the dependent variable, namely math achievement and academic achievement.

In this regards, univariate main effect and interaction effect were examined.

There is significant univariate main effects for self-concept were obtained for Mathematics Achievement, F (41, 25) = 6.018, p=*.000* <.015, partial eta square =.908, power = 1.000; but there is no significant univariate main effects for self-concept were obtained for Academic Achievement, F (41, 25) = 1.362, p=.208 >.015, partial eta square =.691, power = .774.

There is significant univariate main effects for Achievement_Goal were obtained for Mathematics Achievement, F (27, 25) = 3.083, p=.003<.015, partial eta square .769, power = .990; but there is no significant univariate main effects for Achievement_Goal were obtained for Academic Achievement, F (27, 25) = 1.246, p=.291 >.015, partial eta square =.574, power = .667.

There is significant univariate main effects for Anxiety were obtained for Mathematics Achievement, F (8, 25) = 5.816, p=.000<.015, partial eta square .650, power = .996; but there is no significant univariate main effects for Anxiety were obtained for Academic Achievement, F (8, 25) = 2.151, p=.069 >.015, partial eta square =.408, power = .723.

There is significant univariate interaction effects for self concept and Achievement_Goal were obtained for Mathematics Achievement, F (49, 25) = 3.486, p=.000<.015, partial eta square .917, power = 1.000; but there is no significant univariate interaction effects for concept and Achievement_Goal were obtained for Academic Achievement, F (49, 25) = 1.049 , p=.464>.015, partial eta square =.768, power = .687.

There is significant univariate interaction effects for self concept and anxiety were obtained for Mathematics Achievement, F (30, 25) = 3.211, p=.002<.015 , partial eta square .794, power = .995; but there is no significant univariate interaction effects for concept and anxiety were obtained for Academic Achievement, F (30, 25) = 1.135 , p=.377>.015 , partial eta square =.577, power = .629.

There is significant univariate interaction effects for Achievement_Goal and anxiety were obtained for Mathematics Achievement, F (12, 25) = 3.306, p=.006<.015 , partial eta square .613, power = .960; but there is no significant univariate interaction effects for Achievement_Goal and anxiety were obtained for Academic Achievement, F (12, 25) = 1.618, p=.150>.015 , partial eta square =.437, power = .663.

Objective 3: to observe the relationship between Mathematics Learning Motivation and Students' Achievement in the case of undergraduate students in Ethiopian Public Universities.

Case1: the relationship between Mathematics Learning Motivation and Students' Mathematics Achievement in the case of undergraduate students in Ethiopian Public Universities

We observe from Figure 4 and table 4.2 that students' mathematics Self concept is a significant (β =.31, P=.000 <.05) predictor of their mathematics achievement; Mathematics Anxiety is also a significant (β =-.218, p=.000 <.05) predictor of their mathematics achievement; whereas students' mathematics Achievement goal is not a significant (β =.062, p=.347 >.05) predictor of their mathematics achievement.

Case2: the relationship between Mathematics Learning Motivation and Students' Academic Achievement in the case of undergraduate students in Ethiopian Public Universities

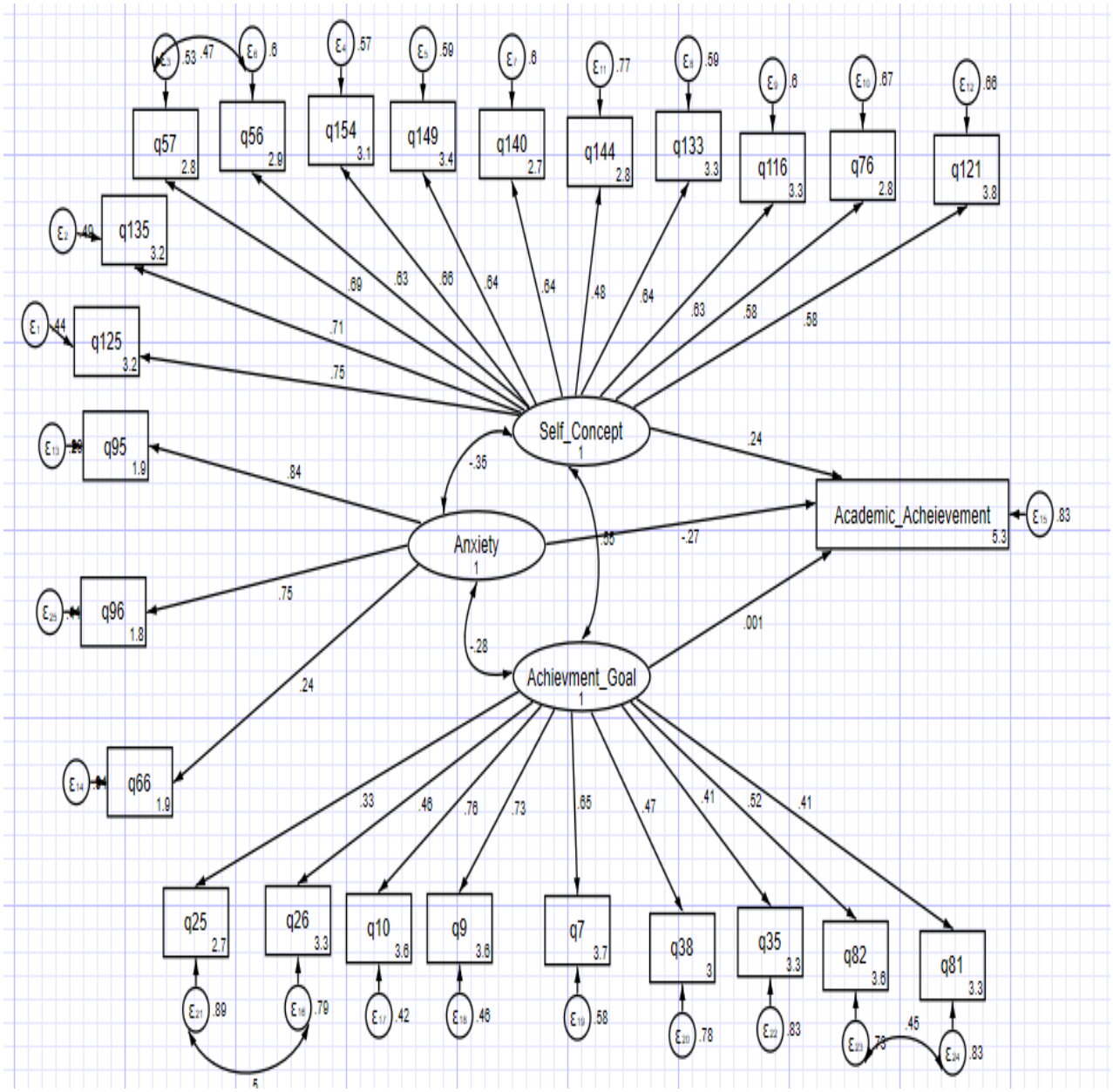


Fig 8: Fully fledged model with respect to Academic achievement

Fig. 8 represents the relationship of each MLM predictors with mathematics achievement. We observe from the figure that anxiety has negative relationship where as achievement goal and self-concept has positive relationship with the academic achievement.

Table 4.19 MLM with respect to Academic Achievement

Standardized	Coef.	Std. Err.	Z	P>|z|	[95% Conf. Interval]

Academic_Acheievement						
Self_Concept	.2372902	.0522809	4.54	0.000	.1348216	.3397589
Achievment_Goal	.0010348	.0025462	0.41	0.684	-.0039557	.0060253
Anxiety	-.2687052	.0549431	-4.89	0.000	-.3763917	-.1610187
_cons	5.310231	.1942889	27.33	0.000	4.929432	5.69103

We observe from table 4.19 that students' mathematics Self concept is a significant (β =.237, P=.000 <.05) predictor of their academic achievement; Mathematics Anxiety is also a significant (β =-.269, p=.000 <.05) predictor of their academic achievement; whereas students' mathematics Achievement Goal is not a significant (β =.001, p=.684 >.05) predictor of their academic achievement.

Objective 4: to identify the motivational factors dominantly affect the achievement of undergraduate students of Ethiopian Public Universities.

We observe from table 4.13 that mathematics achievement can be expressed as a linear combination of mathematics self- concept, mathematics anxiety, and mathematics achievement goal as:

Math Achievement = .31Self-concept -.218 Anxiety +.062 Achievement-goal

This indicate that the predictor variable self-concept contribute higher than that of mathematics Anxiety and Achievement-goal do; Mathematics anxiety is the next higher and Achievement-goal is the least.

That is one standard deviation change(increase or decrease) in self-concept results in .31 standard deviation changes(increase or decrease) in math achievement assuming math anxiety and Achievement-goal remain unchanged; one standard deviation increase(decrease) in math anxiety results in .218 standard deviation decreases(increase) in math achievement assuming the self-concept and Achievement-goal remain unchanged; and one standard deviation change (increase or decrease) in Achievement-goal results in .062 standard deviation change(increase or decrease) in math achievement assuming the self-concept and Anxiety remain unchanged.

Similarly we observe from table 4.19 that mathematics achievement can be expressed as a linear combination of mathematics self- concept, mathematics anxiety, and mathematics achievement goal as:

Academic Achievement = .237Self-concept -.269 Anxiety _.001 Achievement-goal

This indicate that the predictor variable Math anxiety contributes higher than that of mathematics Self-concept and Achievement-goal do; Mathematics self-concept is the next higher and Achievement-goal is the least.

That is one standard deviation change(increase or decrease) in self-concept results in .237 standard deviation changes(increase or decrease) in Academic Achievement assuming math anxiety and Achievement-goal remain unchanged; one standard deviation increase(decrease) in math anxiety results in .269 standard deviation decreases(increase) in Academic Achievement assuming the self-concept and Achievement-goal remain unchanged; and one standard deviation change (increase or decrease) in Achievement-goal results in .001 standard deviation change(increase or decrease) in Academic Achievement assuming the self-concept and Anxiety remain unchanged.

Objective 5: to foresee the effect of mathematics achievement on academic achievement in the case of undergraduate public university students of Ethiopia, controlling possible confounding variables

Univariate analysis of covariance (ANCOVA) was employed to test the effect of mathematics achievement on the academic achievement. In this regard students parental back ground, university, year or stay in university, age, and gender were considered as covariates which stand for a source of disparity that cannot be controlled in the research. Analysis of covariance minimizes this disparity.

Table 4.20 Tests of Between-Subjects Effects

Dependent Variable: Academic_Acheievement

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	81.119[a]	35	2.318	12.062	.000
Intercept	.000	0	.	.	.
Gender	3.600E-5	1	3.600E-5	.000	.989
Age	.000	0	.	.	.
University	1.587	1	1.587	8.260	.004
College	2.037	1	2.037	10.603	.001
Year	2.894	1	2.894	15.061	.000
Mother_Education	.411	1	.411	2.138	.145
Father_Education	.014	1	.014	.075	.784
Father_Employement	1.416	1	1.416	7.369	.007
Mother_Employment	.036	1	.036	.189	.664
Mother_Pofession_in_Science	.239	1	.239	1.246	.265
Father_Profession_in_Science	.531	1	.531	2.764	.097
Math_Achievement	48.874	25	1.955	10.175	.000

Error	69.940	364	.192
Total	4410.709	400	
Corrected Total	151.059	399	

a. R Squared = .537 (Adjusted R Squared = .492)

As depicted in table 4.20, by controlling different confounding variables, namely: the age, the university, the gender, the year and parental background, we detect that there is significant effect of students' mathematics achievement ($p= .000<.05$) on their academic achievement.

Chapter 5: DISCUSSION

The result of this study proveds the following MLM instrument:

English Version MLM items:

Self-Concept:

q125 I feel esteem for myself (dignity, achievement, mastery, independence) in math subject.

q135 I am good at Mathematics as a subject

q57 I would describe mathematics as very interesting.

q154 I believe that I have better mathematical Proficiency.

q149 I have more positive perceptions of my abilities and expectations for success in mathematics than others

q56 I enjoy doing mathematics very much. Mathematics is fun to do.

q140 Mathematics encourages me to apply detailed steps to solving my personal Problems

q133 Mathematics improves my understanding of other subjects

q116 I think I will be able to use the mathematics I learn.

q76 I have always been successful with math.

q144 I do extra work to learn Mathematics

q121 Understanding mathematics is very important to me.

Anxiety:

q95 I start to feel stressed-out as soon as I begin my math work.

q96 My mind goes blank and I am unable to think clearly when doing math work.

Achievement-Goal

q10 I try very hard to understand as deep as possible in mathematics subject matter.

q9 My goal is to learn mathematics as much as I can

q7 My goal is to fully understand the mathematics contents taught in class

q26 My goal is to avoid learning less in mathematics than what it should be

q38 My goal is to avoid getting negative feedback concerning mathematics

q35 I try hard to avoid producing worse work than others concerning mathematics.

q82 When I see how my math teacher solves a problem, I can picture myself solving the problem in the same way.

q81 Seeing adults do well in my math pushes me to do better.

Amharic Version MLM items:

ለራስ ያለ ግምት

q125 በሂሳብ ትምህርት ባለኝ ችሎታ በራስ መተማመን ይሰማኛል

q135 በሂሳብ ትምህርት ጥሩ ነኝ

q57 ሂሳብ በጣም አስደሳች እንደሆነ እገልጻለሁ

q154 በሂሳብ የተሻለ ብቃት እንዳለኝ አምናለሁ

q149 በሂሳብ ትምህርት ስኬታማነትና በችሎታዬ ላይ አዎንታዊ ግንዛቤ አለኝ

q56 የሂሳብን መልመጃ መሥራት ያስደስተኛል፤ ሂሳብ ያዝናናኛል

q140 ሂሳብ የግል ችግሮቼን ሰፋ ባለ መንገድ እንድፈታ ይረዳኛል

q133 ሂሳብ ሌሎች ትምህርቶችን እንድረዳ ይረዳኛል

q116 የተማርኩትን ሂሳብ መጠቀም እችላለሁ ብዬ አስባለሁ

q76 በሂሳብ ትምህርት ሁሌም ስኬታማ ነኝ

q144 ሂሳብን ለመማር ተጨማሪ ተግባራትን አከናዉናለሁ

q121 ሂሳብን መረዳት ለእኔ በጣም አስፈላጊ ነዉ

ጭንቀት

q95 ሂሳብ መሥራት ስጀምር መጨነቅ እጀምራለሁ

q96 ሂሳብ መሥራት ስጀምር አዕምሮዬ ባዶ ሆኖ በግልጽ ማሰብ አልችልም

የስኬት ግብ

q 10 የሂሳብ ትምህርትን በተቻለጥ መጠን በጥልቀት ለመረዳት አጠንክሬ እተጋለሁ

q 9 የሂባብን ትምህርት በምችለው እቅም የመማር ዓላማ አለኝ

q 7 በክፍል ዉስጥ የተማርኩትን የሂሳብ ትምህርት ይዘት ሙሉ በሙሉ የመረዳት እቅድ አለኝ

q 26 በሂሳብ ትምህርት ከሚገባኝ በታች ያለመሆን ዓላማ አለኝ

q 38 በሂሳብ ትምህርት አሉታዊ ግብረ-መልስ ያለማግኘት ዓለማ አለኝ

q 35 የሂሳብ ትምህርትን አስመልክቶ ከሌሎች ተማሪዎች የከፋ ላለመሥራት አጠንክሬ እጥራለሁ

q82 የሂሳብ መምህሬ ጥያቄ ሲሠሩ ማየት እኔም በዚያ አኳኋን እንድሠራ ያደርገኛል

q81 ታላላቆቼ በሂሳብ ጠንክሮ ሲሠሩ ማየት እኔም እነሱን አይቼ እንድበረታ ያደርገኛል

There are many similar studies showing supportive results. E.g., Liang(2016) disclose that the improvement of students' self-concept level, their mathematics achievement shows an upward trend. Not only that, positive self-concept is closely related to positive psychological and behavioral outcomes. (Lu et al., 2017) found that students with high self-concepts usually have good self-efficacy, which is an important predictor of self-efficacy. The research of Solomon et al (2017) found that math self-concept can significantly reduce mathematics anxiety and improve the individual emotional experience. As per Kaskens et al (2020), children's math self-concept is a positive predictor of arithmetic fluency , and promoting the self-confidence of young children is essential for their mathematical development.

He & Qi(2018) found a negative correlation between mathematics anxiety and mathematics achievement in primary and secondary school students. The research of Ramirez et al (2016) also showed that mathematics anxiety is not conducive to the development of students' mathematics achievement. As per Cahyawati, Delima,& Gunarto (2023, math anxiety directly affected academic achievement of undergraduate university students. Fan, Hambleton& Zhang (2019) conducted similar study on profiles of mathematics anxiety among age 15-old students and explored profiles of mathematics anxiety (MA) among 15-year old students from Finland, Korea, and the United States to determine the similarities and differences of MA across the three national samples by applying a multi-group latent profile analysis (LPA). The major findings this study indicate three MA profiles were found in all three national samples, i.e., Low MA, Mid MA, and High MA profile, and the percentages of students classified into each of the three MA profiles differed across the Finnish, Korean, and American samples, with United States having the highest prevalence of High MA, and Finland the lowest. Multi-group LPA also provided clear and useful latent profile separation. The High MA profile demonstrated significant poorer mathematics performance and lower mathematics interest, self-efficacy, and self-concept than the Mid and Low MA profiles. Zhang, Zhao, and Kong (2019) conducted a Meta-Analytic Investigation on the Relationship Between Math Anxiety and Math Performance. The results of this study indicate that there is negative mathematics anxiety and performance link. The link was stronger in studies that involved Asian students, but the link was weakest in studies which involve European students. Furthermore, the link was stronger in studies within a senior high school group, where as it was weakest in the studies with in an elementary group.

Klee, Miller, and Buehl (2022) conducted similar study on Mathematics Anxiety, Self-Concept, and Self-Efficacy: A Multidimensional Scaling Consideration of Measure. The result of this study

indicates that low mathematics self-concept and low mathematics self-efficacy often display high mathematics anxiety. Hiller, Kitsantas, and Poulou (2022) also investigated that mathematics specific anxiety and self-efficacy are strong predictors of mathematics performance. The result of a study conducted by Du, Qin, Wang, and Xin (2021) revealed that the reciprocal relations among mathematics interest (MI), mathematics anxiety (MA), mathematics self-efficacy (MSE) and mathematics achievement of primary school students. Arens, Frenzel, and Goetz (2022) suggested that Prior math self-concept was positively related to subsequent math self-efficacy, but prior math self-efficacy was unrelated to subsequent math self-concept. Considering math grades, reciprocal relations could be found for math self-concept. Math self-efficacy and math grades showed a unidirectional relation with former math grades being related to later math self-efficacy. Considering math test scores, reciprocal relations could be found for math self-efficacy. The relation between math test scores and math self-concept was unidirectional, former math test scores being related to later math self-concept. The relations among self-concept, self-efficacy, and the two types of achievement indicators in math did not vary across time waves which covered adolescent years. Gender invariance was demonstrated with regard to the interrelations of math self-concept and math self-efficacy as well as for their relations to both math achievement indicators. The result is also related with Watts et al. T (2014) who pointed out that there is relations between early mathematics knowledge and high school achievement.

4.4 Implication to Education

4.4.1 Theoretical relevance

While previous studies have separately examined the mathematics motivation instruments by using one or two theories, this research bridge the gap by using the linear combination seven theories of motivation. Moreover, the motivation theories were applied in the context of mathematics learning motivation and in the context of Ethiopia which makes this research unique.

As per Kennedy, L. (2019), the association between feelings towards math and learning outcomes is bidirectional. Positive thoughts towards math can show the way to higher achievement, and high achievement can consequence in more favorable position. Students' attitude towards math can have an effect on their on the whole achievement. Value, self-confidence, enjoyment, motivation and anxiety surrounding math are all reflected in a student's attitude. Getting concerned as before time as

possible is the most excellent means to avoid continuing negative attitudes towards math. There are many likely contributors to negative attitudes towards math, including:

- The thought that math is for “smart people.”
- The opinion of math as a “boring” subject.
- A common be deficient in of self-belief in one’s learning abilities.
- Being overwhelmed by complex and tricky math problems.
- An incapability to realize the importance of math in “the real world.”

Math anxiety is a tremendous exemplar of what can take place with a negative attitude towards math. It is a feeling of tension and worry that interferes with a student's ability to solve math problems. Those with math anxiety encompass very negative perceptions about their own ability to be successful in the subject. They often think:

- *I hate math.*
- *I just can’t do math.*
- *I’ll never be good at it, so what’s the point in trying?*

Higher levels of math anxiety lead to reduced enjoyment and motivation, as well as poor performance. Even if a student is capable of solving math problems, anxiety can still impact their enjoyment of math and motivation to learn more. This gets expressed with worse outcomes on math assignments and tests, which can lead to a continuous cycle of math anxiety.

Fig 9 : Math Anxiety cycle of failure (source : Kennedy (2019))

To get better student Motivation and achievement in math, it's important to be aware of the connection between the two.

If a student has a good Motivation towards math, they'll be more disposed to learn, they'll try harder and their performance will be better.

As Haciomeroglu (2013) says: "Anxiety and attitude towards mathematics are important predictors of motivation and educational outcomes related to achievement." What Haciomeroglu (2013) says and the result of this study imply are:

- A student with a positive attitude towards math is more confident when learning math → enjoys math → is motivated to do more → actively engages during math lessons → gets more practice → achieves more.
- A student with higher achievement in math has more confidence in their abilities → sees the value of math → has a positive attitude towards math.

This bidirectional relationship can often result in a cycle of attitudes and achievement feeding into one another. To improve attitudes and/or achievement, you need to break this cycle and create one of positivity!

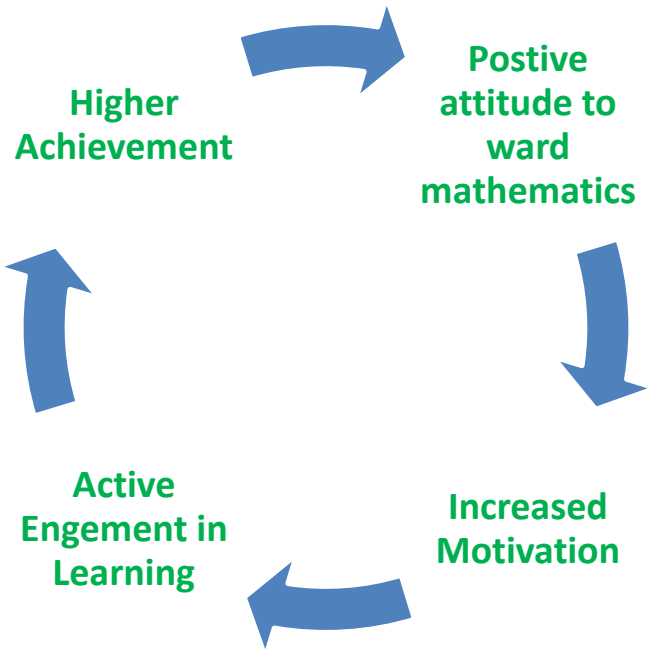


Fig 10: The relationship Attitude toward Math and Achivement (source : Kennedy (2019))

In relation, Kennedy(2019), this dissertation deducts seven theories of mathematics learning motivation to three main theories, namely Achievement goal, self-concept and anxiety constructs of motivation which influences mathematics learning motivation of undergraduate university students in Ethiopia. Thus, this study provides a relevant and unique theoretical combination of constructs in relation to mathematics achievement and academic achievement in the case of Ethiopia.

4.4.2 Practical implications

Beyond theoretical contributions, the study has practical implications for teachers, students, school administrators, parents, researchers, government, curriculum designers and ministry of education. As teachers as the central figures in shaping students' educational experiences (Berkovich and Eyal, 2019; Rezaei et al., 2019; Zadok and Benoliel, 2023), and Since Teachers teaching methods, interpersonal interactions, and individual characteristics contribute to the classroom climate and students' perceptions of their own capabilities (Berkovich and Eyal 2019; Kessler et al., 2019; Aarti and Kadian, 2022), and teachers who create an inclusive and stimulating supportive learning classroom environment often inspire students to perform at their best (Agyemang et al., 2016; Shaninah and Noor, 2023; Zadok and Benoliel, 2023), teachers can use the result of this study to diagnose the level of mathematics learning motivation of students shape students. Researchers can gather information based on the tools validated concerning mathematics learning motivation and can

use this research as a basis or reference for further studies. The study result can give support to Curriculum developers in such a way that they can include Achievement goal, self-concept and anxiety related motivational tasks, activities, exercises and teaching strategies when designing and developing mathematics curriculum; Ministry of education to design policy concerning mathematics learning styles and approaches and motivation strategies; The study helps students, and other stakeholders in such way that they can read use the research result for their own knowledge; They can identify and focus on the dominant factor influencing academic result; they appreciate the multivariate main effect of MLM on academic achievement and the focus on motivational divers; they can be aware of the relationship between academic achievement and mathematic achievement. The result can help educational leaders in such a way that they can plan, control, direct, staff and manage mathematics education as suggested by researcher and use the tools for investigation of motivation.

Chapter 6: CONCLUSION AND RECOMMENDATION

6.1 Conclusion

This is study is conducted on undergraduate university Students in Ethiopia in 2022. The main aim was to develop valid MLM instrument and to check the effect of MLM on academic achievement. The interview was employed to pilot test the instruments validity. Interview was taken place at Bonga University and at Bonga Education College. 9 experts, three from the field of psychology, three from the field of measurement and evaluation, and three from the field mathematics were participated in experts' review of the MLM items and the MAT items. Also 5 respondent students from Bonga University were participated in cognitive interview. These, 5 participants, were discussed on MLM items as well as MAT items being in group and identified those items with ambiguity meanings.

Considerable effort has made to control the cofounding variables which might result in research bias. In this regard, sufficient and representative sample size was considered, appropriate statistical data analysis tool was employed, and appropriate research design, sampling technique were used. Possible psychometric tests were also made to have valid d gathering tools. The primary data were collected by using self-developed- questionnaires, Mathematics achievement test and interviews.

Academic achievement: is a measurable variable which can be measured in terms of achievement test or achievement results obtained from students' current grade report. That is, students reported their commutative grade point average (CGPA) , which was considered to be their academic achievement. Students were also administered Mathematics Achievement Test (MAT) which indicated their mathematics achievement.

Undergraduate students in Addis Ababa, Hawassa and Jimma Universities were the respondents of this study. The first tool was the experts' interview concerning items of Mathematics Learning Motivation (MLM);

Nine experts, three from the psychology field, three from the measurement and evaluation field and three from the mathematics fields were made to fill the content validation form. The Experts were chosen according to their field of study from Bonga Education College and from Bonga University, Ethiopia.

The experts review has been taken place at Bonga University and at Bonga College. Each expert was made to put expert judgment on the domain on the degree of relevant each item to the measured domains based on the definition and relevant terminologies provided to them. 5 students selected from Bonga University were also interviewed to think aloud the entire question in their group and

answer Which item do they think is (are) confusing or misleading about the survey question. The MLM items were adapted from different related surveys and then re-developed in university students' context in Ethiopia. The MLM is a self-report Likert-type scale which was adapted and contextualized from Butler (2016). At first stage 160- items based on different motivation theories was adapted and only 51 items which was validated by experts review and cognitive interview of group debriefing was retained for data collection.

The Mathematics Achievement Test (MAT) was developed by the authors and pilot tested. The items consist of all freshman mathematics contents which are given as common course for first year university students. Primarily 31 items was developed and pilot tested on 150(male= 86, Female=64) university students in Bonga University. The item was analyzed by using Item Response Theory(IRT). The item difficulty and discrimination indices were verified. The item characteristic curve and test information curve were employed. Finally only 25 items which fulfill these psychometric properties were retained for further data collection.

Starting with items anticipated to determine factors related with self-determination, self-concept, self-efficacy, achievement goal theory, attribution, and expectancy-value, I carried out an investigation for a joint MLM tool in the context of Ethiopia. There were Factors which were removed as the result showed that the associated construct was not well represented. In this regard I suppressed items as evidence suggested they were not the best representatives of their construct. The findings reveal that the following English Version Amharic version MLM scales were retained. The reason to include the Amharic version was that Ethiopians use Amharic language as national language and teachers, researchers or other concerned body can easily use this version for measuring the MLM of students.

Regarding the multivariate main or interaction effect Mathematics Learning Motivation on Academic Achievement on undergraduate students in Selected Public Universities of Ethiopia, Multiple Analysis of Covariance (MANCOVA) was employed and the findings pointed out that there is multivariate main effect and interaction effect of mathematics self-concept, anxiety, and achievement goal on students' academic success.

With reference to the relationship between Mathematics Learning Motivation and Students' Achievement in the case of Undergraduate Students in Ethiopian Public Universities, structural equation modeling(SEM) were employed and the findings demonstrate that there is Mathematics self-Concept and anxiety are significant predictors of mathematics achievement as well as academic achieving, whereas Achievement goal is not significant predictor of mathematics achievement as well as academic achievement.

On the subject of the motivational factors that dominantly affect the achievement of undergraduate students of Ethiopian Public Universities, SEM were engaged in calculating the standardized coefficient of each predictor with respect to the mathematics achievement and the academic achievement of under graduate university students. In this regard, the findings depicted that Self concept and anxiety are the two dominant factors influencing mathematics achieving as well as academic achievements of university students in Ethiopia.

In relation to the effect of mathematics achievement on academic achievement in the case of undergraduate Public university students of Ethiopia, analysis of covariance (ACOVA) was applied and the findings designate that there is significant effect of Mathematics achievement on academic achievement of undergraduate university students in Ethiopia.

According to the findings acquired, the following conclusion was articulated:

Self-concept, Anxiety, and achievement Goal are significant MLM Constructs in the case of university students of Ethiopia; The valid MLM items include Self-concept, Anxiety, and Achievement Goal constructs in the case of undergraduate university students in Ethiopia;There is a multivariate main effect of Self-concept on academic success; There is a multivariate main effect of Anxiety on academic success; There is a multivariate main effect of Achievement Goal on academic success; There is a multivariate interaction effect of Self-concept and anxiety on academic success; There is a multivariate interaction effect of Self-concept and Achievement Goal on academic success; There is a multivariate interaction effect of Anxiety and Achievement Goal on academic success. Self- concept and Anxiety are significant predictors of mathematics achievement; Self concept and Anxiety dominantly influence mathematics achievement than the Achievement- goal does; Self- concept and Anxiety are significant predictors of Academic achievement; Self concept and Anxiety dominantly influence Academic achievement than the Achievement does; Mathematics achievement has significant effect on Academic Achievement of undergraduate university students of Ethiopia.

6.2 Recommendation

As Self concept, Anxiety and Achievement Goal constructs validly measures the MLM, whoever concerned body including Education policy makers, Ministry of Education, curriculum designers, Education bureaus and offices, school principals, university teachers, researchers and other concerned bodies should use these constructs so as to find the measure MLM accordingly. Though educational and training policy of Ethiopia(2022) stated that numeracy , literacy , home science ,

health services, agriculture and civics are the focal point of basic education where as research oriented education which make possible to solve problems, which make professional leader, and which satisfy societal needs is the focus of higher education, the numeracy and literacy issue is directly related to mathematics learning motivation, MLM, highest focus should be taken to MLM by every concerned bodies so as to achieve the objective of educational and training policy of Ethiopia(2022).

In view of the fact that the Ethiopian Education Development Road Map (2018-30), the curriculum ought to put forward teaching of science technology and math subjects corresponding to each grade level in order to bring higher order thinking skills; The growth and transformation plan - GTP2 (2016, p.189) of Ethiopia also recommends that sum total of students in higher education be supposed to be greater than before and the number of higher institutions be supposed to also be increased, and to get better of the achievements of preparatory school students in mathematics and science subjects, the university should work in collaboration to schools. Hence university and preparatory school teachers should focus on the MLM variables which has main and interaction effect on academic achievement as well as mathematics achievement.

As GTP 2 also suggests to use qualified and skilled man power which can empower technology transformation; the 70:30, that is 70% Natural and computational science and 30% Social Science, university students admission policy of Ethiopia should be supported by encouraging activities MLM activities specially the activities which encourage mathematics self-concept, decrease mathematics anxiety, and enhance the achievement goals of students.

The 70: 30 plan makes the enrollment of natural and computational science students in university to be very large than that of Social Science students. Mathematics curriculum should include research results concerning the best practices beliefs that children can learn mathematics and the curriculum revision should incorporate classroom performance involving self concept, anxiety and achievement goal.

As it has been distinguished by EGMA (2009) report, there was deviation in skill levels among students in early grade level throughout the countries. This means that there will be dissimilarity in level of motivation or self-beliefs in learning mathematics among students. Thus in the higher grade level also it is not predictable that all the 70% of students enrolled to be science pupil in Universities of Ethiopia are high achievers in mathematics and highly motivated to learn mathematics. Hence every concerned stake-holder should give attention on the MLM variables, especially mathematics self- concept and mathematics anxiety, which dominantly influence the mathematics achievement and academic achievement. The study results pointed out those MLM variables highly predict

mathematics achievement and mathematics achievement in turn highly influence academic achievement. Thus students should pay much attention MLM variables namely self concept, anxiety and achievement goal so as to achieve high in mathematics and achieve high in other subjects.

In view of the fact that mathematics Self-concept, Anxiety, and Achievement Goal pair wise-interact to influence academic sues of undergraduate university Students of Ethiopia, further researchers should verify the orientation that in which way they interact to influence students' academic success. Moreover, the bidirectional relationship of math attitudes and math achievement should further be investigated by other researchers by encompassing different attitudinal variables.

References

Aarti, M. and Kadian, R. (2022), Modeling academic performance through personality traits, self efficacy, disaffection among university students. Journal of Applied Research in Higher Education, 15(5), 1353-1369. https://doi.org/10.1108/JARHE-05-2022-0133.

Abidin, Z., Mathrani, A., & Hunter, R. (2018). Gender-related differences in the use of technology in mathematics classrooms: Student participation, learning strategies and attitudes. The International Journal of Information and Learning Technology, 35(4), 266-284. https://doi.org/10.1108/IJILT-11-2017-0109

Aboma, O. (2009). Predicting first year university students' academic success. Electronic Journal of Research in Educational Psychology, 7(3), 1053-1072.

Abu-Hilal, M. M. (2000). A structural model for predicting Mathematics achievement: Its relation with anxiety and self-concept in Mathematics. Psychological Reports, 86(3), 835-847.

Adegboyega, O. L. (2018). Influence of achievement motivation on Nigerian undergraduates' attitude towards examination. International Journal of Instruction, 11(1), 77–88.

Adem K. (2005). Factors affecting students‟ performance in higher institutions: The case of Alemaya University. Journal of the Ethiopian Statistical Association, 14, 73-82.

Agyemang, F. G., Dzandu, M. D., & Boateng, H. (2016). Knowledge sharing among teachers: the role of the Big Five Personality traits. VINE Journal of Information and Knowledge Management Systems, 46(1), 64-84. https://doi.org/10.1108/VJIKMS-12-2014-0066

Al Mutawah, M.A (2015).The Influence of Mathematics Anxiety in Middle and High School Students Math Achievement. International Education Studies, 8(11), 339-252.

Alderman,K. (2007). Motivation for achievement: Possibilities for teaching and learning. Mahwah, NJ: Erlbaum.

Alexander, P. A. (2003). The development of expertise: The journey from acclimation to proficiency. Educational Researcher, 32(8), 10–14.

Alivernini, F., Cavicchiolo, E., Palmerio, L., & Girelli, L. (2015). Representations of study and students' academic motivation. Procedia–Social and Behavioral Sciences, 205, 302–305.

Ames, C. (1992). Classrooms: Goals, structures, and student motivation. Journal of Educational Psychology, 84(3), 261–271.

Arem, C.A., 2009. Conquering Math Anxiety. 3rd Edn., Cengage Learning, Belmont, ISBN-10: 0495829404, pp: 215.

Arens, A. K., Frenzel, A. C., and Goetz, T. (2022). Self-concept and self-efficacy in math: longitudinal interrelations and reciprocal linkages with achievement. *The Journal of Experimental Education*, *90*(3), 615-633.

Asad, M. M., Khan, S., Sherwani, F., & Banerjee, J. S. (2022). Impact of asynchronous Web-based learning environment on students' interest and motivation in mathematics: a quantitative research study. The International Journal of Information and Learning Technology, 39(4), 340-359. https://doi.org/10.1108/IJILT-10-2021-0159

Ashcraft, M. H. (2002). Math anxiety: Personal, educational, and cognitive consequences. Current Directions in Psychological Science, 11(5), 181−185. https://doi.org/10.1111/1467-8721.00196

Ashcraft, M. H., & Moore, A. M. (2009). Mathematics anxiety and the affective drop in performance. Journal of Psychoeducational Assessment, 27(3), 197-205.

Asif, S., Kamal, A., Fahim, M., Naveen, N., & Yousaf, F. (2018). Exploring gender differences in academic motivation among adolescents. Ophthalmology Update, 16, 918–922. Retrieved from http://www.ophthalmologyupdate.com/

Atkinson, J. W. (1957). Motivational determinants of risk-taking behaviour. Psychological Review, 64(6), 359–372.

Ayodele, O. J. (2011). Self-concept and performance of secondary school students in mathematics. Journal of Educational and Developmental Psychology, 1(1), 176-183.

Baker, M. (2015). First results from psychology's largest reproducibility test. Nature, 30(10.1038).

Barclay, D., Higgins, C., & Thompson, R. (1995). The partial least squares (PLS) approach to causal modelling: Personal computer adoption and use as an illustration. Technology Studies (Special Issue on Research Methodology), 2(2), 285–309.

Berger, J. (2009). The influence of achievement goals on metacognitive processes in math problem solving. Journal of Cognitive Education and Psychology, 8(2), 165-181.

Berkovich, I., & Eyal, O. (2021). Teachers' Big Five personality traits, emotion regulation patterns, and moods: Mediation and prototype analyses. Research papers in education, 36(3), 332-354. https://doi.org/10.1080/02671522.2019.1677758

Blaskova, M. (2014). Influencing academic motivation, responsibility and creativity. Procedia–Social Behavioral Sciences, 159, 415–425. Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. Psychological Review, 84(2), 191–215.

Bandura, A. (1997). Self-efficacy: The exercise of control. London, UK: Worth Publishers.

Boateng, G. O., Neilands, T. B., Frongillo, E. A., Melgar-Quiñonez, H. R., & Young, S. L. (2018). Best practices for developing and validating scales for health, social, and behavioral research: a primer. Frontiers in public health, 6, 149.

Bomia, L., Beluzo, L., Demeester, D., Elander, K., Johnson, M., & Sheldon, B. 1997. The Impact of Teaching Strategies on Intrinsic Motivation. Champaign, IL: ERIC Clearing house on Elementary and Early Childhood Education.

Brown, G. T. L. (2011). Self-regulation of assessment beliefs and attitudes: A review of the students' conceptions of assessment inventory. Educational Psychology, 31(6), 731–748.

Bryman, A., & Bell, E. (2007). Business Research Methods (2nd Edition ed.). New York: Oxford University Press Inc.

Bryne, B. M. (1984). The general/academic self-concept nomological network: A review of construct validation research. Review of Educational Research, 54, 427-456.

Butler, K.L.(2016). Motivation for mathematics: The Development and initial Validation of an abbreviated instrument.

Cahyawati, D., Delima, N., & Gunarto, M. (2023). The impact of undergraduate students' mathematics anxiety and self-concept on their self-regulated learning and academic achievement. Jurnal Elemen, 9(1), 183-196.

Campbell DT, Fiske DW. (1959). Convergent and discriminant validity by the multitrait-multi method matrix. Psychol Bull. 56:81–105.

Carmines, E. G., & Zeller, R. A. (1979). Reliability and validity assessment. N. 07-017, Sage University Paper Series on Quantitative Applications in the Social Sciences. Beverly Hills, CA:Sage.

Chan, J. C. Y., & Lam, S.-f. (2008). Effects of competition on students' self-efficacy in vicarious learning. British Journal of Educational Psychology, 78(1), 95-108.

Charles, C. M. & Mertler, C. A. (2002). Introduction to educational research (4th ed.). Boston, MA: Allyn and Bacon.

Chin, W. W. (1998b). The partial least squares approach to structural equation modelling. In G. A. Marcoulides (Ed.), Modern methods for business research (pp. 295–336).

Churchill GA. (1979). A paradigm for developing better measures of marketing constructs. J Mark Res. **16**:64–73

Clements, D. H. (2004b). Major themes and recommendations. In D. H. Clements and J. Sarama (Eds.), Engaging young children in mathematics: Standards for early childhood mathematics education (pp. 7–72). Mahwah, New Jersey: Lawrence Erlbaum Associates.

Cockcroft, W.H (1986). Mathematics Counts. London: HMSO

Comrey, A. L., & Lee, H. B. (1992). Interpretation and application of factor analytic results. Comrey AL, Lee HB. A first course in factor analysis, 2, 1992.

Covington, M. (2000). Goal theory, motivation, and school achievement: A integrative review. Annual Review ofPsychology, 51, 171-200.

Cresswell, C., & Speelman, C. P. (2020). Does mathematics training lead to better logical thinking and reasoning? A cross-sectional assessment from student to professors. PLoS ONE, 15(7), e0236153. https://doi.org/10.1371/journal.pone.0236153

Creswell, J. W. (1998). Qualitative inquiry and research design: Choosing among five traditions.Thousand Oaks, CA: Sage Publications.

Creswell, J. W. (2002). Educational research: Planning, conducting, and evaluating quantitative and qualitative approaches to research. Upper Saddle River, NJ: Merrill/Pearson Education.

Creswell, J. W. (2003). Research design: Qualitative, quantitative, and mixed methods approaches (2nd ed.). Thousand Oaks, CA: Sage Publications.

Daniel, T. (1992). Personaity types and academic achievement motivation as correlates of college academic performance. Unpublished Master‟s Thesis, Addis Ababa University, Addis Ababa, Ethiopia.

Daniels, D., Kalkman, D., & McCombs, B. (2001). Young children's perspectives on learning and teacher practices in different classroom contexts: Implications for motivation. Early Education and Development, 12(2), 253-273.

Deci, E. L., & Ryan, R. M. (1985). Intrinsic motivation and self-determination in human behavior. New York, NY: Plenum Press.

Delgado-Rico, E., Carretero-Dios, H., & Ruch, W. (2012). Content validity evidences in test development: An applied perspective. International Journal of Clinical and Health Psychology España, 12(3), 449-460.

Dembo, M., & Eaton, M. (2000). Self-regulation of academic learning in middle-level schools. Elementary School Journal, 100, 473-490.

Dembo, M., & Seli, H. (2004). Students' resistance to change in learning strategies courses. Journal of Developmental Education, 27(3), 2-1 l .

Dembo, M.H. (2000). Motivation and learning strategies for college success: A self-management approach. Mahwah, NJ: Erlbaum.

Demewez, A., Mehadi, A., & Tesfaye, S. (2005). Impact of varying entry behavior on students' academic and psychological outcomes in higher education. The Ethiopian Journal of Higher Education, 2(2), 47-72.

Dennis, M.S. (2022). Intensive Intervention for Students with Mathematics Learning Difficulties. Tankersley, M., Cook, B.G. and Landrum, T.J. (Ed.) Delivering Intensive, Individualized Interventions to Children and Youth with Learning and Behavioral Disabilities (Advances in Learning and Behavioral Disabilities, Vol. 32), Emerald Publishing Limited, Leeds, pp. 167-188. https://doi.org/10.1108/S0735-004X20220000032010

Bezzina, F. H. (2010). Investigating gender differences in mathematics performance and in self-regulated learning: An empirical study from Malta. Equality, Diversity and Inclusion: An International Journal, 29(7), 669-693. https://doi.org/10.1108/02610151011074407

DeVellis RF(2012). Scale Development: Theory and Application. Los Angeles, CA: Sage Publications.

Devine, A., Fawcett, K., Szucs, D., & Dowker, A. (2012). Gender differences in mathematics anxiety and the relation to mathematics performance while controlling for test anxiety. Behavioral and Brain Function, 8, 33-41. http://dx.doi.org/10.1186/1744-9081-8-3

Dowson, M., & Mcinerney, D. (2003). What do students say about their motivational goals? Towards a more complex and dynamic perspective on student motivation. Contemporary Educational Psychology 28(1), 91-1 13.

Du, C., Qin, K., Wang, Y., & Xin, T. (2021). Mathematics interest, anxiety, self-efficacy and achievement: Examining reciprocal relations. Learning and Individual Differences, 91, 102060.

Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality.Psychological Review, 95(2), 256–273.

Eccles, J. (1983). Expectancies, values and academic behaviors. In J. T. Spence (Ed.), Achievement and achievement motives: Psychological and sociological approaches (pp. 75– 146). San Francisco, CA: Freeman.

Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values, and goals. Annual Review of Psychology, 53, 109–132.

EdData, I. I. (2009). Early Grade Mathematics Assessment (EGMA): A Conceptual Framework Based on Mathematics Skills Development in Children.

Eklof, H. (2007). Self-concept and valuing of mathematics in TIMSS 2003: Scale structure and relation to performance in a Swedish setting. Scandinavian Journal of Educational Research, 51(3), 297–313.

Eklof, H. (2010). Skill and will: Test-taking motivation and assessment quality. Assessment in Education: Principles, Policy and Practice, 17(4), 345–356.

Elliot, A., & McGregor, H. (2001). A 2X2 achievement goal framework. Journal of Personality and Social Psychology, 80, 501-519.

Elliot, A., & Thrash, T. (2001). Achievement goals and the hierarchical model of achievement motivation. Educational Psychology Review, 13, 139-156.

Elliot, A., Murayama, K., & Pekrun, R. (2013). A 3x2 achievement goal model. Journal of Educational Psychology, 103(3), 623-648.

Elliott, E. S., & Dweck, C. S. (1988). Goals: An approach to motivation and achievement. Journal of Personality and Social Psychology, 54(1), 5–12.

Ezema, O., & Ogunshola, R.F. Impact of Principals Motivational Techniques in students academic Performance in Federal Capital Junior Secondary Schools, Abuja, Nigeria.

Fan, X., Hambleton, R. K., & Zhang, M. (2019). Profiles of mathematics anxiety among 15-year-old students: A cross-cultural study using multi-group latent profile analysis. Frontiers in Psychology, 10, 1217.

Fentaw, A. (1991). Factors affecting academic performance of students at Addis Ababa university. Unpublished Master‟s Thesis, Addis Ababa University, Addis Ababa, Ethiopia.

Fentaw, A. (2001). Admission type and female students‟ academic success at Addis Ababa University: The case of social science students. The Ethiopian Journal of Education, 21(1), 49- 64.

Field, A(2009). Discovering Statistics Using SPSS, 2nd ed.; SAGE Publications Ltd.: London, UK.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. Journal of Marketing Research, 18, 39–50.

Fowler FJ.(1995). Improving Survey Questions: Design and Evaluation. Thousand Oaks, CA: Sage Publications.

Fox, N., Hunn, A., & Mathers, N. (2009). Sampling and sample size calculation. East Midlands/Yorkshire: the National Institutes for Health Research. Research Design Service for the East Midlands/Yorkshire & the Humber.

Gefen, D., & Straub, D. (2005). A practical guide to factorial validity using PLS-Graph: Tutorial and annotated example. Communications of the Association for Information systems, 16(1), 5.

Gersten, R., Jordan, N. C., & Flojo, J. R. (2005). Early identification and interventions for students with mathematics difficulties. Journal of Learning Disabilities, 38(4), 293–304.

Gierl, M. J., & Bisanz, J. (1995). Anxieties and Attitudes Related to Mathematics in Grades 3 and 6. The Journal of Experimental Education, 63(2), 139–158.

Girma, A. (1997). Differences in academic performance as a function of temperature comfort and academic achievement motivation among trainees in Gambela and Debrebirhan Teachers'Traianing Institutes (TTI). Unpublished Master's Thesis, Addis Ababa University, Addis Ababa, Ethiopia.

Gorman, D. (2010). Maslow's hierarchy and social and emotional wellbeing. Aboriginal & Islander Health Worker Journal, 34 (1), 27-29.

Guba, E., & Lincoln, Y. (1982, Winter). Epistemological and methodological bases of naturalistic inquiry. Educational Communications and Technology Journal, 232- 252.

Guion R (1977). Content validity - the source of my discontent. Appl Psychol Meas. **1**:1–10.

Habte, T. B. (1988). An investigation into some factors affecting academic performance of first year regular science degree students of 1987/88. Unpublished Master's Thesis, Addis Ababa University, Addis Ababa, Ethiopia.

Haciomeroglu, G. (2013). Mathematics Anxiety and Mathematical Beliefs: What Is the Relationship in Elementary Pre-Service Teachers?. Issues in the Undergraduate Mathematics Preparation of School Teachers, 5.

Hair, J.F., Ringle, C.M., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. Journal of Marketing Theory and Practice, 19(2), 137–149.

Hannula, M. S. (2006). Motivation in mathematics: Goals reflected in emotions. Educational Studies in Mathematics, 63(2), 165-178. doi:10.1007/s10649-005-9019-8

Harter, S. (1990). Self and identity development. In S.S. Feldman & G.R. Elliott (Eds.), At the threshold: The developing adolescent. Cambridge, MA: Harvard University Press.

Harter, S., & Pike, R. (1984). The pictorial scale of perceived competence and social acceptance for young children. Child Development, 55(6), 1969-1982

Harter, S., & Whitesell, N. (2003). Beyond the debate: Why some adolescents report stable self-worth overtime and situation whereas others report changes in self-worth. Journal of Personality, 71 (6), 1027-1058.

Hattie, J. A. C. (1992). Self-concept. Hillsdale, NJ: LEA.

Hattie, J. A. (2009). Visible learning: A synthesis of 800+ meta-analyses on achievement. Abingdon, UK: Routledge.

Hattie, J. A. C., & Donoghue, G. M. (2016). Learning strategies: a synthesis and conceptual model. npj Science Of Learning, 1, 16013. Retrieved from http://www.nature.com/articles/npjscilearn201613.

Haynes, S. N., Richard, D., & Kubany, E. S. (1995). Content validity in psychological assessment: A functional approach to concepts and methods. Psychological assessment, 7(3), 238.

He, Shengqing, & Qi, Chunxia. (2018). The effects of teacher-student relationship and interest in mathematics learning on academic performance in mathematics - The chain mediating role of self-efficacy and mathematics anxiety. Educational Science Research, 12, 47-54.

Hedija, M. (2002). Enrollment and academic performance of female students in higher learning institutions: A case study. Institute of Educational Research (IER) Flambeau, 9(2), 9-15.

Hembree, R. (1990) .The Nature, Effects and Relief of Mathematics Anxiety, Journal for Research in Mathematics Education, 21 (1) , 33-46.

Hembree, R. 1988. "Correlates, causes, effects, and treatment of test anxiety", Review of Educational Research, 58(1), 47-77.

Hiller, S. E., Kitsantas, A., Cheema, J. E., & Poulou, M. (2022). Mathematics anxiety and self-efficacy as predictors of mathematics literacy. International Journal of Mathematical Education in Science and Technology, 53(8), 2133-2151.

Hinkin TR(1995). A review of scale development practices in the study of organizations. J Manag. 21:967–88.

Hodges, C. B., Stackpole-Hodges, C. L., & M., C. K. (2008). Self-Efficacy, SelfRegulation, and Cognitive Style as Predictors of Achievement with Podcast Instruction. Journal of Educational Computing Research, 38(2), 139-153.

Hooper, M., Mullis, I. V. S., & Martin, M. O. (2013). TIMSS 2015 context questionnaire framework. In I. V. S. Mullis, & M. O. Martin (Eds.), TIMSS 2015 assessment frameworks (pp. 61–82).Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

Hooper,M.,Mullis,I. V. S.,Martin,M. O.,& Fishbein, B.(2017). TIMSS 2019 context questionnaire framework. In I. V. S. Mullis, & M. O. Martin (Eds.), TIMSS 2019 assessment frameworks (pp. 57–78). Chestnut Hill, MA: TIMSS & PIRLS International

Study Center, Boston College. Retrieved from: http://timssandpirls.bc.edu/timss2019/frameworks/.

Israel, G.D.(1992). Determining sample size.

Jacob, F. (1977). Evolution and tinkering. Science, 196, 1161–1166.

Karadag, E. (Ed.). (2017). The factors effecting student achievement: Meta-analysis of empirical studies. Cham, Switzerland: Springer International Publishing. Retrieved from https://www.springer.com/gp/book/9783319560823.

Karimi, A., & Venkatesh, K. G. (2010). Mathematics anxiety, mathematics performance and overall academic performance in high school students. Journal of the Indian Academy of Applied Psychology, 36(1), 147−150. https://doi.org/10.1177/0258042X0903400406

Kaskens, J., Segers, E., Goei, S. L., van Luit, J. E., & Verhoeven, L. (2020). Impact of Children's math self-concept, math self-efficacy, math anxiety, and teacher competencies on math development. Teaching and teacher education, 94, 103096.

Kazelskis, R. (1998). Some dimensions of mathematics anxiety: a factor analysis across instruments. Educational and Psychological Measurement, 58, 623-633.

Kennedy, L. (2019). How attitude towards math impacts student achievement. Retrieved on January, 18, 2021.

Kent, R. (2007). Marketing Research, Approaches, Methods and Applications in Europe. London: Thomson Learning.

Kessler, A., Boston, M., & Stein, M. K. (2019). Exploring how teachers support students' mathematical learning in computer-directed learning environments. Information and Learning Sciences, 121(1/2), 52-78. https://doi.org/10.1108/ILS-07-2019-0075

Khatoon, T. and S. Mahmood, 2010. Mathematics anxiety among secondary school students in India and its relationship to achievement in mathematics. Eur. J. Soc. Sci., 16: 75-86.

Kim, C., Park, S. W., & Cozart, J. (2014). Affective and motivational factors of learning in online mathematics course. British Journal of Educational Technology, 45(1), 171-185.

Klee, H. L., Miller, A. D., & Buehl, M. M. (2022). Mathematics Anxiety, Self-Concept, and Self-Efficacy: A Multidimensional Scaling Consideration of Measures. The Journal of Experimental Education, 1-23.

Kline P (1993). A Handbook of Psychological Testing. 2nd Edn. London: Routledge; Taylor & Francis Group.

Kovács, G., & Spens, K. M. (2005). Abductive reasoning in logistics research. International Journal of Physical Distribution & Logistics Management, 35(2), 132-144.

Kucuk, F., & Walters, J. (2009). How good is your test?. ELT journal, 63(4), 332-341.

Lacobucci, F.,Touhy, C.J., & Tuohy, C.H.(Eds.).(2005). Taking public universities seriously.

Lee, E. (2017). Effects of South Korean high school students' motivation to learn science and technology on their concern related to engineering. Educational Sciences: Theory & Practice, 17, 549–571.

Lee, J., & Stankov, L. (2018). Non-cognitive predictors of academic achievement: Evidence from TIMSS and PISA. Learning and Individual Differences, 65, 50–64.

Lemos, M. S., & Verissimo, L. (2014). The relationship between intrinsic motivation, extrinsic motivation, and achievement, along elementary school. Procedia–Social and Behavioral Sciences, 112, 930–938.

Lent, R. W., Sheu, H. B., Miller, M. J., Cusick, M. E., Penn, L. T., & Truong, N. N. (2018). Predictors of science, technology, engineering, and mathematics choice options: A meta-analytic path analysis of the social–cognitive choice model by gender and race/ethnicity. Journal of counseling psychology, 65(1),17. https://doi.org/10.1037/cou0000243

Onal, H., Inan, M., & Bozkurt, S. (2017). A Research on Mathematical Thinking Skills: Mathematical Thinking Skills of Athletes in Individual and Team Sports. Journal of Education and Training Studies, 5(9), 133−139. http://dx.doi.org/10.11114/jets.v5i9.2428

Liang, Hao-Cui. (2016). A quantitative analysis of the factors influencing middle school students' mathematical self-concept based on "individual students" and "mathematics classroom culture". Journal of Mathematics Education, 25(4), 25-29.

Loevinger J (1957). Objective tests as instruments of psychological theory. Psychol Rep. **3**:635–94.

Lu, F.-Y., Wen, S., Deng, G., & Tang, Y.-L. (2017). Self-concept mediate the relationship between childhood maltreatment and abstinence motivation as well as self-efficacy among drug addicts. Addictive Behaviors, 68, 52–58.

Lubienski, S. T., Robinson, J. P., Crane, C. C., & Ganley, C. M. (2013). BRIEF REPORT: Girls' and Boys' Mathematics Achievement, Affect, and Experiences: Findings From ECLS-K. Journal for Research in Mathematics Education, 44(4), 634-645.

Luo, X,, Wang, F. & Luo, Z. (2009). Investigations and Analysis on Mathematics Anxiety of Middle School Students[J]; Journal of Mathematics Education; 2008-05.

Ma, X. (1999). A meta-analysis of the relationship between anxiety toward mathematics and achievement in mathematics. Journal for Research in Mathematics Education, 30(5), 520-540. http://dx.doi.org/10.2307/749772

Marsh, H. W. (1990). The structure of academic self-concept: The Marsh/Shavelson model. Journal of Educational Psychology, 82(4), 623–636.

Marsh, H. W. (1990a). Causal ordering of academic self-concept and academic achievement: A multivariate, longitudinal panel analysis. Journal of Educational Psychology, 82, 646-656.

Marsh, H. W. (1990b). The structure of academic self-concept: The Marsh/Shavelson model. Journal of Educational Psychology, 82(4), 623-636.

Marsh, H. W., Abduljabbar, A. S., Abu-Hilal, M. M., Morin, A. J., Abdelfattah, F., Leung, K. C., & Parker, P. (2013). Factorial, convergent, and discriminant validity of TIMSS math and science motivation measures: A comparison of Arab and Anglo-Saxon countries. Journal of Educational Psychology, 105(1), 108–128.

Marsh, H. W., Hau, K. T., Artelt, C., Baumert, J., & Peschar, J. L. (2006). OECD's brief selfreport measure of educational psychology's most useful affective constructs: Cross-cultural, psychometric comparisons across 25 countries. International Journal of Testing, 6(4), 311– 60.

Maslow, A. H. (1943). A Theory of Human Motivation. Psychological Review, 50, 370-96.

Maxcy, S. J. (2003). Pragmatic threads in mixed methods research in the social sciences: The search for multiple modes of inquiry and the end of the philosophy of formalism. In: A. Tashakkori & C. Teddlie (Eds.), Handbook on mixed methods in the behavioral and social sciences, pp. 51-89. Thousand Oaks, CA: Sage Publications.

McAuley, E., Duncan, T., & Tammen, V. V. (1987). Psychometric properties of the Intrinsic Motivation Inventory in a competitive sport setting: A confirmatory factor analysis. Research Quarterly for Exercise and Sport, 60, 48-58.

McCombs, B.L. (1 996). Integrating metacognition, affect, and motivation in improving teacher education. In L. Baker, P. Aferbach, et al. (Eds.), Developing engaged readers in school and home communities. Mahwah, NJ: Erlbaum.

McCombs, B.L. (1 998). Integrating metacognition, affect, and motivation in improving teacher education. In N.M. Lamber, B.L. McCombs, et al. (Eds.), How students learn: Reforming schools through learner-centered education. Washington, DC: American Psychological Association.

McCoach, D. B., Gable, R. K., & Madura, J. P. (2013). Instrument development in the affective domain (Vol. 10, pp. 978-971). New York, NY: Springer.

McLeod, S. A. (2007). Maslow's Hierarchy of Needs. Retrieved from http://www.simplypsychology.org/maslow.html

Meece, J. L., Anderman, E. M., & Anderman, L. H. (2006). Classroom goal structure, student motivation, and academic achievement. Annual Review of Psychology, 57, 487–503.

Meece, J. L., Wigfield, A., & Eccles, J. S. (1990). Predictors of math anxiety and its influence on young adolescents' course enrollment intentions and performance in mathematics. Journal of Educational Psychology, 82(1), 68–81.

Mercier, H., & Sperber, D. (2017). The enigma of reason. Cambridge, MA: Harvard University Press.

Mertens, D. M. (2003). Mixed methods and the politics of human research: The transformative-emancipatory perspective. In: A. Tashakkori & C. Teddlie (Eds.), Handbook on mixed methods in the behavioral and social sciences, pp. 135-164. Thousand Oaks, CA: Sage Publications.

Messer, B., & Harter, S. (1 985). Theself-perception scale for adults. Unpublished manuscript, University of Denver.

Messick S. (1995). Validity of psychological assessment: validation of inferences from persons' responses and performance as scientifica inquiry into score meaning. Am Psychol. 50:741–9.

Michaelides, M. P. (2008). Emerging themes from early research on self-efficacy beliefs in school mathematics. Electronic Journal of Research in Educational Psychology, 6(1), 219–234.

Middleton, J. A. & Spanias, P. A. 1999. "Motivation for achievement in mathematics: Findings, generalization and criticism of the research", Journal for Research in Mathematics Education,30(1), 65–88.

Midgley, C., Kaplan, A., Middleton, M., Maehr, M. L., Urdan, T., Anderman, L. H, & Roeser, R. (1998). The development and validation of scales assessing students' achievement goal orientations. Contemporary Educational Psychology, 23, 113-131.

Midgley, C., Maehr, M. L., Hruda, L. Z., Anderman, E., Anderman, L., Freeman, K. E., Urdan, T. (2000). Manual for the patterns of adaptive learning scales (PALS). Ann Arbor, MI: University of Michigan.

Miller, R. B., DeBacker, T. K., & Greene, B. A. (1999). Perceived instrumentality and academics: The link to task valuing. Journal of Instructional Psychology, 26, 250.

Moddleton, J. A. (2020). Motivation in mathematics learning. In *Encyclopedia of mathematics education* (pp. 635-637). Cham: Springer International Publishing.

Morgado FFR, Meireles JFF, Neves CM, Amaral ACS, Ferreira MEC(2018). Scale development: ten main limitations and recommendations to improve future research practices. Psicol Reflex E Crítica. 30:3.
Morgado FFR, Meireles JFF, Neves CM, Amaral ACS, Ferreira MEC(2018). Scale development: ten main limitations and recommendations to improve future research practices. Psicol Reflex E Crítica. 30:3.
Morgan, T.M., & Case, L.D.(2013). Conservative sample size determination for repeated measures analysis for covariance, Annals of biometrics & biostatatistics, 1(1).

Morin, A. J., Arens, A. K., & Marsh, H. W. (2016). A bifactor exploratory structural equation modeling framework for the identification of distinct sources of construct-relevant psychometric multidimensionality. Structural Equation Modeling: A Multidisciplinary Journal, 23(1), 116-139.

Morony, S. (2013). Predicting achievement: Confidence vs self-efficacy, anxiety, and selfconcept in Confucian and European countries. International Journal of Educational Research, 18.

Mullis, I. V., Martin, M. O., Foy, P., & Arora, A. (2012). TIMSS 2011 international results in mathematics. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College. Retrieved from https://timssandpirls.bc.edu/timss2011/downloads/T11_IR_ Mathematics_FullBook.pdf.

Mulugeta, T. (1998). Locus of control, self-efficacy, and academic achievement motivation as predictors of academic performance of college freshmen: The case of Addis Ababa University. Unpublished Master‟s Thesis, Addis Ababa University, Addis Ababa, Ethiopia.

Murdock, T. B., Stephens, J. M., & Groteweil, M. M. (2016). Student dishonesty in the face of assessment: Who, why, and what we can do about it. In G. T. L. Brown, & L. R. Harris (Eds.), Handbook of human and social conditions in assessment (pp. 186–203). New York, NY:Routledge.

National Planning Commission. (2016). Federal Democratic Republic of Ethiopia: Growth and Transformation Plan II (GTP II)(2015/16-2019/20). Addis Ababa, Ethiopia.

Ngo, L. V., & O'Cass, A. (2009). Creating value offerings via operant resource-based capabilities. Industrial marketing management, 38(1), 45-59.

Ngo, L. V., & O'Cass, A. (2012). In search of innovation and customer-related performance superiority: The role of market orientation, marketing capability, and innovation capability interactions. Journal of Product Innovation Management, 29(5), 861-877.

Nicholls, J. G. (1984). Achievement motivation: Conceptions of ability, subjective experience, task choice, and performance. Psychological Review, 91(3), 328–346.

O'Neil, H. F. & Schacter, J. (1997). Test Specifications for Problem Solving Assessment, CSE Technical Report 463. Los Angeles, CA: Center for the Study of Evaluation.

OECD. (2014a). In PISA 2012 results: What students know and can do- Student performance in mathematics,reading and science (Revised ed., Vol. 1). OECD Publishing.

Opstad, L. (2018). Success in business studies and mathematical background: The case of Norway. Journal of Applied Research in Higher Education, 10(3), 399-408. https://doi.org/10.1108/JARHE-11-2017- 0136

Osborne, J., Simon, S., & Collins, S. (2003). Attitudes towards science: A review of the literature and its implications. International Journal of Science Education, 25(9), 1049–1079.

Pajares, F. & Urdan, T. 1996. "Exploratory factor analysis of the Mathematics Anxiety Scale", Measurement and Evaluation in Counseling and Development, 29, 35-47.

Pajares, F. (1997). Current directions in self-efficacy research. In M. Maehr & P. R. Pintrich (Eds.), Advances in motivation and achievement (Vol. 10, pp. 1-49). Greenwich, CT: JAI Press.

Patrick, H., Kaplan, A., & Ryan, A. M. (2011). Positive classroom motivational environments: Convergence betweenmastery goal structure and classroom social climate. Journal of
, Educational Psychology, 103(2), 367–382.

Peker, M., & Ertekin, E. (2011). The relationship between Mathematics teaching anxiety and Mathematics anxiety. The New Educational Review, 23(1), 213-226.

Pelletier, L. G., Fortier, M. S., Vallerand, R. J., Tuson, K. M., Briere, N. M., & Blais, M. R. (1995). Toward a new measure of intrinsic motivation, extrinsic motivation, and amotivation in sports: The Sport Motivation Scale (SMS). Journal of Sport and Exercise Psychology, 17, 35-35.

Perry, A. B. (2004). Deacreasing Math anxiety in College students. College students Journal, 38(2), 19-20.

Pintrich, P. (2000). Multiple goals, multiple pathways: The role of goal orientation in learning and achievement. Journal of Educational Psychology, 92, 544-555.

Pintrich, P. (2003). A motivational science perspective on the role of student motivation in learning and teaching contexts. Journal of Educational Psychology, 95, 667-686.

Pintrich, P. R. (2000). The role of goal orientation in self-regulated learning. In M. Boekaerts, P. R. Pintrich, & M. Ziedner (Eds.), Handbook of self-regulation (pp. 451–502). London, UK: Academic Press.

Pintrich, P. R., & Schunk, D. H. (1995). Motivation in education: Theory, research and applications. Englewood Cliffs, NJ: Prentice Hall.

Pintrich, P. R., & Schunk, D. H. (2002). Motivation in education: Theory, research, and applications (Second ed.). New Jersey, NJ: Merril Prentice Hall.

Pintrich, P. R., Smith, D., Garcia, T., & McKeachie, W. J. (1992). A manual for the use of the Motivated Strategies for Learning Questionnaire (MSLQ). Washington, DC: Office of Educational Research and Improvement.

Polit, D. F., & Beck, C. T. (2006). The content validity index: are you sure you know what's being reported? Critique and recommendations. Research in nursing & health, 29(5), 489-497.

Polit, D. F., Beck, C. T., & Owen, S. V. (2007). Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. Research in nursing & health, 30(4), 459-467.

Ramirez, G., Chang, H., Maloney, E. A., Levine, S. C., & Beilock, S. L. (2016). On the relationship between math anxiety and math achievement in early elementary school: The role of problem solving strategies. Journal of experimental child psychology, 141, 83-100.

Raykov T, Marcoulides GA(2011). Introduction to Psychometric Theory. New York, NY: Routledge, Taylor & Francis Group.

Rezaei, O., Vasheghani Farahani, M., & Musaei Sejzehei, F. (2019). Relationship between novice versus experienced EFL teacher's Big Five personality traits and their ambiguity tolerance and risk taking. Journal of Applied Research in Higher Education, 11(3), 342-351. https://doi.org/10.1108/JARHE-08-2018-017

Richardson, R. C., & Suinn, R. M. (1972). The Mathematics Anxiety Rating Scale: Psychometric data. Journal of Counseling Psychology, 19, 551–554.

Roldán, J. L., & Sánchez-Franco, M. J. (2012). Variance-based structural equation modeling: Guidelines for using partial least squares in information systems research. In Research methodologies, innovations and philosophies in software systems engineering and information systems (pp. 193-221). IGI Global.

Ross, S. (2008). Motivation correlates of academic achievement: Exploring how motivation influences academic achievement in the PISA 2003 dataset (Doctoral dissertation).

University of Victoria, BC. Retrieved from https://dspace.library.uvic.ca/handle/1828/3209

Ryan, B., Scapens, R. W., & Theobald, M. (2003). Research Method & Methodology in Finance and Accounting (2nd Edition ed.). London: Thomson.

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. Contemporary Educational Psychology, 25(1), 54–67.

Ryan, R. M., & Deci, E. L. (2017). Self-determination theory: Basic psychological needs in motivation, development, and wellness. New York, NY: Guilford Press.

Ryan, R., & Deci, E. (2000a). Intrinsic and extrinsic motivations: Classic definitions and new directions. Contemporary Educational Psychology, 25, 54-67.

Ryan, R., & Deci, E. (2000b). Self determination theory and the facilitation of intrinsic motivation, social development, and well-being. American Psychologist, 55(1), 68-78.

Ryan, R. M. (1998). Commentary: Human psychological needs and the issues of volition, control, and outcome focus. In J. Heckhausen, & C. S. Dweck (Eds.), Motivation and self-regulation across the life span (pp. 114–133). New York, NY: Cambridge University Press.

Saki, K., & Nadari, M. (2018). The relationship between self-regulated learning, academic selfconcept and the academic achievement motivation of students in the second grade of high school. Middle East Journal of Family Medicine, 16, 324–335.

Samir, A., & Tabatabaee-Yazdi, M. (2020). Translation Quality Assessment Rubric: A Rasch Model-Based Validation. *International Journal of Language Testing*, *10*(2), 101-128.

Satake, E., & Amato, P. P. (1995). Mathematics anxiety and achievement among Japanese elementary school students. Educational and Psychological Measurement, 55(6), 1000-1007.

Saunders, M., Lewis, P. H. I. L. I. P., & Thornhill, A. D. R. I. A. N. (2007). Research methods. Business Students 4th edition Pearson Education Limited, England, 6(3), 1-268.

Saunders, M., Lewis, P., & Thornhill, A. (2009). Research methods for business students (5th Edition ed.). Harlow: Pearson Professional Ltd.

Scarpello, G.V., (2005). The effects of Mathematics anxiety on the course and career choice of high school vocational – technical education students. Unpublished Docter of Philosophy Thesis, Drexel University. Retrieved from : http://idea.library.drexel.edu/bitsream/1860/49218/scarpello.Gary.pdf.

Schiefele, U., & Csikszentmihalyi, M. (1995). Motivation and ability as factors in mathematics experience and achievement. Journal for Research in Mathematics Education, 26(2), 163-181.

Schinka JA, Velicer WF, Weiner IR(2012). Handbook of Psychology,Research Methods in Psychology. Hoboken, NJ: John Wiley & Sons, Inc.

Schunk, D. H. (1991). Self-efficacy and academic motivation. Educational Psychologist, 26, 207-231.

Schunk, D., & Pajares, F. (2005). Competence perceptions and academic functioning. In A. J. Elliot & C. S. Dweck (Eds.), Handbook of competence and motivation (pp. 85-104). New York, NY: Guilford.

Seipp, B. 1991. "Anxiety and academic performance: A meta-analysis of the findings". Anxiety Research. 4, 27-41.

Shaninah, F. S. E., & Mohd Noor, M. H. (2023). The impact of big five personality trait in predicting student academic performance. Journal of Applied Research in Higher Education. https://doi.org/10.1108/JARHE-08-2022-0274

Shavelson, R. J., & Bolus, R. (1982). Self concept: The interplay of theory and methods. Journal of Educational Psychology, 74(1), 3–17.

Shavelson, R. J., Hubner, J. J., & Stanton, G. C. (1976). Validation of construct interpretations. Review of Educational Research, 46, 407-441.

Sheffield, D., & Hunt, T. (2006). How does anxiety influence maths performance and what can we do about it? MSOR (Maths, Stats & OR Network) Connections, 6(4), 19−23. https://doi.org/10.11120/msor.2006.06040019

Sherman, B. F., & Wither, D. P. (2003). Mathematics anxiety and mathematics achievement. Mathematics Education Research Journal, 15(2), 138-150.

Singh, A.S., & Masuku , M.B.(2014). Sampling techniques and & determination of sample size in applied statistics research: An overview. International Journal of economics, commerce and management, 2(11), 1-22.

Sini, B., Muzzulini, B., Schmidt, S., & Tinti, C. (2018). School motivation: A comparison between Kenya and Italy. Journal of Educational Research, 111, 746–755.

Skinner, E. & Belmont, M. (1991). A longitudinal study of motivation in school: Reciprocal effects of teacher behavior and student engagement. Unpublished manuscript, University of Rochester, Rochester, NY.

Solomon, S. D., Chew, E., Duh, E. J., Sobrin, L., Sun, J. K., VanderBeek, B. L., ... & Gardner, T. W. (2017). Diabetic retinopathy: a position statement by the American Diabetes Association. Diabetes care, 40(3), 412.

Spinath, B., & Steinmayr, R. (2012). The roles of competence beliefs and goal orientations for change in intrinsic motivation. Journal of Educational Psychology, 104(4), 1135-1148.

Stankov, L., Morony, S., Kleitman, S.& Lee, Y.P. (2012). Confidence, Self-efficacy, anxiety and Self-concept as Predictors of Achievement in Confucian and European Countries.

Straub, D., Boudreau, M. C., & Gefen, D. (2004). Validation guidelines for IS positivist research. Communications of the Association for Information Systems, 14, 380–426.

Tamire, A. (1997). Attributions and academic achievement of education, medicine, and polytechnic freshman students in Bahir Dar. The Ethiopian Journal of Education, 17(2), 59-77.

Tayyaba, S. (2010). Mathematics achievement in middle school level in Pakistan: Findings from the first national assessment. International Journal of Educational Management, 24(3), 221-249. https://doi.org/10.1108/09513541011031583

Tesfaye, S. (2007). Identification of factors contributing to gender disparity in an Ethiopian university. Eastern Africa Social Science Research Review, 23(2), 71-93.

Timmons, A. C. (2010). Establishing factorial invariance for multiple-group confirmatory factor analysis. KUant Guide, 22.

Tirussew Teferra, Amare Asgedom, Jeilu Oumer, Tassew W/hanna, Aklilu Dalelo & Berhannu Assefa (2017). Ethiopian Education Development Roadmap (2018-30): An integrated summary. Ministry of Education Education Strategy Center (ESC).

Tsige, G-M. (2001). Effect of accommodation in academic achievement: The case of Addis Ababa Commercial College students who came from regions. The Ethiopian Journal of Education, 21(2), 83-125.

Tsige, G-M. (2006). Some correlates of academic performance among students of College of Commerce, Addis Ababa University. The Ethiopian Journal of Education, 26(1), 67-98.

Usher, E. L., & Pajares, F. (2009). Sources of self-efficacy in mathematics: A validation study. Contemporary Educational Psychology, 34, 89-101.

Vallerand, R. J., & Blssonnette, R. (1992). Intrinsic, extrinsic, and amotivational styles as predictors of behavior: A prospective study. Journal of personality, 60(3), 599-620.

Van Yperen, N., Blaga, M., & Postmes, T. (2014). A meta-analysis of self-reported achievement goals and nonself-report performance across three achievement domains (work, sports, and education). PLOS ONE, 9(4), 1-16.

Walter, J. G., & Hart, J. (2009). Understanding the complexities of student motivations in mathematics learning. The Journal of Mathematical Behaviour, 162-170.

Watts, T. W., Duncan, G. J., Siegler, R. S., & Davis-Kean, P. E. (2014). What's past is prologue: Relations between early mathematics knowledge and high school achievement. Educational Researcher, 43(7), 352-360.

Werts, C. E., Linn, R. L., & Jöreskog, K. G. (1974). Intraclass reliability estimates: Testing structural assumptions. Educational and Psychological measurement, 34(1), 25-33.

Wigfield, A. (1994). Expectancy-value theory of achievement motivation: A developmental perspective. Educational Psychology Review, 6, 49–78.

Wigfield, A., & Eccles, J. (2002). The development of competence beliefs, expectancies for success, and achievement values from childhood through adolescence. In A. Wigfield, & J. Eccles (Eds.), Development of achievement motivation (pp. 92–120). New York, NY: Academic Press.

Wigfield, A., & Eccles, J., S. (2000). Expectancy-value theory of achievement motivation. Contemporary Educational Psychology, 25, 68-81.

Wigfield, A., & Meece, J. L. 1988. "Math anxiety in elementary and secondary school students", Journal of Educational Psychology, 80, 210-216.

Williams, K. L., Burt, B. A., & Hilton, A. A. (2016). Math achievement: A role strain and adaptation approach. Journal for Multicultural Education, 10(3), 368-383. https://doi.org/10.1108/JME-01-2016- 0005

Woldemichael, B. B. (2023, November 8). Mathematics Learning Motivation (MLM). https://doi.org/10.17605/OSF.IO/F67KR

Wolters, C., & Daugherty, S. (2007). Goal structures and teachers' sense of efficacy: Their relation and association to teaching experience and academic level. Journal of Educational Psychology, 99(1), 181-193.

Wudu, M., & Getahun, F. (2009). Trend and causes of female students' dropout from teacher education institutions of Ethiopia: The case of Jimma University. Ethiopian Journal of Education Science, 5(1), 1-19.

Yalew, E. (2003). Causes of students attrition in Bahir Dar University: Qualitative and quantitative analyses. The Ethiopian Journal of Education, 23(1), 31-66.

Yeo, W. L., Tan, C. K., & Lew, S. L. (2015). Mathematics Anxiety among Male and Female Students. International Journal of Psychological and Behavioral Sciences, 9(8), 2830−2835.

Yuksel-Sahin, F., 2008. Mathematics anxiety among 4th and 5th grade turkish elementary school students. Int. Elect. J. Math. Educ., 3: 179-192.

Yurtcu, M., & Dogan, N. (2015). Scaling with Paired Comparison Method for Reasons for Mathematics Anxiety of Secondary School Students. Procedia Social and Behavioral Sciences, 197, 851−857. https://doi.org/10.1016/j.sbspro.2015.07.209

Yusoff, M. S. B. (2019). ABC of content validation and content validity index calculation. Education in Medicine Journal, 11(2), 49-54.

Zadok, A., & Benoliel, P. (2023). Middle-leaders' transformational leadership: big five traits and teacher commitment. International Journal of Educational Management, 37(4), 810-829. https://doi.org/10.1108/IJEM-12-2022-0541

Zhang, J., Zhao, N., & Kong, Q. P. (2019). The relationship between math anxiety and math performance: A meta-analytic investigation. Frontiers in psychology, 10, 1613.

Appendices

Appendix-1**A: English Version items pool**

Mathematics learning Motivation (MLM) - item pool

#		Theory
q1	I like mathematics that I'll learn from even if I make a lot of mistakes.	Mastery approach (achievement goal theory)
q2	An important reason why I do mathematics is because I like to learn new things.	
q3	I like mathematics best when it really makes me think.	
q4	An important reason why I do mathematics is because I want to get better at	
q5	An important reason I do mathematics is because I enjoy it.	
q 6	I do mathematics because I'm interested in it.	
q 7	My goal is to fully understand the mathematics contents taught in class	
q 8	One of my goals in my math courses has been to learn as much as I can.	
q 9	My goal is to learn mathematics as much as I can	
q 10	I try very hard to understand as deep as possible in mathematics subject matter	
q 11	It's important to me that I improve my math skills this year	
q 12	I would feel good if I was the only one who could answer the teacher's questions.	Performance approach (achievement goal theory)
q 13	In math courses, I have wanted to do better than other students.	
q 14	I have felt successful in my math courses when I did better than the other students.	
q 15	I have liked showing math teachers that I'm smarter than the other students.	
q 16	Doing better than other students in my math courses has been important to me.	
q 17	In math courses, it has been important to me that other students think I am good at mathematics.	
q 18	One of my goals is to show others that I'm good at mathematics.	
q 19	I am determined to do mathematics well when compared to other	
q 20	In my math courses, one of my goals has been to look smart in comparison to the other students.	
q 21	In my math courses, it has been important that I look smart compared to	
q 22	In my math courses, trying hard has been very important to avoid failure.	
q 23	In my math courses, how much I improve has been really important to avoid failure..	
q 24	Understanding the Mathematics has been the main goal to avoid failure.	
q 25	My goal is to avoid learning less in mathematics than my capability	
q 26	My goal is to avoid learning less in mathematics than what it should be	
q 27	To avoid failure in my math courses, it has been ok to make mistakes as long as I am learning.	

q 28	My goal is to focus on trying hard in mathematics to avoid failure.	Mastery avoidance (achievement goal theory)
q 29	In my math courses, learning new ideas and concepts has been very important to avid failure.	
q 30	I try to avoid partially understanding of the subject in mathematics	
q 31	To avoid failure, it's important to me that I thoroughly understand	
q 32	To avoid failure, it's important to me that I learn a lot of new math concepts.	
q 33	To avoid failure, One of my goals is to master a lot of new mathematics	
q 34	My goal is to avoid having bad work when compared to other students concerning mathematics	Performance avoidance (achievement goal theory)
q 35	I try hard to avoid producing worse work than others concerning mathematics.	
q 36	To avoid bad work in math, it has been important to get high scores on tests.	
q 37	My goal is to avoid scoring worse than my classmates in mathematics	
q 38	My goal is to avoid getting negative feedback concerning mathematics	
q 39	My goal is to avoid being less effective in mathematics than other students	
q 40	My goal is to exercise in mathematics to avoid being a worse student than	
q 41	I learn mathematics how to get my work done better and faster	
q 42	I do mathematics for the pleasure that I feel while engaging in difficult tasks.	Intrinsic motivation (Self-determination) goal theory)
q 43	I do mathematics for the pleasure that I feel while learning techniques that I have never tried before.	
q 44	I do mathematics because I feel a lot of personal satisfaction while mastering certain difficult concepts.	
q 45	I do mathematics for the excitement I feel when I am really involved in the activity.	
q 46	I do mathematics for the intense emotions that I feel while I am doing activities that I like.	
q 47	I do mathematics because I like the feeling of being totally immersed in the activity.	
q 48	I do mathematics for the pleasure I feel in discovering new knowledge.	
q 49	I do mathematics for the pleasure it gives me to know more about the concepts I am studying.	
q 50	I do mathematics for the pleasure of discovering new strategies to be successful on tests.	
q 51	I do mathematics for the pleasure of discovering new solution. strategies.	
q 52	In my math courses, I have preferred assignments that really challenge me so I can learn new things.	
q 53	In my math courses, I have preferred assignments that arouse my curiosity, even if they are difficult to learn.	
q 54	The most satisfying thing for me in my math courses has been trying to understand the content as thoroughly as possible.	
q55	In my math courses, when I have had the opportunity I choose assignments that I can learn from even if they don't guarantee a good grade.	

q56	I enjoy doing mathematics very much. Mathematics is fun to do.	
q57	I would describe mathematics as very interesting.	
q58	I think mathematics is enjoyable.	
q59	While doing mathematics, I think about how much I enjoy it.	
q60	Getting a good grade in my math courses has been the most satisfying thing for me.	
q61	The most important thing for me right now is improving my overall grade point average, so my main concern in my math courses has been getting a good grade.	
q62	If I can I want to get better grades in my math courses than most of the other students.	
q63	I want to do well in my math courses because it is important to show my ability to my family, friends, employer, or others.	
q64	I do mathematics because I must do it to feel good about myself.	Extrinsic motivation (Self-determination) goal theory)
q65	I do mathematics because people around me think it is important to be intelligent.	
q66	I do mathematics to show others how good I am at it.	
q67	I do mathematics because it helps me maintain good relationships with my peers.	
q68	I do mathematics because it allows me to be well regarded by people that I know.	
q69	I do mathematics because, in my opinion, it is a good way to meet people.	
q70	I do mathematics because I would feel bad if I was not taking time to do it.	
q71	I do mathematics because it is one of the best ways to develop other aspects of myself.	
q72	I do mathematics because it is a good way to learn lots of things which could be useful to me in other areas of my life.	
q73	I do mathematics because it is absolutely necessary to do mathematics if one wants to understand the world.	
q74	I do mathematics for the prestige of being mathematically literate.	
q75	I make excellent grades on math tests.	Self-efficacy
q76	I have always been successful with math.	
q77	Even when I study very hard, I do poorly in my math.	
q78	I got good grades in my math on my last report card.	
q79	I do well on math assignments.	
q80	I do well on even the most difficult math assignments.	
q81	Seeing adults do well in my math pushes me to do better.	
q82	When I see how my math teacher solves a problem, I can picture myself solving the problem in the same way.	
q83	Seeing kids do better than me in my math pushes me to do better.	
q84	When I see how another student solves a math problem, I can see myself solving the problem in the same way.	
q85	I imagine myself working through challenging math problems successfully.	
q86	I compete with myself in my math.	
q87	My math teachers have told that I am good at learning math.	

q88	People have told me that I have a talent for math.	
q89	Adults in my family have told me what a good math student I am.	
q90	I have been praised for my ability in my math.	
q91	Other students have told me that I'm good at learning math.	
q92	My classmates like to work with me in my math because they think I'm good at it.	Anxiety
q93	Just being in my math class makes feel stressed and nervous.	
q94	Doing math work takes all of my energy.	
q95	I start to feel stressed-out as soon as I begin my math work.	
q96	My mind goes blank and I am unable to think clearly when doing math work.	
q97	I get depressed when I think about learning math.	
q98	My whole body becomes tense when I have to do math.	
q99	If I study in appropriate ways, then I will be able to learn the mathematics for this course.	Expectancy (Expectancy value theory)
q100	It is my own fault when I don't learn mathematics.	
q101	When I try hard enough, then I understand mathematics.	
q102	When I don't understand mathematics, it is because I didn't try hard enough.	
q103	I believe I will receive excellent grades in a math class.	
q104	I'm certain I can understand the most difficult material presented in a math class.	
q105	I'm confident I can understand the basic concepts taught in a math class.	
q106	I'm confident I can understand the most complex material presented by the instructor in a math class.	
q107	I'm confident I can do an excellent job on the assignments and tests in a math class.	
q108	I expect to do well in a math class.	
q109	I'm certain I can master the skills being taught in a math class.	
q110	Considering the difficulty of mathematics and my skills, I think I will do well a math class.	
q111	I do mathematics because learning math plays a role in reaching my future goals.	Task-value (Expectancy Value theory)
q112	I do mathematics because learning math is important for attaining my dreams.	
q113	I do mathematics because my achievement is important for attaining my dreams.	
q114	I do mathematics because my achievement plays a role in reaching my future goals.	
q115	I do mathematics because understanding math is important for becoming the person I want to be.	
q116	I think I will be able to use the mathematics I learn.	
q117	It is important for me to learn mathematics.	
q118	I am very interested in mathematics.	
q119	I think mathematics is useful for me to learn.	

q120	I like mathematics.	
q121	Understanding mathematics is very important to me.	
q122	I am happy in math class room as my need for food, water, shelter, clothing, comfort, rest or sleep, was satisfied	Self-Concept
q123	I am happy in math class room as my Safety need of being protected from dangerous physical and social situations was satisfied	
q124	I feel belongingness in math class room.	
q125	I feel esteem for myself (dignity, achievement, mastery, independence) in math subject.	
q126	I desire for reputation or respect from others (e.g., status, prestige) in math subject.	
q127	I desire to become everything, one is capable of becoming in math subject	
q128	Mathematics is an easy subject to learn	
q129	Mathematics is an easy subject to pass	
q130	Mathematics helps me find a new way of doing things	
q131	Every question in Mathematics is answerable	
q132	Mathematics lessons give me satisfaction	
q133	Mathematics improves my understanding of other subjects	
q134	Mathematics improves my learning and retention capacities	
135	I am good at Mathematics as a subject	
q136	I am capable of making a good grade in Mathematics	
q137	I feel delighted when answering Mathematics questions	
q138	Mathematics facilitates my studying independently	
q139	Mathematics is suitable only for the gifted students	
q140	Mathematics encourages me to apply detailed steps to solving my personal Problems	
q141	Mathematics makes me think fast	
q142	My present knowledge of Mathematical concepts is high	
q143	Mathematics is worth passing well	
q144	I do extra work to learn Mathematics	
q145	Mathematics is important in my future career	
q146	I am comfortable in Mathematics lessons	
q147	I attributed my successes to internal stable causes (ability) in mathematics	
q148	I respond more negatively to competitive learning conditions in mathematics	

q149	I have more positive perceptions of my abilities and expectations for success in mathematics	Attribution (attribution theory)
q150	I feel that I use group work in mathematics class.	
q151	I feel that I have an influence over the mathematics content and I have more involved during the lesson.	
q152	I usually interact more with my teacher in mathematics class	
q153	I feel that I have more often thought of as self-regulating and on-task in mathematics	
q154	I believe that I have better mathematical Proficiency.	
q155	I feel I get less attention and I was not involved in mathematics classroom communications to the same degree.	
q156	I perceive that mathematics is more important.	
q157	I value knowledge and good grades in mathematics	
q158	I handle mathematics in order to be able to work in professions such as engineer, architect or scientist.	
q159	I feel mathematics as difficult subject so that I was not involved in communications about mathematics	
q160	I less believe by my own competence in mathematics	

Additional information (if any)

_____

_____

Appendix 1B: Amharic version questionnaire- for pilot test

ሐዋሳ ዩኒቨርሲቲ
የመምህራን ኮሌጅ
በ Measurement and Evaluation የፒኤች ዲ ዲግሪ ማሟያ ጥናት ለማጥናት

በተሳታፊዎች የሚሞላ ቃለ መጠይቅ

ውድ የጥናቱተሳታፊ፡-

ይህ የፅሑፍ መጠይቅ የተማሪዎች በሂሳብ ትምህርት ላይ ያላቸዉንተነሳሽነት ለማጥናት የሚያገለግል መረጃ ለመሰብሰብ ታስቦ የተዘጋጀ ነዉ። ስለዚህ መጠይቁን ስትመልስ/ሺ በተጠየቁ መጠይቆች መሠረት በሂሳብ ትምህርት ላይ ያለህን/ሽን አመለካከት እያሰብክ/ሽ ይሆናል ማለትነው። የተሰበሰበዉ መረጃ የሚጠቅመዉ የተማሪዎችን የሂሳብ ትምህርት ተነሳሽነት የሚለካ መሳሪያ ለማዘጋጀት ነዉ። ተሳታፊዎች የሚሰጡት ታማኝና ቅን ምላሽ ለጥናቱ የሚኖረው ዋጋ በጣም ከፍተኛ ነው።ስለሆነም በዚህ የፅሁፍመጠይቅ ለቀረቡ ጥያቄዎች ታማኝና ቅን ምላሽ በመስጠት እንድትተባበሩ በትህትና እጠይቃለሁ።በዚህ መጠይቅ የሚሰበሰበው <u>መረጃ ሁሉ ሚስጢራዊነቱ የሚጠበቅ ከመሆኑም በላይ ጥቅም ላይ የሚውለውም ለዚህ ምርምር ስራ ብቻ ይሆናል</u>። ማንኛውንም አይነት ጥያቄ ሲኖርዎት፤እባክዎትን እኔን ለማግኘት ወደ ኋላ እንዳይሉ።በመሆኑም እኔን ለማግኘት በፈለጉ ሰዓት(በሞባይል ስልክ ቁጥር፡0920591011 ወይም በኢሜይል፤belaybekele19@gmail.com) ያገኙኛል።

ለሚደረግልኝ ትብብር በቅድሚያ አመሰግናለሁ!

ክፍልአንድ፡የተሳታፊው ዳራዊ መረጃ

ተገቢውንመልስየ“√” ምልክት በማድረግ መልስ/ሺ።

1. ፆታ፡ሴት ☐ ወንድ ☐

2. ዕድሜ(በዓመት)፡ ከ18 ዓመት በታች ☐ 18- 25 ☐ 26-45 ☐ ከ46 በላይ ☐

3.ዩኒቨርሲቲ: ቦንጋ ☐ ጂማ ☐ ሐዋሳ ☐ አዲስ አበባ ☐ ሌላ ☐

4. የዩኒቨርሲቲ ቆይታ (ዓመት)፡ 1ኛ ዓመት ☐ 2ኛ ዓመት ☐ 3ኛ ዓመት ☐ 4ኛ ዓመትና በላይ ☐

5. ዲፓርትመንት _____

6. የአንተ/ የአንቺ/መታወቂያ ቁጥር: _____

7. የአንተ/ የአንቺ/አጠቃለይ ጂፒኤ/CGPA/ ፡ _____

8. የወላጅ/አሳዳጊ/ የትምህርት ደረጃ

- የእናት ትምህርት ደረጃ፡
  የመጀመሪያ ደረጃ ትምህርትና ከዚያ በታች ☐ ሁለተኛ ደረጃ/ሀይስኩል/ ትምህርት ☐
  የኮሌጅ ዲፕሎማ ☐ ከፍተኛ ደረጃ ትምህርት ☐
- የአባት ትምህርት ደረጃ፡
  የመጀመሪያ ደረጃ ትምህርትና ከዚያ በታች ☐ ሁለተኛ ደረጃ/ሀይስኬል/ ትምህርት ☐
  የኮሌጅ ዲፕሎማ ☐ ከፍተኛ ደረጃ ትምህርት ☐

9. የወላጅ/ያሳዳጊ/ የሥራ ሁኔታ ፡

- የአባት የሥራ ሁኔታ:
  የመንግሥት ሠራተኛ ☐ የግል ሥራ ☐ ግብርና ☐ ሌላ ☐
- የአባት የሥራ ሁኔታ:
  የመንግሥት ሠራተኛ ☐ የግል ሥራ ☐ ግብርና ☐ ሌላ ☐

10. የወላጅ/ያሳዳጊ/ በሳይንስ ያላቸዉ ሙያ

- እናቴ የሳይንስ ሙያ አላት: አዉ ☐ አይደለም ☐
- አባቴ የሳይንስ ባለሙያ ነዉ : አዉ ☐ አይደለም ☐

ክፍል ሁለት፡ የሂሳብ ትምህርት የመማር ተነሳሽነት /**Mathematics Learning Motivation (MLM)/**

ከዚህ ቀጥሎ የሂሳብ ትምህርት የመማር ተነሳሽነት የሚያመለክቱ ዓረፍተ ነገሮች ከነመልሶቻቸው ቀርበዋል።ዓረፍተ ነገሩን በጥንቃቄ ካነበብክ/ሽ በኋላ ከፊት ለፊት ከተዘረዘሩት (1-5) ቁጥሮች ከሃሳቡ ጋር የሚኖርህን/ሽን የስምምነት መጠን በትክክል የሚገልጽ ቁጥርን በመክበብ መልስ/ሺ።

1= አጥብቄ አልስማማም 2= አልስማማም 3= አልወሰንኩም 4= እስማማለሁ 5= አጥብቄእስማማለሁ

#	ዐ/ነገር	1	2	3	4	5
q1	በሂሳብ ትምህርት ብዙ ብሳሳትም ከስህተቴ ስለምማርበት እወደዋለሁ።	1	2	3	4	5
q2	የሂሳብ መልመጃ የሚሰራበት ዋናዉ ምክንያት አዳድስ ነገሮችን ስለሚማርበት ነዉ።	1	2	3	4	5
q3	የሂሳብ ትምህርት እንዳስብ ሲያደርገኝ የበለጠ እወደዋለሁ።	1	2	3	4	5
q4	የሂሳብ መልመጃ የምሰራበት ዋናዉ ምክንያት የተሻለ ዉጤት ለማስመዝገብ ነዉ።	1	2	3	4	5
q5	የሂሳብ መልመጃ የምሰራበት ዋናዉ ምክንያት በትምህርቱ ስለምደሰትበት ነዉ።	1	2	3	4	5
q 6	የሂሳብ መልመጃ የምሰራበት ዋናዉ ምክንያት በትምህርቱ ፍላጎት ስላለኝ ነዉ።	1	2	3	4	5
q 7	በክፍል ዉስጥ የተማርኩትን የሂሳብ ትምህርት ይዘት ሙሉ በሙሉ የመረዳት እቅድ አለኝ።	1	2	3	4	5
q 8	በሂሳብ ትምህርት ካሉኝ ግቦች አንዱ ትምህርቱን የቻልኩትን ያክል መማር ነዉ።	1	2	3	4	5
q 9	የሂባብን ትምህርት በምችለው እቅም የመማር ዓላማ አለኝ።	1	2	3	4	5
q 10	የሂሳብ ትምህርትን በተቻለጥ መጠን በጥልቀት ለመረዳት አጠንክሬ እተጋለሁ።	1	2	3	4	5
q 11	በዚህ ዓመት የሂሳብ ትምህርት ችሎታዬን ማሻሻል ያስፈልገኛል።	1	2	3	4	5
q 12	መምህሩ በክፍል ዉስጥ ሲጠይቅ እኔ ብቻ በትክክል ስመልስ ጥሩ ስሜት ይሰማኛል።	1	2	3	4	5
q 13	በሂሳብ ትምህርት ከሌሎች ተማሪዎች የተሻለ ለመሥራት እፈልጋለሁ።.	1	2	3	4	5
q 14	ከሌሎች ተማሪዎች የተሻለ ከሠራሁ በሂሳብ ትምህርት እንደተሳካልኝ ይሰማኛል።.	1	2	3	4	5
q 15	ከሌሎች ተማሪዎች የተሻለ ጎበዝ መሆኔን ለሂሳብ መምህሬ ማሳየት እወዳለሁ።	1	2	3	4	5
q 16	በሂሳብ ትምህርት ከሌሎች ተማሪዎች የተሻለ መሥራት ለእኔ አስፈላጊ ነዉ ።	1	2	3	4	5
q 17	ሌሎች ተማሪዎች በሂሳብ ትምህርት የተሻልኩ እንደሆንኩ ማሰብ አለባቸዉ።	1	2	3	4	5
q 18	ከግቦቼ አንዱ በሂሳብ ትምህርት የተሻልኩ እንደሆንኩ ለሌሎች ማሳየት ነዉ።	1	2	3	4	5
q 19	በሂባብ ትምህርት ደህና በመሥራት ከሌሎች ይልቅ ቆራጥ ነኝ።	1	2	3	4	5
q 20*	ከግቦቼ አንዱ በሂሳብ ትምህርት ከሌሎች ተማሪዎች የተሻልኩ ጎበዝ መሆን ነዉ።	1	2	3	4	5
q 21*	በሂሳብ ትምህርት ከሌሎች ተማሪዎች የተሻልኩ ጉበዝ መሆን ለእኔ አስፈላጊ ነዉ።	1	2	3	4	5
q 22	በሂሳብ ትምህርት ጠንክሮ መሞከር ላለመዉደቅ አስፈላጊ ነዉ።	1	2	3	4	5
q 23	በሂሳብ ትምህርት መሻሻል ማሳየት ላለመዉደቅ አስፈላጊ ነዉ።.	1	2	3	4	5
q 24	ሂሳብን በትክክል መረዳት በዋናነት በሂሳብ ትምህርት ላለመዉደቅ ይጠቅማል።.	1	2	3	4	5
q 25	በሂሳብ ትምህርት ከምችለዉ አቅም በታች ያለመሥራት ዓላማ አለኝ።	1	2	3	4	5
q 26	በሂሳብ ትምህርት ከሚገባኝ በታች ያለመሆን ዓላማ አለኝ ።.	1	2	3	4	5
q 27*	በሂሳብ ትምህርት እስካልወደኩና ከስህተቴ እየተማርኩ እስከሆንኩ ድረስ ብሳሳትም ግድ የለኝም።	1	2	3	4	5
q 28	በሂሳብ ትምህርት ላለመዉደቅ አጠንክሬ የመሥራት ግብ አለኝ	1	2	3	4	5
q 29	በሂሳብ ትምህርት ላለመዉደቅ አዳዲስ የሂሳብ ጽንሰ-ሐሳቦችን መማር ጠቃሚ ነዉ	1	2	3	4	5
q 30	የሂሳብ ትምህርት በከፊል መረዳትን ለመተው እጥራለሁ።	1	2	3	4	5
q 31	ላለመዉደቅ ሂሳብን በዝርዝር መረዳት ጠቃሚ ነዉ ።	1	2	3	4	5
q 32	ላለመዉደቅ ብዙ አዳዲስ የሂሳሕብ ጽንሰ-ሐሳቦችን መማር ጠቃሚ ነዉ።	1	2	3	4	5
q 33	በሂሳብ ላለመዉደቅ ከግቦቼ አንዱ ብዙ አዳዲስ ሂሳቦችን ማስተር ማድረግ ነዉ።	1	2	3	4	5
q 34	የሂሳብ ትምህርትን አስመልክቶ ከሌሎች ተማሪዎች የከፋ ላለመሥራት ዓላማ አለኝ ።	1	2	3	4	5
q 35	የሂሳብ ትምህርትን አስመልክቶ ከሌሎች ተማሪዎች የከፋ ላለመሥራት አጠንክሬ እጥራለሁ።	1	2	3	4	5
q 36	ከሌሎች የከፋ ላለመሥራት በሂሳብ ትምህርት በቴስት ከፍተኛ ማስመዝገብ አስፈላጊ ነዉ።	1	2	3	4	5
q 37*	በሂሳብ ትምህርት ከሌሎች ተማርዎች ዝቅ ያለማለት ዓላማ አለኝ።	1	2	3	4	5
q 38*	በሂሳብ ትምህርት አሉታዊ ግብረ-መልስ ያለማግኘት ዓለማ አለኝ	1	2	3	4	5
q 39	በሂሳብ ትምህርት ከሌሎች ተማርዎች ባነሰ መልኩ ዉጤታማ ያለመሆን ዓላማ አለኝ።	1	2	3	4	5
q 40	ለሌሎች ተማሪዎች ዝቅ ላለማለት በሂሳብ ትምህርት የመለማመድ ዓላማ አለኝ	1	2	3	4	5
q 41	ሂሳብን የምማረዉ ሥራዬን በፍጥነትና በተቀላጠፈ መንገድ ለመሥራት እንዲረዳኝ ነዉ	1	2	3	4	5
q 42	የሂሳብን መልመጃ የምሰራዉ አስቸጋሪ መልመጃዎችን ስሰራ ደስታ ስለሚሰጠኝ ነዉ።	1	2	3	4	5
q 43	የሂሳብን መልመጃ የምሰራዉ ያልሞከርኳቸዉን ሥልቶች ተምሬ ስለምደሰትበት ነዉ።	1	2	3	4	5
q 44	የሂሳብን መልመጃ የምሰራዉ አስቸጋሪ ሐሳቦችን ማስተር ሳደርግ ለሚሰጠኝ የግል እርካታ ነዉ።	1	2	3	4	5
q 45	የሂሳብን መልመጃ የምሰራዉ በሥራዉ በተጨባጭ ስሳተፍ በዉስጤ ስለሚፈጥርብኝ አድናቆት ነዉ።	1	2	3	4	5
q 46	የሂሳብን መልመጃ የምሰራዉ የምወዳቸዉን ጥያቄዎች ስሠራ ከፍተኛ ስሜት ስለሚፈጥርብኝ ነዉ።	1	2	3	4	5

q 47	የሂሳብን መልመጃ የምሰራዉ በዉሰጡ መስመጥ ስለሚፈጥርብኝ ስሜት ነዉ።	1	2	3	4	5
q 48	የሂሳብን መልመጃ የምሰራዉ አዲስ እዉቀት ሳገኝ ስለሚፈጥርብኝ ደስታ ነዉ።	1	2	3	4	5
q 49	የሂሳብን መልመጃ የምሰራዉ ስለምማረዉ ትምህርት ብዙ ስለሚያሳዉቅ ነዉ ።	1	2	3	4	5
q 50	የሂሳብን መልመጃ የምሰራዉ በቴስት እንድሳካልኝ አዲስ ስልት ስለሚያሳይ ነዉ ።	1	2	3	4	5
q 51	የሂሳብን መልመጃ የምሰራዉ አዲስ የመፍትሔ ስልት ስለሚያሳይ ነዉ።	1	2	3	4	5
q 52	የሂሳብ ትምህርት ስማር ጠንከር ያለ አሳይመንትን አዲስ ነገር ስለሚማርበት እመርጣለሁ።	1	2	3	4	5
q 53	የሂሳብ ትምህርት ስማር የማወቅ ጉጉት የሚያነሳሳ አሳይመንትን ጠንከር ቢልም እመርጣለሁ።	1	2	3	4	5
q 54	የሂሳብን ትምህርት ይዘቱን በተቻለ መጠን በደንብ መረዳት መሞከር አስፈላጊ ነዉ።	1	2	3	4	5
q55*	የሂሳብ ትምህርት ስማር አስተማሪ የሆነ አሳይመንትን ስለምማርበት ጥሩ ግሬድ ባለገኝ እንኳ እመርጣለሁ።	1	2	3	4	5
q56	የሂሳብን መልመጃ መሥራት ያስደስተኛል፤ ሂሳብ ያዝናናኛል።	1	2	3	4	5
q57	ሂሳብ በጣም አስደሳች እንደሆነ እገልጻለሁ ።	1	2	3	4	5
q58	ሂሳብ ተወዳጅ እንደሆነ አዉቃለሁ.	1	2	3	4	5
q59	የሂሳብን መልመጃ ስሠራ ምን ያህል እንደሚያስደስተኝ እስባለሁ	1	2	3	4	5
q60*	በሂሳብ ትምህርት ጥሩ ግሬድ ማግኘት ለእኔ በጣም ያረካኛል ።	1	2	3	4	5
q61	አጠቃለይ ግሬድ ማሻሻል ስለምፈልግ በሂሳብ ትምህርት ጥሩ ግሬድ ማግኘት ለእኔ ትልቁ ጉዳዬ ነዉ።	1	2	3	4	5
q62*	በሂሳብ ትምህርት ጥሩ ግሬድ ማስመዝገብ እችላለሁ።	1	2	3	4	5
q63	ለቤተሰቦቼ፣ ለጓደኞቼ፣ ለቀጣሪዬና ለሌሎች ችሎታዬን ስለሚያሳይ በሂሳብ ትምህርት ጥሩ መሥራት እፈልጋለሁ ።	1	2	3	4	5
q64	የሂሳብ መልመጃ የምሰራዉ በሂሳብ ጥሩ እንደሆነኩ ለማሰብ የግድ መሥራት ስላለብኝ ነዉ።	1	2	3	4	5
q65	የሂሳብ መልመጃ የምሰራዉ ሰዎች ሂሳብ ብልህ ያደርጋል ስለሚሉ ነዉ።	1	2	3	4	5
q66	የሂሳብ መልመጃ የምሰራዉ ሌለሎች ምን ያህል በሂሳብ ጎበዝ እንደሆንኩ ለማሳየት ነዉ።	1	2	3	4	5
q67	የሂሳብ መልመጃ የምሰራዉ ከእኩዮቼ ጋር ጥሩ ግኑኝነት እንዲኖረኝ ስለሚያደርግ ነዉ።	1	2	3	4	5
q68	የሂሳብ መልመጃ የምሰራዉ ለማቃቸዉ ሰዎች ጥሩ ክብር እንዲኖረኝ ስለሚያደርግ ነዉ።	1	2	3	4	5
q69*	የሂሳብ መልመጃ የምሰራዉ በእኔ አመለካከት ከሰዉ ለመወያየት ጥሩ መንገድ ስለሚከፍት ነዉ።	1	2	3	4	5
q70	የሂሳብ መልመጃ የምሰራዉ ጊዜ ወስጄ ካልሠራሁት ጥሩ ስሜት ስለማይሰማኝ ነዉ።	1	2	3	4	5
q71	የሂሳብ መልመጃ የምሰራዉ እይታዎቼን ለማስፋት አንዱ መንገድ ስለሆነ ነዉ።	1	2	3	4	5
q72	የሂሳብ መልመጃ የምሰራዉ ሌሎች በህይወቴ ጠቃሚ ነገሮችን ስለሚማርበት ነዉ።	1	2	3	4	5
q73	የሂሳብ መልመጃ የምሰራዉ ዓለምን ለመረዳት ሂሳብን መማር በእጅጉ አስፈላጊ በመሆኑ ነዉ።	1	2	3	4	5
q74	የሂሳብ መልመጃ የምሰራዉ ሂሳብ ማወቅ ክብር ስላለዉ ነዉ።	1	2	3	4	5
q75	በሂሳብ ፈተና እጅግ አመሪቂ ዉጤት አስመዘግባለሁ።	1	2	3	4	5
q76	በሂሳብ ትምህርት ሁሌም ስኬታማ ነኝ።	1	2	3	4	5
q77	ምንም እንኳ ጠንክሬ ባጠናም በሂሳብ ውጤታማ አልሆንም።	1	2	3	4	5
q78*	በሂሳብ ትምህርት ጥሩ ግሬድ በስተመጨረሻ አገኛለሁ።	1	2	3	4	5
q79	በሂሳብ አሳይመንቶች ደህና እሠራለሁ።	1	2	3	4	5
q80*	በሂሳብ አሳይመንቶች ምንም አስቸጋሪ ቢሆን እንኳ ደህና እሠራለሁ።	1	2	3	4	5
q81	ታላላቆቼ በሂሳብ ጠንክሮ ሲሠሩ ማየት እኔም እነሱን አይቼ እንድበረታ ያደርገኛል ።	1	2	3	4	5
q82	የሂሳብ መምህሬ ጥያቄ ሲሠሩ ማየት እኔም በዚያ አኳኋን እንድሠራ ያደርገኛል።	1	2	3	4	5
q83	ታናናሾቼ በሂሳብ ጠንክሮ ሲሠሩ ማየት እኔም የበለጠ እንድሠራ ያበረታኛል።	1	2	3	4	5
q84	ሌሎች ተማሪዎች ጥያቄ ሲሠሩ ማየት እኔም በዚያ አኳኋን እንድሠራ ያደርገኛል።	1	2	3	4	5
q85	ጠንከር ያሉ የሂሳብ ጥያቄዎችን በተሳካ ሁኔታ እንደምሠራ አዉቃለሁ።	1	2	3	4	5
q86	በሂሳብ ትምህርት ከራሴ ጋር እወዳደራለሁ።	1	2	3	4	5
q87	በሂሳብ ትምህርት ደህና መሆኔን መምህራኖቼ ይነግሩኛል።	1	2	3	4	5
q88	የሂሳብ ተሰጥኦ እንዳለኝ ሰዎች ይነግሩኛል።	1	2	3	4	5
q89*	ጥሩ የሂሳብ ተማሪ መሆኔን ከቤተሰቦቼ ታላላቆቼ ነግረዉኛል።	1	2	3	4	5
q90	በሂሳብ ችሎታዬ ምስጉን ነኝ።	1	2	3	4	5

q91	በሂሳብ ትምህርት ጥሩ መሆኔን ሌሎች ተማሪዎች ነግረዉኛል።	1	2	3	4	5
q92	የክፍሌ ተማሪዎች በሂሳብ ትምህርት ደህና በመሆኔ አብረዉኝ ለመሥራት ይፈልጋሉ።	1	2	3	4	5
q93	በሂሳብ ክፍለ ጊዜ ክፍል ዉስጥ ዉጥረትና ጭንቀት ይሰማኛል።	1	2	3	4	5
q94*	ሂሳብ ስሠራ አቅሜን ይጨርስብኛል።	1	2	3	4	5
q95	ሂሳብ መሥራት ስጀምር መጨነቅ እጀምራለሁ።	1	2	3	4	5
q96	ሂሳብ መሥራት ስጀምር አዕምሮዬ ባዶ ሆኖ በግልጽ ማሰብ አልችልም።	1	2	3	4	5
q97	ስለሂሳብ ትምህርት መማር ሳስብ ያስጨንቀኛል።	1	2	3	4	5
q98	ሂሳብ ልሠራ ሲል ሁሉም ሰዉነቴ ይወጣጠራል።	1	2	3	4	5
q99*	በአግባቡ ባጠና የሂሳብ ትምህትን በአግባቡ እመራለሁ የሚል ግምት አለኝ።	1	2	3	4	5
q100	ሂሳብን በአግባቡ የማልማረዉ በራሴ ጥፋት ነዉ።	1	2	3	4	5
q101	ጠንክሬ ብሞክር ሂሳብን እረዳለሁ ብዬ እገምታለሁ።።	1	2	3	4	5
q102*	ሂሳብን በአግባቡ የማልማረዉ ጠንክሬ ባለመሞከሬ ምክንያት ነዉ።	1	2	3	4	5
q103	በሂሳብ ጥሩ ዉጤት የማስመዝገብ እምነት አለኝ።	1	2	3	4	5
q104	ክፍል ዉስጥ ስማር ማነኛዉንም አስቸጋሪ ሂሳብ እንደምረዳ እርግጠኛ እሆናለሁ።	1	2	3	4	5
q105	ሂሳብ ስማር መሠረታዊ ፅንሰ ሀሳቡን እንደምረዳ በራሴ እተማመናለሁ።	1	2	3	4	5
q106	ክፍል ዉስጥ ስማር ማነኛዉንም አስቸጋሪ የሂሳብ ፅንሰ ሀሳብ እንደምረዳ በራሴ እተማመናለሁ።	1	2	3	4	5
q107	በሂሳብ ቴስትና አሳይመንት አመሪቂ ዉጤት እንደማስመዘግብ በራሴ እተማመናለሁ።	1	2	3	4	5
*q108	በሂሳብ ክፍለጊዜ ጥሩ እንደምሰራ አስባለሁ።	1	2	3	4	5
q109	በሂሳብ ክፍለጊዜ የተማሪኩትን ችሎታ ማስተር እንደማደርግ እርግጠኛ እሆናለሁ ።	1	2	3	4	5
q110	የሂሳብን አስቸጋሪነትና ችሎታዬን በማገናዘብ በሂሳብ ትምህርት ጠንክሬ እሠራሁ።	1	2	3	4	5
q111	ሂሳብን የምሠራዉ የሂሳብ ትምህርት ለወደፊቱ ዓላማ አወንታዊ ሚና ስላለዉ ነዉ።	1	2	3	4	5
*q112	ሂሳብን የምሠራዉ የሂሳብ ትምህርት ሀልሜን ለማሳካት አስፈላጊ ስለሆነ ነዉ።	1	2	3	4	5
q113	ሂሳብን የምሠራዉ ሀልሜን ለማሳካት ጥሩ ዉጤት አስፈላጊ ስለሆነ ነዉ።	2	3	4	5	
*q114	ሂሳብን የምሠራዉ የወደፊቱን ዓላማ ለማሳካት ጥሩ ዉጤት አስፈላጊ ስለሆነ ነዉ።	2	3	4	5	
q115	ሂሳብን የምሠራዉ የሚፈልጉትን ሰዉ ለመሆን ሂሳብ ማወቅ በማስፈለጉ ነዉ።	1	2	3	4	5
q116	የተማርኩትን ሂሳብ መጠቀም እችላለሁ ብዬ አስባለሁ።	1	2	3	4	5
*q117	ሂሳብ መማር ለእኔ አስፈላጊ ነዉ።	1	2	3	4	5
q118	በሂሳብ በጣም ደስተኛ ነኝ።	1	2	3	4	5
q119	ሂሳብ መማር ለእኔ ጠቃሚ ነዉ ብዬ አስባለሁ።	1	2	3	4	5
q120	ሂሳብን እወዳለሁ።	1	2	3	4	5
q121	ሂሳብን መረዳት ለእኔ በጣም አስፈላጊ ነዉ።	1	2	3	4	5
q122	ምግብ፣ ዉሃ፣ልብስ፣ማረፍያ ቤትና በቂ እረፍት ስለማገኝ በሂሳብ ትምህርት ደስተኛ ሆኜ እማራለሁ።	1	2	3	4	5
q123	ጸጥታና ደህንነቴ ስለሚጠበቅ በሂሳብ ትምህርት ደስተኛ ሆኜ እማራለሁ።	1	2	3	4	5
q124	የሂሳብን ትምህርት በፍቅር እማራለሁ።	1	2	3	4	5
q125	በሂሳብ ትምህርት ባለኝ ችሎታ በራስ መተማመን ይሰማኛል።	1	2	3	4	5
q126	በሂሳብ ትምህርት ባለኝ ችሎታ ሰዎች እንዲያደንቁኝ እፈልጋለሁ።	1	2	3	4	5
q127	በሂሳብ ትምህርት ባለኝ ችሎታ ሰዎች የደረሱበት መድረስ እፈልጋለሁ።	1	2	3	4	5
q128	የሂሳብ ትምህርት ለመማር ቀላል ነዉ	1	2	3	4	5
q129	የሂሳብ ትምህርት ለማለፍ ቀላል ነዉ	1	2	3	4	5
q130	ሂሳብ ነገሮችን በተለየ መንገድ እንድሠራ ይረዳኛል	1	2	3	4	5
q131	ሁሉም የሂሳብ ጥያቄዎች የሚመለሱ ናቸዉ	1	2	3	4	5
q132	የሂሳብ ትምህርት እርካታ ይሰጠኛል	1	2	3	4	5
q133	ሂሳብ ሌሎች ትምህርቶችን እንድረዳ ይረዳኛል	1	2	3	4	5
q134	ሂሳብ የመማርና የማስተዋል አቅሜን ያሻሽልልኛል	1	2	3	4	5

q135	በሂሳብ ትምህርት ጥሩ ነኝ	1	2	3	4	5
q136	በሂሳብ ጥሩ ዉጤት ለማስመዝገብ ብቁ ነኝ	1	2	3	4	5
q137	የሂሳብ ጥያቄዎችን ስመልስ ደስታ ይሰማኛል	1	2	3	4	5
q138	ሂሳብ በግሌ እንዳጠና ይረዳኛል	1	2	3	4	5
q139	ሂሳብ ሚቹ የሚሆነዉ ተሰጥኦ ላላቸዉ ተማሪዎች ብቻ ነዉ	1	2	3	4	5
q140	ሂሳብ የግል ችግሮቼን ሰፋ ባለ መንገድ እንድፈታ ይረዳኛል	1	2	3	4	5
q141	ሂሳብ በፍጥነት እንዳስብ ያደርገኛል	1	2	3	4	5
q142	በሂሳብ ትምህርት ያለኝ እዉቀት ከፍ ያለ ነዉ	1	2	3	4	5
q143	ሂሳብ በሚገባ ነገሮችን እንድፈጽም ይረዳኛል	1	2	3	4	5
*q144	ሂሳብን ለመማር ተጨማሪ ተግባራትን አከናዉናለሁ	1	2	3	4	5
q145	ሂሳብ ለወደፊቱ ሙያዬ ጠቃሚ ነዉ	1	2	3	4	5
q146	በሂሳብ ትምህርት ምቾት ይሰማኛል	1	2	3	4	5
*q147	የሂሳብ ትምህርት ስኬቴ ከሂሳብ ችሎታዬ ጋር የተየያዘ ነዉ።	1	2	3	4	5
q148	በሂሳብ ትምህርት የፉክክር አኳኋን ላይ አሉታዊ ምላሽ አለኝ።	1	2	3	4	5
q149	በሂሳብ ትምህርት ስኬታማነትና በችሎታዬ ላይ አዎንታዊ ግንዛቤ አለኝ።	1	2	3	4	5
q150	በሂሳብ ክፍለ ጊዜ የቡድን ሥራ ይመቸኛል።	1	2	3	4	5
q151	በሂሳብ ትምህርት ይዘት ላይ ተፅእኖ እንዳለኝና ብዙ እንደምሳተፍ ይሰማኛል።	1	2	3	4	5
q152	በሂሳብ ትምህርት ከመምህሬ ጋር ብዙ መስተጋብር እፈጥራለሁ።	1	2	3	4	5
q153	በሂሳብ ትምህርት በአብዛኛዉ በግል በማጥናትና ጥያቄ በመሥራት እማራለሁ።	1	2	3	4	5
q154	በሂሳብ የተሻለ ብቃት እንዳለኝ አምናለሁ።	1	2	3	4	5
q155	በሂሳብ ክፍለ ጊዜትኩረት እንደማላገኝና ከሌሎች በእኩል እንደማልሳተፍ ይሰማኛል።.	1	2	3	4	5
q156*	ሂሰብ በጣም ጠቃሚ እንደሆነ እገነዘባለሁ።	1	2	3	4	5
q157	ለሂሳብ ትምህርት እዉቀትና ለጥሩ ዉጤት ዋጋ እሰጣለሁ።	1	2	3	4	5
q158	ሂሳብን የምማረዉ በምሕንድስና፣ በንድፍና ፕላን፣ በምርምርና በመሳሰሉ ሙያዎች ብቁ ለመሆን ነዉ።	1	2	3	4	5
q159	ሂሳብ አስቸጋር ትምህርት እንደሆነ ስለማስብ በክፍል ዉስጥ አልሳተፍም።	1	2	3	4	5
q160	በሂሳብ ብቃቴ አልተማመንም።	1	2	3	4	5

ተጨማሪ ሐሳብ (ካለ)

_____

_____

Appendix-2 A: The experts Review

Dear Experts,

This inventory contains 12 domains and 160 items related to mathematics learning Motivation. I need your expert judgment on the degree of relevant each item to the measured domains. Your review should be based on the definition and relevant terminologies that are provided to you. Please be as objective and constructive as possible in your review and use the following rating scale.

1=Very weakly represents the Construct
2= somewhat weakly represents the Construct
3= Unsure
4= somewhat strongly represents the Construct
5= Very strongly represents the Construct

Constructs and definitions	Item No.	Potential Items	Epert-1	Expert-2	Expert-3	Expert-4	Expert-5	Expert-6	Expert-7	Exper-8	Expert_9	Comment
Mastery approach Definition : Mastery-approach goals represent a focus on learning and understanding the course material	1	I like mathematics that I'll learn from even if I make a lot of mistakes.	3	4	4	4	5	4	4	4	5	
	2	An important reason why I do mathematics is because I like to learn new things.	3	5	5	4	4	5	5	5	5	
	3	I like mathematics best when it really makes me think.	3	5	4	4	3	4	4	4	5	
	4	An important reason why I do mathematics is because I want to get better at it.	4	5	4	5	5	5	3	4	5	
	5	An important reason I do mathematics is because I enjoy it.	2	4	4	4	5	4	3	3	5	
	6	I do mathematics because I'm interested in it.	3	5	3	3	4	4	5	3	5	
	**7	My goal is to fully understand the mathematics contents taught in class	5	4	5	4	4	4	4	4	4	
	8	One of my goals in my math courses has been to learn as much as I can.	3	4	3	3	3	3	3	3	3	

	**9	My goal is to learn mathematics as much as I can	4	4	5	5	4	5	4	5	5	
	**10	I try very hard to understand as deep as possible in mathematics subject matter	4	4	4	4	5	5	5	4	4	
	11	It's important to me that I improve my math skills this year	3	5	4	5	3	4	5	5	4	
Performance approach Definition: performance-approach goals, generally defined as goals oriented toward outperforming others	12	I would feel good if I was the only one who could answer the teacher's questions.	3	3	4	4	3	3	4	4	5	
	13	In math courses, I have wanted to do better than other students.	1	4	4	5	5	4	4	5	4	
	14	I have felt successful in my math courses when I did better than the other students.	1	5	4	4	4	4	5	5	5	
	15	I have liked showing math teachers that I'm smarter than the other students.	1	5	5	5	4	5	5	5	4	
	16	Doing better than other students in my math courses has been important to me.	3	4	5	5	5	5	5	5	5	
	17	In math courses, it has been important to me that other students think I am good at mathematics.	4	3	4	5	5	5	5	4	3	

	18	One of my goals is to show others that I'm good at mathematics.	3	3	5	5	5	5	5	5	5	
	**19	I am determined to do mathematics well when compared to other students	5	5	5	4	4	5	4	5	4	
	20	In my math courses, one of my goals has been to look smart in comparison to the other students.	3	3	5	5	5	5	5	5	5	
	21	In my math courses, it has been important that I look smart compared to others.	3	5	4	4	4	3	5	5	5	
Mastery avoidance Definition: mastery-avoidance goals represent a focus on not losing one's skills or competence	22	In my math courses, trying hard has been very important to avoid failure.	1	5	4	5	4	4	5	5	5	
	23	In my math courses, how much I improve has been really important to avoid failure..	3	5	4	4	5	4	4	4	5	
	24	Understanding the Mathematics has been the main goal to avoid failure.	3	5	3	4	3	4	4	4	3	
	**25	My goal is to avoid learning less in mathematics than my capability	4	4	4	5	4	5	4	5	4	
	**26	My goal is to avoid learning less in mathematics than what it should be	5	5	5	4	4	5	4	4	5	
	27	To avoid failure in my math courses, it has been ok to make mistakes as long as I am learning.	5	4	3	5	3	3	4	5	5	

	28	My goal is to focus on trying hard in mathematics to avoid failure.	3	5	3	4	4	3	4	3	4	
	***29	In my math courses, learning new ideas and concepts has been very important to avid failure.	5	5	5	4	4	4	5	5	5	
	**30	I try to avoid partially understanding of the subject in mathematics	4	5	5	4	5	4	4	5	4	
	**31	To avoid failure, it's important to me that I thoroughly understand mathematics	5	5	4	5	4	5	4	4	5	
	32	To avoid failure, it's important to me that I learn a lot of new math concepts.	3	3	5	5	5	5	5	5	5	
	33	To avoid failure, One of my goals is to master a lot of new mathematics	3	3	5	5	4	5	4	5	4	
Performance avoidance Definition: performance-avoidance goals are where students are focused on not looking incompetent to others	**34	My goal is to avoid having bad work when compared to other students concerning mathematics	4	5	4	5	5	5	4	4	4	
	**35	I try hard to avoid producing worse work than others concerning mathematics.	5	4	5	5	4	5	5	4	5	
	36	To avoid bad work in math, it has been important to get high scores on tests.	4	5	4	3	5	5	5	5	4	
	37	My goal is to avoid scoring worse than my classmates in mathematics	2	2	5	5	5	5	5	5	5	

	***38	My goal is to avoid getting negative feedback concerning mathematics	4	4	5	5	5	5	5	5	5	
	**39	My goal is to avoid being less effective in mathematics than other students	4	5	4	4	5	4	4	5	4	
	40	My goal is to exercise in mathematics to avoid being a worse student than others	2	5	3	3	4	4	4	3	3	
	41	I learn mathematics how to get my work done better and faster	3	4	3	5	5	4	4	5	4	
Intrinsic motivation Definition: Intrinsic motivation is students' motivation to learn mathematics for their own personal goals, mental satisfaction, physical well-being, or enjoyment in the moment and so on.	42	I do mathematics for the pleasure that I feel while engaging in difficult tasks.	1	3	4	4	4	4	4	5	5	
	**43	I do mathematics for the pleasure that I feel while learning techniques that I have never tried before.	4	5	5	5	4	4	5	5	4	
	**44	I do mathematics because I feel a lot of personal satisfaction while mastering certain difficult concepts.	4	4	5	4	4	5	5	5	5	
	45	I do mathematics for the excitement I feel when I am really involved in the activity.	2	5	3	3	4	4	4	3	3	
	46	I do mathematics for the intense emotions that I feel while I am doing activities that I like.	3	4	3	5	5	4	4	5	4	
	47	I do mathematics because I like the feeling of being totally immersed in the activity.	1	3	4	4	4	4	4	5	5	

	**48	I do mathematics for the pleasure I feel in discovering new knowledge.	5	4	5	5	4	4	5	5	5	
	**49	I do mathematics for the pleasure it gives me to know more about the concepts I am studying.	4	4	5	5	4	5	4	5	5	
	**50	I do mathematics for the pleasure of discovering new strategies to be successful on tests.	5	5	5	4	4	4	5	4	4	
	**51	I do mathematics for the pleasure of discovering new solution. strategies.	4	4	4	5	5	4	5	5	4	
	52	In my math courses, I have preferred assignments that really challenge me so I can learn new things.	2	4	3	4	4	4	4	5	4	
	53	In my math courses, I have preferred assignments that arouse my curiosity, even if they are difficult to learn.	3	4	3	3	3	3	4	4	3	
	54	The most satisfying thing for me in my math courses has been trying to understand the content as thoroughly as possible.	3	4	4	5	5	4	5	5	5	
	55	In my math courses, when I have had the opportunity I choose assignments that I can learn from even if they don't guarantee a good grade.	3	4	4	5	5	4	5	5	4	

	**56	I enjoy doing mathematics very much. Mathematics is fun to do.	5	5	4	4	5	4	5	5	4	
	**57	I would describe mathematics as very interesting.	5	5	5	4	4	4	5	5	5	
	58	I think mathematics is enjoyable.	4	4	4	5	5	4	5	4	3	
	59	While doing mathematics, I think about how much I enjoy it.	2	3	3	4	3	3	5	4	4	
	60	Getting a good grade in my math courses has been the most satisfying thing for me.	4	4	3	5	3	3	3	5	5	
	**61	The most important thing for me right now is improving my overall grade point average, so my main concern in my math courses has been getting a good grade.	4	4	4	4	5	4	4	4	5	
	62	If I can I want to get better grades in my math courses than most of the other students.	2	3	4	4	5	4	5	5	5	
	***63	I want to do well in my math courses because it is important to show my ability to my family, friends, employer, or others.	4	4	4	4	5	4	4	4	4	
Extrinsic motivation Definition: Extrinsic	**64	I do mathematics because I must do it to feel good about myself.	4	4	4	5	4	4	4	5	4	

motivation is students' motivation to learn mathematics fearing to fail exam in mathematics and expecting good results in mathematics.	65	I do mathematics because people around me think it is important to be intelligent.	1	5	5	5	4	4	4	3	2	
	**66	I do mathematics to show others how good I am at it.	4	5	5	5	5	5	5	4	4	
	**67	I do mathematics because it helps me maintain good relationships with my peers.	4	4	4	4	4	5	5	5	4	
	68	I do mathematics because it allows me to be well regarded by people that I know.	3	4	3	4	5	5	4	5	4	
	69	I do mathematics because, in my opinion, it is a good way to meet people.	3	4	3	4	3	4	3	4	5	
	70	I do mathematics because I would feel bad if I was not taking time to do it.	3	4	3	4	4	5	4	3	4	
	71	I do mathematics because it is one of the best ways to develop other aspects of myself.	4	4	4	4	4	5	4	4	3	
	72	I do mathematics because it is a good way to learn lots of things which could be useful to me in other areas of my life.	3	5	4	3	5	4	5	5	4	
	**73	I do mathematics because it is absolutely necessary to do mathematics if one wants to understand the world.	4	4	4	4	4	4	5	5	5	
	74	I do mathematics for the prestige of being mathematically literate.	1	5	5	4	5	4	3	3	3	

	75	I make excellent grades on math tests.	1	4	5	5	4	5	3	3	4	
Self-efficacy **Definition**: students ask themselves whether they are **cable of fully performing** given task in the process of learning mathematics	**76	I have always been successful with math.	5	5	5	5	5	5	5	5	5	
	**77	Even when I study very hard, I do poorly in my math.	5	5	5	5	5	5	5	5	4	
	***78	I got good grades in my math on my last report card.	4	5	4	4	4	4	4	4	4	
	79	I do well on math assignments.	3	4	3	5	5	4	4	5	4	
	80	I do well on even the most difficult math assignments.	1	3	4	4	4	4	4	5	5	
	**81	Seeing adults do well in my math pushes me to do better.	5	4	4	5	5	5	5	5	5	
	**82	When I see how my math teacher solves a problem, I can picture myself solving the problem in the same way.	4	4	4	4	5	4	5	4	4	
	83	Seeing kids do better than me in my math pushes me to do better.	2	4	3	4	4	4	4	5	4	
	84	When I see how another student solves a math problem, I can see myself solving the problem in the same way.	3	4	3	3	3	3	4	4	3	

	85	I imagine myself working through challenging math problems successfully.	3	4	4	5	5	4	5	5	5	
	86	I compete with myself in my math.	3	4	4	5	5	4	5	5	4	
	**87	My math teachers have told that I am good at learning math.	5	5	5	4	4	5	5	4	4	
	88	People have told me that I have a talent for math.	2	3	4	4	5	4	5	5	5	
	89	Adults in my family have told me what a good math student I am.	2	3	3	4	5	4	3	4	4	
	**90	I have been praised for my ability in my math.	5	5	4	5	5	5	5	4	4	
	**91	Other students have told me that I'm good at learning math.	4	4	5	5	5	5	5	5	5	

	92	My classmates like to work with me in my math because they think I'm good at it.	2	5	3	3	4	4	4	3	3	
	93	Just being in my math class makes feel stressed and nervous.	3	4	3	5	5	4	4	5	4	
	94	Doing math work takes all of my energy.	1	3	4	4	4	4	4	5	5	
Anxiety : A feeling of tension on operating mathematics	**95	I start to feel stressed-out as soon as I begin my math work.	5	5	4	4	4	4	4	4	4	
	**96	My mind goes blank and I am unable to think clearly when doing math work.	4	4	5	4	4	5	4	4	5	
	97	I get depressed when I think about learning math.	2	4	3	4	4	4	4	5	4	
	98	My whole body becomes tense when I have to do math.	3	4	3	3	3	3	4	4	3	
Expectancy **Definition**: focuses on the role of students' expectancies for academic success	***99	If I study in appropriate ways, then I will be able to learn the mathematics for this course.	4	4	4	5	5	4	5	5	5	
	100	It is my own fault when I don't learn mathematics.	3	4	4	5	5	4	5	5	4	
	**101	When I try hard enough, then I understand mathematics.	4	5	5	4	5	4	5	5	4	
	102	When I don't understand mathematics, it is because I didn't try hard enough.	4	5	5	4	4	3	3	4	4	

	103	I believe I will receive excellent grades in a math class.	4	4	4	5	5	4	5	3	5	
	104	I'm certain I can understand the most difficult material presented in a math class.	4	5	5	4	4	4	3	5	4	
	105	I'm confident I can understand the basic concepts taught in a math class.	4	4	5	5	5	5	5	5	3	
	106	I'm confident I can understand the most complex material presented by the instructor in a math class.	2	4	4	4	5	4	3	3	5	
	107	I'm confident I can do an excellent job on the assignments and tests in a math class.	4	4	3	5	5	4	3	5	4	
	108	I expect to do well in a math class.	4	4	5	5	4	5	5	5	3	
	109	I'm certain I can master the skills being taught in a math class.	3	5	5	3	4	3	3	4	4	
	**110	Considering the difficulty of mathematics and my skills, I think I will do well a math class.	4	4	4	4	4	4	4	4	5	
Task-value: focus on the role of students' perceived value for academic tasks;	**111	I do mathematics because learning math plays a role in reaching my future goals.	5	4	4	4	4	4	4	5	4	
	112	I do mathematics because learning math is important for attaining my dreams.	4	4	4	5	5	4	5	4	3	

	113	I do mathematics because my achievement is important for attaining my dreams.	2	3	3	4	3	3	5	4	4	
	114	I do mathematics because my achievement plays a role in reaching my future goals.	4	4	3	5	3	3	3	5	5	
	**115	I do mathematics because understanding math is important for becoming the person I want to be.	5	4	4	5	4	4	4	4	4	
	**116	I think I will be able to use the mathematics I learn.	5	5	5	5	4	4	5	5	5	
	117	It is important for me to learn mathematics.	2	5	3	3	4	4	4	3	3	
	118	I am very interested in mathematics.	3	4	3	5	5	4	4	5	4	
	119	I think mathematics is useful for me to learn.	1	3	4	4	4	4	4	5	5	
	**120	I like mathematics.	5	5	5	5	5	5	5	5	5	
	**121	Understanding mathematics is very important to me.	4	5	5	4	5	5	5	5	4	
Self-Concept Definition: In this study, self concept will be used as a measure of	122	I am happy in math class room as my need for food, water, shelter, clothing, comfort, rest or sleep, was satisfied	2	5	3	3	4	4	4	3	3	

students confidence and the value that students place on themselves as whether they are good in mathematics or not.	123	I am happy in math class room as my Safety need of being protected from dangerous physical and social situations was satisfied	3	4	3	5	5	4	4	5	4	
	124	I feel belongingness in math class room.	3	3	4	4	4	4	4	5	5	
	**125	I feel esteem for myself (dignity, achievement, mastery, independence) in math subject.	4	4	4	4	4	4	4	4	4	
	126	I desire for reputation or respect from others (e.g., status, prestige) in math subject.	4	5	5	4	5	3	4	4	5	
	127	I desire to become everything, one is capable of becoming in math subject	2	3	4	3	5	3	3	4	4	
	128	Mathematics is an easy subject to learn	2	4	4	5	4	4	4	5	5	
	129	Mathematics is an easy subject to pass	5	5	5	4	5	4	4	3	4	
	130	Mathematics helps me find a new way of doing things	5	5	5	5	4	5	3	4	5	
	***131	Every question in Mathematics is answerable	4	4	4	4	5	4	5	5	5	
	132	Mathematics lessons give me satisfaction	2	3	3	4	5	4	3	4	4	

	**133	Mathematics improves my understanding of other subjects	4	4	4	4	4	4	4	5	5	
	134	Mathematics improves my learning and retention capacities	2	4	4	3	3	4	5	5	5	
	**135	I am good at Mathematics as a subject	4	5	4	4	4	4	4	4	4	
	136	I am capable of making a good grade in Mathematics	2	4	3	4	4	4	4	5	4	
	137	I feel delighted when answering Mathematics questions	3	4	3	3	3	3	4	4	3	
	138	Mathematics facilitates my studying independently	3	4	4	5	5	4	5	5	5	
	139	Mathematics is suitable only for the gifted students	3	4	4	5	5	4	5	5	4	
	**140	Mathematics encourages me to apply detailed steps to solving my personal Problems	5	5	5	5	5	5	5	5	4	

	141	Mathematics makes me think fast	2	3	4	4	5	4	5	5	5	
	142	My present knowledge of Mathematical concepts is high	2	3	3	4	5	4	3	4	4	
	**143	Mathematics is worth passing well	4	4	4	4	5	5	5	5	5	
	***144	I do extra work to learn Mathematics	4	4	4	4	4	4	4	4	4	
	**145	Mathematics is important in my future career	5	5	5	5	5	5	4	5	5	
	146	I am comfortable in Mathematics lessons	2	3	4	4	5	4	5	5	5	
Gender Stereotype(attribution theory) Definition: attribution theory is interpreted as students' perception on gender differences in achievement motivation during Mathematics Learning.	147	I attributed my successes to internal stable causes (ability) in mathematics	2	3	3	4	5	4	3	4	4	
	148	I respond more negatively to competitive learning conditions in mathematics	3	5	4	4	4	4	4	3	3	
	**149	I have more positive perceptions of my abilities and expectations for success in mathematics	4	4	4	4	4	4	4	4	5	
	**150	I feel that I use group work in mathematics class.	2	4	3	4	4	4	4	5	4	

	151	I feel that I have an influence over the mathematics content and I have more involved during the lesson.	3	4	3	3	3	3	4	4	3	
	152	I usually interact more with my teacher in mathematics class	3	4	4	5	5	4	5	5	5	
	153	I feel that I have more often thought of as self-regulating and on-task in mathematics	3	4	4	5	5	4	5	5	4	
	**154	I believe that I have better mathematical Proficiency.	5	5	5	5	4	5	4	5	5	
	**155	I feel I get less attention and I was not involved in mathematics classroom communications to the same degree.	2	5	3	3	4	4	4	3	3	
	156	I perceive that mathematics is more important.	3	4	3	5	5	4	4	5	4	
	157	I value knowledge and good grades in mathematics	1	3	4	4	4	4	4	5	5	
	158	I handle mathematics in order to be able to work in professions such as engineer, architect or scientist.	2	3	4	4	4	4	4	4	4	
	**159	I feel mathematics as difficult subject so that I was not involved in communications about mathematics	4	4	4	5	5	4	4	4	4	

	**160	I less believe by my own competence in mathematics	5	5	5	5	4	4	5	5	5		

Appendix 2B: Content validity Index (CVI)for each item

Item No.	Epert-1	Expert-2	Expert-3	Expert-4	Expert-5	Expert-6	Expert-7	Exper-8	Expert_9		Experts in agreement	I-CVI	UA
1	0	1	1	1	1	1	1	1	1		8	0.89	0
2	0	1	1	1	1	1	1	1	1		8	0.89	0
3	0	1	1	1	0	1	1	1	1		7	0.78	0
4	1	1	1	1	1	1	0	1	1		8	0.89	0

5	0	1	1	1	1	1	0	0	1		6	0.67	0
6	0	1	0	0	1	1	1	0	1		5	0.56	0
**7	1	1	1	1	1	1	1	1	1		9	1.00	1
8	0	1	0	0	0	0	0	0	0		1	0.11	0
**9	1	1	1	1	1	1	1	1	1		9	1.00	1
**10	1	1	1	1	1	1	1	1	1		9	1.00	1
11	0	1	1	1	0	1	1	1	1		7	0.78	0
12	0	0	1	1	0	0	1	1	1		5	0.56	0
13	0	1	1	1	1	1	1	1	1		8	0.89	0
14	0	1	1	1	1	1	1	1	1		8	0.89	0
15	0	1	1	1	1	1	1	1	1		8	0.89	0

16	0	1	1	1	1	1	1	1	1		8	0.89	0
17	1	0	1	1	1	1	1	1	0		7	0.78	0
18	0	0	1	1	1	1	1	1	1		7	0.78	0
**19	1	1	1	1	1	1	1	1	1		9	1.00	1
20	0	0	1	1	1	1	1	1	1		7	0.78	0
21	0	1	1	1	1	0	1	1	1		7	0.78	0
22	0	1	1	1	1	1	1	1	1		8	0.89	0
23	0	1	1	1	1	1	1	1	1		8	0.89	0
24	0	1	0	1	0	1	1	1	0		5	0.56	0
**25	1	1	1	1	1	1	1	1	1		9	1.00	1
**26	1	1	1	1	1	1	1	1	1		9	1.00	1

27	1	1	0	1	0	0	1	1	1		6	0.67	0
28	0	2	0	1	1	1	1	1	1		7	0.78	0
***29	1	1	1	1	1	1	1	1	1		9	1.00	1
**30	1	1	1	1	1	1	1	1	1		9	1.00	1
**31	1	1	1	1	1	1	1	1	1		9	1.00	1
32	0	0	1	1	1	1	1	1	1		7	0.78	0
33	0	0	1	1	1	1	1	1	1		7	0.78	0
**34	1	1	1	1	1	1	1	1	1		9	1.00	1
**35	1	1	1	1	1	1	1	1	1		9	1.00	1
36	1	1	1	0	1	1	1	1	1		8	0.89	0
37	0	0	1	1	1	1	1	1	1		7	0.78	0

***38	1	1	1	1	1	1	1	1	1		9	1.00	1
**39	1	1	1	1	1	1	1	1	1		9	1.00	1
40	0	1	0	0	1	1	1	0	0		4	0.44	0
41	0	1	0	1	1	1	1	1	1		7	0.78	0
42	0	0	1	1	1	1	1	1	1		7	0.78	0
**43	1	1	1	1	1	1	1	1	1		9	1.00	1
**44	1	1	1	1	1	1	1	1	1		9	1.00	1
45	0	1	0	0	1	1	1	0	0		4	0.44	0
46	0	0	0	1	1	1	1	1	1		6	0.67	0
47	0	0	1	1	1	1	1	1	1		7	0.78	0
**48	1	1	1	1	1	1	1	1	1		9	1.00	1

**49	1	1	1	1	1	1	1	1	1		9	1.00	1
**50	1	1	1	1	1	1	1	1	1		9	1.00	1
**51	1	1	1	1	1	1	1	1	1		9	1.00	1
52	0	1	0	1	1	1	1	1	1		7	0.78	0
53	0	1	0	0	0	0	1	1	0		3	0.33	0
54	0	1	1	1	1	1	1	1	1		8	0.89	0
55	0	1	1	1	1	1	1	1	1		8	0.89	0
**56	1	1	1	1	1	1	1	1	1		9	1.00	1
**57	1	1	1	1	1	1	1	1	1		9	1.00	1
58	1	1	1	1	1	1	1	1	0		8	0.89	0

59	0	0	0	1	0	0	1	1	1		4	0.44	0
60	1	1	0	1	0	0	0	1	1		5	0.56	0
**61	1	1	1	1	1	1	1	1	1		9	1.00	1
62	0	0	1	1	1	1	1	1	1		7	0.78	0
***63	1	1	1	1	1	1	1	1	1		9	1.00	1
**64	1	1	1	1	1	1	1	1	1		9	1.00	1
65	0	1	1	1	1	1	1	0	0		6	0.67	0
**66	1	1	1	1	1	1	1	1	1		9	1.00	1
**67	1	1	1	1	1	1	1	1	1		9	1.00	1
68	0	1	0	1	1	1	1	1	1		7	0.78	0

69	0	1	0	1	0	1	0	1	1		5	0.56	0
70	0	1	0	1	1	1	1	0	1		6	0.67	0
71	1	1	1	1	1	1	1	1	0		8	0.89	0
72	0	1	1	0	1	1	1	1	1		7	0.78	0
**73	1	1	1	1	1	1	1	1	1		9	1.00	1
74	0	1	1	1	1	1	0	0	0		5	0.56	0
75	0	1	1	1	1	1	0	0	1		6	0.67	0
**76	1	1	1	1	1	1	1	1	1		9	1.00	1
**77	1	1	1	1	1	1	1	1	1		9	1.00	1
***78	1	1	1	1	1	1	1	1	1		9	1.00	1

79	0	1	0	1	1	1	1	1	1		7	0.78	0
80	0	0	1	1	1	1	1	1	1		7	0.78	0
**81	1	1	1	1	1	1	1	1	1		9	1.00	1
**82	1	1	1	1	1	1	1	1	1		9	1.00	1
83	0	1	0	1	1	1	1	1	1		7	0.78	0
84	0	1	0	0	0	0	1	1	0		3	0.33	0
85	0	1	1	1	1	1	1	1	1		8	0.89	0
86	0	1	1	1	1	1	1	1	1		8	0.89	0
**87	1	1	1	1	1	1	1	1	1		9	1.00	1
88	0	0	1	1	1	1	1	1	1		7	0.78	0
89	0	0	0	1	1	1	0	1	1		5	0.56	0

**90	1	1	1	1	1	1	1	1	1		9	1.00	1
**91	1	1	1	1	1	1	1	1	1		9	1.00	1
92	0	1	0	0	1	1	1	0	0		4	0.44	0
93	0	1	0	1	1	1	1	1	1		7	0.78	0
94	0	0	1	1	1	1	1	1	1		7	0.78	0
**95	1	1	1	1	1	1	1	1	1		9	1.00	1
**96	1	1	1	1	1	1	1	1	1		9	1.00	1
97	0	1	0	1	1	1	1	1	1		7	0.78	0
98	0	1	0	0	0	0	1	1	0		3	0.33	0
***99	1	1	1	1	1	1	1	1	1		9	1.00	1

100	0	1	1	1	1	1	1	1	1		8	0.89	0
**101	1	1	1	1	1	1	1	1	1		9	1.00	1
102	1	1	1	1	1	0	0	1	1		7	0.78	0
103	1	1	1	1	1	1	1	0	1		8	0.89	0
104	1	1	1	1	1	1	0	1	1		8	0.89	0
105	1	1	1	1	1	1	1	1	0		8	0.89	0
106	0	1	1	1	1	1	0	0	1		6	0.67	0
107	1	1	0	1	1	1	0	1	1		7	0.78	0
108	1	1	1	1	1	1	1	1	0		8	0.89	0
109	0	1	1	0	1	0	0	1	1		5	0.56	0
**110	1	1	1	1	1	1	1	1	1		9	1.00	1

**111	1	1	1	1	1	1	1	1	1		9	1.00	1
112	1	1	1	1	1	1	1	1	0		8	0.89	0
113	0	0	0	1	0	0	1	1	1		4	0.44	0
114	0	0	0	1	0	0	0	1	1		3	0.33	0
**115	1	1	1	1	1	1	1	1	1		9	1.00	1
**116	1	1	1	1	1	1	1	1	1		9	1.00	1
117	0	1	0	0	1	1	1	0	0		4	0.44	0
118	0	1	0	1	1	1	1	1	1		7	0.78	0
119	1	0	1	1	1	1	1	1	1		8	0.89	0
**120	1	1	1	1	1	1	1	1	1		9	1.00	1

**121	1	1	1	1	1	1	1	1	1		9	1.00	1
122	0	1	0	0	1	1	1	0	0		4	0.44	0
123	0	1	0	1	1	1	1	1	1		7	0.78	0
124	0	0	1	1	1	1	1	1	1		7	0.78	0
**125	1	1	1	1	1	1	1	1	1		9	1.00	1
126	1	1	1	1	1	0	1	1	1		8	0.89	0
127	0	0	1	0	1	0	0	1	1		4	0.44	0
128	0	1	1	1	1	1	1	1	1		8	0.89	0
129	1	1	1	1	1	1	1	0	1		8	0.89	0
130	1	1	1	1	1	1	0	1	1		8	0.89	0
***131	1	1	1	1	1	1	1	1	1		9	1.00	1

132	0	0	0	1	1	1	0	1	1		5	0.56	0
**133	1	1	1	1	1	1	1	1	1		9	1.00	1
134	0	1	1	0	0	1	0	0	0		3	0.33	0
**135	1	1	1	1	1	1	1	1	1		9	1.00	1
136	0	1	0	1	1	1	1	1	1		7	0.78	0
137	0	1	0	0	0	0	1	1	0		3	0.33	0
138	0	1	1	1	1	1	1	1	1		8	0.89	0
139	0	1	1	1	1	1	1	1	1		8	0.89	0
**140	1	1	1	1	1	1	1	1	1		9	1.00	1
141	0	0	1	1	1	1	1	1	1		7	0.78	0

142	0	0	0	1	1	1	0	1	1		5	0.56	0
**143	1	1	1	1	1	1	1	1	1		9	1.00	1
***144	1	1	1	1	1	1	1	1	1		9	1.00	1
**145	1	1	1	1	1	1	1	1	1		9	1.00	1
146	0	0	1	1	1	1	1	1	1		7	0.78	0
147	0	0	0	1	1	1	0	1	1		5	0.56	0
148	0	1	1	1	1	1	1	0	0		6	0.67	0
**149	1	1	1	1	1	1	1	1	1		9	1.00	1
**150	1	1	1	1	1	1	1	1	1		9	1.00	1
151	0	1	0	0	0	0	1	1	0		3	0.33	0
152	0	1	1	1	1	1	1	1	1		8	0.89	0

Proportion relevance	**160	**159	158	157	156	**155	**154	153
0.48	1	1	0	0	0	1	1	0
0.83	1	1	0	0	1	1	1	1
0.76	1	1	1	1	0	1	1	1
0.89	1	1	1	1	1	1	1	1
0.89	1	1	1	1	1	1	1	1
0.89	1	1	1	1	1	1	1	1
0.88	1	1	1	1	1	1	1	1
0.89	1	1	1	1	1	1	1	1
0.86	1	1	1	1	1	1	1	1
S-CVI/AVE	9	9	7	7	7	9	9	8
0.82	1.00	1.00	0.78	0.78	0.78	1.00	1.00	0.89
	1	1	0	0	0	1	1	0

Average proportion of Items judged relevance across the nine experts	0.82
S-CVI/AU=0.37	

Appendix 2C: Items in which all experts agreed up on

No.	Item No.	Epert-1	Expert-2	Expert-3	Expert-4	Expert-5	Expert-6	Expert-7	Exper-8	Expert_9	Experts in agreement	I-CVI	UA
1	**7	1	1	1	1	1	1	1	1	1	9	1.00	1
2	**9	1	1	1	1	1	1	1	1	1	9	1.00	1
3	**10	1	1	1	1	1	1	1	1	1	9	1.00	1
4	**19	1	1	1	1	1	1	1	1	1	9	1.00	1
5	**25	1	1	1	1	1	1	1	1	1	9	1.00	1
6	**26	1	1	1	1	1	1	1	1	1	9	1.00	1

7	***29	1	1	1	1	1	1	1	1	1	9	1.00	1
8	**30	1	1	1	1	1	1	1	1	1	9	1.00	1
9	**31	1	1	1	1	1	1	1	1	1	9	1.00	1
10	**34	1	1	1	1	1	1	1	1	1	9	1.00	1
11	**35	1	1	1	1	1	1	1	1	1	9	1.00	1
12	***38	1	1	1	1	1	1	1	1	1	9	1.00	1
13	**39	1	1	1	1	1	1	1	1	1	9	1.00	1
14	**43	1	1	1	1	1	1	1	1	1	9	1.00	1
15	**44	1	1	1	1	1	1	1	1	1	9	1.00	1
16	**48	1	1	1	1	1	1	1	1	1	9	1.00	1
17	**49	1	1	1	1	1	1	1	1	1	9	1.00	1

18	**50	1	1	1	1	1	1	1	1	1	9	1.00	1
19	**51	1	1	1	1	1	1	1	1	1	9	1.00	1
20	**56	1	1	1	1	1	1	1	1	1	9	1.00	1
21	**57	1	1	1	1	1	1	1	1	1	9	1.00	1
22	**61	1	1	1	1	1	1	1	1	1	9	1.00	1
23	***63	1	1	1	1	1	1	1	1	1	9	1.00	1
24	**64	1	1	1	1	1	1	1	1	1	9	1.00	1
25	**66	1	1	1	1	1	1	1	1	1	9	1.00	1
26	**67	1	1	1	1	1	1	1	1	1	9	1.00	1
27	**73	1	1	1	1	1	1	1	1	1	9	1.00	1
28	**76	1	1	1	1	1	1	1	1	1	9	1.00	1

29	**77	1	1	1	1	1	1	1	1	1	9	1.00	1
30	***78	1	1	1	1	1	1	1	1	1	9	1.00	1
31	**81	1	1	1	1	1	1	1	1	1	9	1.00	1
32	**82	1	1	1	1	1	1	1	1	1	9	1.00	1
33	**87	1	1	1	1	1	1	1	1	1	9	1.00	1
34	**90	1	1	1	1	1	1	1	1	1	9	1.00	1
35	**91	1	1	1	1	1	1	1	1	1	9	1.00	1
36	**95	1	1	1	1	1	1	1	1	1	9	1.00	1
37	**96	1	1	1	1	1	1	1	1	1	9	1.00	1
38	***99	1	1	1	1	1	1	1	1	1	9	1.00	1
39	**101	1	1	1	1	1	1	1	1	1	9	1.00	1

40	**110	1	1	1	1	1	1	1	1	1	9	1.00	1
41	**111	1	1	1	1	1	1	1	1	1	9	1.00	1
42	**115	1	1	1	1	1	1	1	1	1	9	1.00	1
43	**116	1	1	1	1	1	1	1	1	1	9	1.00	1
44	**120	1	1	1	1	1	1	1	1	1	9	1.00	1
45	**121	1	1	1	1	1	1	1	1	1	9	1.00	1
46	**125	1	1	1	1	1	1	1	1	1	9	1.00	1
47	***131	1	1	1	1	1	1	1	1	1	9	1.00	1
48	**133	1	1	1	1	1	1	1	1	1	9	1.00	1
49	**135	1	1	1	1	1	1	1	1	1	9	1.00	1
50	**140	1	1	1	1	1	1	1	1	1	9	1.00	1

51	**143	1	1	1	1	1	1	1	1	1	9	1.00	1
52	***144	1	1	1	1	1	1	1	1	1	9	1.00	1
53	**145	1	1	1	1	1	1	1	1	1	9	1.00	1
54	**149	1	1	1	1	1	1	1	1	1	9	1.00	1
55	**150	1	1	1	1	1	1	1	1	1	9	1.00	1
56	**154	1	1	1	1	1	1	1	1	1	9	1.00	1
57	**155	1	1	1	1	1	1	1	1	1	9	1.00	1
58	**159	1	1	1	1	1	1	1	1	1	9	1.00	1
59	**160	1	1	1	1	1	1	1	1	1	9	1.00	1

Appendix 2 D : List of 59 items retaind by CVI

No.	Item No.	The item
1	q 7	My goal is to fully understand the mathematics contents taught in class
2	q 9	My goal is to learn mathematics as much as I can
3	q 10	I try very hard to understand as deep as possible in mathematics subject matter.
4	q 19	I am determined to do mathematics well when compared to other
5	q 25	My goal is to avoid learning less in mathematics than my capability
6	q 26	My goal is to avoid learning less in mathematics than what it should be
7	q29	In my math courses, learning new ideas and concepts has been very important to avid failure.
8	q 30	I try to avoid partially understanding of the subject in mathematics
9	q 31	To avoid failure, it's important to me that I thoroughly understand mathematics
10	q 34	My goal is to avoid having bad work when compared to other students concerning mathematics
11	q 35	I try hard to avoid producing worse work than others concerning mathematics.
12	q38	My goal is to avoid getting negative feedback concerning mathematics
13	q 39	My goal is to avoid being less effective in mathematics than other students
14	q 43	I do mathematics for the pleasure that I feel while learning techniques that I have never tried before.
15	q 44	I do mathematics because I feel a lot of personal satisfaction while mastering certain difficult concepts.
16	q 48	I do mathematics for the pleasure I feel in discovering new knowledge.
17	q 49	I do mathematics for the pleasure it gives me to know more about the concepts I am studying.
18	q 50	I do mathematics for the pleasure of discovering new strategies to be successful on tests.
19	q 51	I do mathematics for the pleasure of discovering new solution. strategies.
20	q56	I enjoy doing mathematics very much. Mathematics is fun to do.
21	q57	I would describe mathematics as very interesting.
22	q61	The most important thing for me right now is improving my overall grade point average, so my main concern in my math courses has been getting a good grade.
23	q63	I want to do well in my math courses because it is important to show my ability to my family, friends, employer, or others.
24	q64	I do mathematics because I must do it to feel good about myself.
25	q66	I do mathematics to show others how good I am at it.
26	q67	I do mathematics because it helps me maintain good relationships with my peers.

27 q73 I do mathematics because it is absolutely necessary to do mathematics if one wants to understand the world.
28 q76 I have always been successful with math.
29 q77 Even when I study very hard, I do poorly in my math.
30 q78 I got good grades in my math on my last report card.
31 q81 Seeing adults do well in my math pushes me to do better.
32 q82 When I see how my math teacher solves a problem, I can picture myself solving the problem in the same way.
33 q87 My math teachers have told that I am good at learning math.
34 q90 I have been praised for my ability in my math.
35 q91 Other students have told me that I'm good at learning math.
36 q95 I start to feel stressed-out as soon as I begin my math work.
37 q96 My mind goes blank and I am unable to think clearly when doing math work.
38 q99 If I study in appropriate ways, then I will be able to learn the mathematics for this course.
39 q101 When I try hard enough, then I understand mathematics.
40 q110 Considering the difficulty of mathematics and my skills, I think I will do well a math class.
41 q111 I do mathematics because learning math plays a role in reaching my future goals.
42 q115 I do mathematics because understanding math is important for becoming the person I want to be.
43 q116 I think I will be able to use the mathematics I learn.
44 q120 I like mathematics.
45 q121 Understanding mathematics is very important to me.
46 q125 I feel esteem for myself (dignity, achievement, mastery, independence) in math subject.
47 q131 Every question in Mathematics is answerable
48 q133 Mathematics improves my understanding of other subjects
49 q135 I am good at Mathematics as a subject
50 q140 Mathematics encourages me to apply detailed steps to solving my personal Problems
51 q143 Mathematics is worth passing well
52 q144 I do extra work to learn Mathematics
53 q145 Mathematics is important in my future career
54 q149 I have more positive perceptions of my abilities and expectations for success in mathematics
55 q150 I feel that I use group work in mathematics class.
56 q154 I believe that I have better mathematical Proficiency.
57 q155 I feel I get less attention and I was not involved in mathematics classroom communications to the same degree.
58 q159 I fee mathematics as difficult subject so that I was not involved in communications about mathematics
59 q160 I less believe by my own competence in mathematics

Appendix-3:Cognitive interview

Think aloud all the question in you group and answer the following questions

Which item do you think is(are) confusing or misleading about the survey question? What do you believe you are being asked?

No	Item number	Item	Meaning it gives when students think aloud	Confusion	Remark
1	q29	In my math courses, learning new ideas and concepts has been very important to avid failure.	New concepts is cause to not to be failed	The statement Not convincing	Suppressed by debriefing stage
2	q34	My goal is to avoid having bad work when compared to other students concerning mathematics	"Bad work" on math has to be avoided for other students whose concern is math	Bad work is not specified and the meantime is confusing	Suppressed by group debriefing
3	q63	I want to do well in my math courses because it is important to show my ability to my family, friends, employer, or others.	Math is ability indicator	Employer and others are not applicable for students	Suppressed by debriefing stage
4	q78	I got good grades in my math on my last report card.	I achieved well in math	"On my last report card" is confusing	Suppressed by debriefing stage
5	q99	If I study in appropriate ways, then I will be able to learn the mathematics for this course.	Appropriate study results ability of appropriate learning	" for this course" does not imply which course.	Suppressed by debriefing stage
6	q110	Considering the difficulty of mathematics and my	Mathematics is difficult	It frustrate as math is difficult	Suppressed by debriefing stage

		skills, I think I will do well a math class.			
7	q143	Mathematics is worth passing well	Mat is good to pass	The word " worth passing well is confusing	Suppressed from other steps
8	q149	I have more positive perceptions of my abilities and expectations for success in mathematics	I perceived good in my abilities and success	The word "more positive" was Confusing as it compares to others	Retained with modification
9	q155	I feel I get less attention and I was not involved in mathematics classroom communications to the same degree.	I am disadvantaged and I do not react in the same way	The word " the same degree" is not clear that it is comparing to what	Retained with modification

Appendix-4**A: English Version Questionnaire- for data collection**

Hawassa University

College of Teacher Education

Measurement and Evaluation Unit

Questioner to be filled by key participants

For partial fulfillment of PhD Degree in Measurement and Evaluation

General: Dear participant, this questionnaire is aimed at collecting reliable information on Mathematics Learning Motivation (MLM).The data collected will be used to develop instrument which can measure the level of MLM of students. The honest and correct information you provided will have much value in providing valid result to this study. Finally, I confirm that the information you provide will be kept confidential and it will be used for this study purpose only.

In case you have any questions contact me by phone: +251920591011 or by my Email: belaybekele19@gmail.com Thank you in advance for your cooperation!

Part I: Demographic information

Put your answer by marking "√" sign in the box provided

1. Gender : Male ☐ Female ☐
2. Age : Below 18 ☐ 18-25 ☐ 26-45 ☐ 46 and above ☐
3. University: Bonga University ☐ Jimma University ☐
   Hawassa University ☐ Addis Ababa University ☐
   Other ☐
4. Year : first year ☐ 2nd year ☐ 3rd year ☐ 4th year and above ☐
5. Your Department_____
6. Your ID _____
7. Your Cumulative GPA_____
8. Parental Education

- Mother Education
  Primary Education and below ☐ Secondary education ☐
  College Diploma ☐ Higher education ☐
- Father's Education
  Primary Education and below ☐ Secondary education ☐
  College Diploma ☐ Higher education ☐

9. Employment status of the Father & mother
   - Employment status of the Father:
     Government Employee ☐ Self-Employed ☐ Farmer ☐ Other ☐
   - Employment status of the Father & mother
     Government Employed ☐ Self-Employed ☐ Not employed ☐ Other ☐

10. Parental Profession in science
    - Father's Profession in Science: Yes ☐ No ☐
    - Mother Profession in Science : Yes ☐ No ☐

Part- II: Mathematics learning Motivation (MLM)

The following are statements on Mathematics Learning Motivation (MLM) and their corresponding likert scale levels of agreements. Circle one of your agreement levels for each of statement provided.

1= Strongly Disagree 2= Disagree 3= Neutral 4= Agree 5= Strongly Agree

#						
q 7	My goal is to fully understand the mathematics contents taught in class	1	2	3	4	5
q 9	My goal is to learn mathematics as much as I can	1	2	3	4	5
q 10	I try very hard to understand as deep as possible in mathematics subject	1	2	3	4	5
q 19	I am determined to do mathematics well when compared to other	1	2	3	4	5
q 25	My goal is to avoid learning less in mathematics than my capability	1	2	3	4	5
q 26	My goal is to avoid learning less in mathematics than what it should be	1	2	3	4	5
q 30	I try to avoid partially understanding of the subject in mathematics	1	2	3	4	5
q 31	To avoid failure, it's important to me that I thoroughly understand	1	2	3	4	5
q 35	I try hard to avoid producing worse work than others concerning	1	2	3	4	5
q38	My goal is to avoid getting negative feedback concerning mathematics	1	2	3	4	5
q 39	My goal is to avoid being less effective in mathematics than other students	1	2	3	4	5
q 43	I do mathematics for the pleasure that I feel while learning techniques that I have never tried before.	1	2	3	4	5
q 44	I do mathematics because I feel a lot of personal satisfaction while mastering certain difficult concepts.	1	2	3	4	5
q 48	I do mathematics for the pleasure I feel in discovering new knowledge.	1	2	3	4	5
q 49	I do mathematics for the pleasure it gives me to know more about the concepts I am studying.	1	2	3	4	5
q 50	I do mathematics for the pleasure of discovering new strategies to be successful on tests.	1	2	3	4	5
q 51	I do mathematics for the pleasure of discovering new solution strategies.	1	2	3	4	5
q56	I enjoy doing mathematics very much. Mathematics is fun to do.	1	2	3	4	5

q57	I would describe mathematics as very interesting.	1	2	3	4	5
q61	The most important thing for me right now is improving my overall grade point average, so my main concern in my math courses has been getting a good grade.	1	2	3	4	5
q64	I do mathematics because I must do it to feel good about myself.	1	2	3	4	5
q66	I do mathematics to show others how good I am at it.	1	2	3	4	5
q67	I do mathematics because it helps me maintain good relationships with my peers.	1	2	3	4	5
q73	I do mathematics because it is absolutely necessary to do mathematics if one wants to understand the world.	1	2	3	4	5
q76	I have always been successful with math.	1	2	3	4	5
q77	Even when I study very hard, I do poorly in my math.	1	2	3	4	5
q81	Seeing adults do well in my math pushes me to do better.	1	2	3	4	5
q82	When I see how my math teacher solves a problem, I can picture myself solving the problem in the same way.	1	2	3	4	5
q87	My math teachers have told that I am good at learning math.	1	2	3	4	5
q90	I have been praised for my ability in my math.	1	2	3	4	5
q91	Other students have told me that I'm good at learning math.	1	2	3	4	5
q95	I start to feel stressed-out as soon as I begin my math work.	1	2	3	4	5
q96	My mind goes blank and I am unable to think clearly when doing math work.	1	2	3	4	5
q101	When I try hard enough, then I understand mathematics.	1	2	3	4	5
q111	I do mathematics because learning math plays a role in reaching my future goals.	1	2	3	4	5
q115	I do mathematics because understanding math is important for becoming the person I want to be.	1	2	3	4	5
q116	I think I will be able to use the mathematics I learn.	1	2	3	4	5
q120	I like mathematics.	1	2	3	4	5
q121	Understanding mathematics is very important to me.	1	2	3	4	5
q125	I feel esteem for myself (dignity, achievement, mastery, independence) in math subject.	1	2	3	4	5
q131	Every question in Mathematics is answerable	1	2	3	4	5
q133	Mathematics improves my understanding of other subjects	1	2	3	4	5
q135	I am good at Mathematics as a subject	1	2	3	4	5
q140	Mathematics encourages me to apply detailed steps to solving my personal Problems	1	2	3	4	5
q144	I do extra work to learn Mathematics					
q145	Mathematics is important in my future career	1	2	3	4	5
q149	I have more positive perceptions of my abilities and expectations for success in mathematics than others	1	2	3	4	5
q150	I feel that I use group work in mathematics class.	1	2	3	4	5
q154	I believe that I have better mathematical Proficiency.	1	2	3	4	5
q155	I feel I get less attention and I was not involved in mathematics classroom communications to the same degree with others					

Additional information (if any)

_____
_____
_____

Appendix-4**B: Amharic Version Questionnaire-for data collection**

ሐዋሳ ዩኒቨርሲቲ
የመምህራን ኮሌጅ
በ Measurement and Evaluation የፒኤች ዲ ዲግሪ ማሟያ ጥናት ለማጥናት
በተሳታፊዎች የሚሞላ ቃለ መጠይቅ

ውድ የጥናቱተሳታፊ፡-
ይህ የፅሑፍ መጠይቅ የተማሪዎች በሂሳብ ትምህርት ላይ ያላቸዉንተነሳሽነት ለማጥናት የሚያገለግል መረጃ ለመሰብሰብ ታስቦ የተዘጋጀ ነዉ። ስለዚህ መጠይቁን ስትመልስ/ሺ በተጠየቁ መጠይቆች መሠረት በሂሳብ ትምህርት ላይ ያለህን/ሽን አመለካከት እያሰብክ/ሽ ይሆናል ማለትነው። የተሰበሰበዉ መረጃ የሚጠቅመዉ የተማሪዎችን የሂሳብ ትምህርት ተነሳሽነት የሚለካ መሳሪያ ለማዘጋጀት ነዉ። ተሳታፊዎች የሚሰጡት ታማኝና ቅን ምላሽ ለጥናቱ የሚኖረው ዋጋ በጣም ከፍተኛ ነው።ስለሆነም በዚህ የፅሁፍመጠይቅ ለቀረቡ ጥያቄዎች ታማኝና ቅን ምላሽ በመስጠት እንድትተባበሩ በትህትና እጠይቃለሁ።በዚህ መጠይቅ የሚሰበሰበው መረጃ ሁሉ ሚስጢራዊነቱ የሚጠበቅ ከመሆኑም በላይ ጥቅም ላይ የሚውለውም ለዚህ ምርምር ስራ ብቻ ይሆናል። ማንኛውንም አይነት ጥያቄ ሲኖርዎት፤እባክዎትን እኔን ለማግኘት ወደ ኋላ እንዳይሉ።በመሆኑም እኔን ለማግኘት በፈለጉ ሰዓት(በሞባይል ስልክ ቁጥር፡0920591011 ወይም በኢሜይል፤belaybekele19@gmail.com) ያገኙኛል።
ለሚደረግልኝ ትብብር በቅድሚያ አመሰግናለሁ!

ክፍልአንድ፡የተሳታፊው ዳራዊ መረጃ
ተገቢውንመልስየ“√” ምልክት በማድረግ መልስ/ሺ።
1. ፆታ፡ሴት ☐ ወንድ ☐
2. ዕድሜ(በዓመት)፡ ከ18 ዓመት በታች ☐ 18- 25 ☐ 26-45 ☐ ከ46 በላይ ☐
3.ዩኒቨርሲቲ: ቦንጋ ☐ ጂማ☐ ሐዋሳ ☐ አዲስ አበባ ☐ ሌላ ☐
4. የዩኒቨርሲቲ ቆይታ (ዓመት)፡ 1ኛ ዓመት ☐ 2ኛ ዓመት ☐ 3ኛ ዓመት ☐ 4ኛ ዓመትና በላይ ☐
5. ዲፓርትመንት _____
6. የአንተ/ የአንቺ/መታወቂያ ቁጥር: _____
7. የአንተ/ የአንቺ/አጠቃላይ ጂፒኤ/CGPA/ ፡ _____
8. የወላጅ/አሳዳጊ/ የትምህርት ደረጃ
   - የእናት ትምህርት ደረጃ፡
     የመጀመሪያ ደረጃ ትምህርትና ከዚያ በታች ☐ ሁለተኛ ደረጃ/ሀይስኩል/ ትምህርት ☐
     የኮሌጅ ዲፕሎማ ☐ ከፍተኛ ደረጃ ትምህርት ☐
   - የአባት ትምህርት ደረጃ፡
     የመጀመሪያ ደረጃ ትምህርትና ከዚያ በታች ☐ ሁለተኛ ደረጃ/ሀይስኬል/ ትምህርት ☐
     የኮሌጅ ዲፕሎማ ☐ ከፍተኛ ደረጃ ትምህርት ☐
9. የወላጅ/ያሳዳጊ/ የሥራ ሁኔታ ፡

   - የአባት የሥራ ሁኔታ:
     የመንግሥት ሠራተኛ ☐ የግል ሥራ ☐ ግብርና ☐ ሌላ ☐
   - የአባት የሥራ ሁኔታ:
     የመንግሥት ሠራተኛ ☐ የግል ሥራ ☐ ግብርና ☐ ሌላ ☐
10. የወላጅ/ያሳዳጊ/ በሳይንስ ያላቸዉ ሙያ

- እናቴ የሳይንስ ሙያ አላት: አው ☐ አይደለም ☐
- አባቴ የሳይንስ ባለሙያ ነዉ : አው ☐ አይደለም ☐

ክፍል ሁለት፡ የሂሳብ ትምህርት የመማር ተነሳሽነት /**Mathematics Learning Motivation (MLM)/**
ከዚህ ቀጥሎ የሂሳብ ትምህርት የመማር ተነሳሽነት የሚያመለክቱ ዓረፍተ ነገሮች ከነመልሶቻቸው ቀርበዋል፡፡ዓረፍተ ነገሩን በጥንቃቄ ካነበብክ/ሽ በኋላ ከፊት ለፊት ከተዘረዘሩት (1-5) ቁጥሮች ከሃሳቡ ጋር የሚኖርህን/ሽን የስምምነት መጠን በትክክል የሚገልጽ ቁጥርን በመክበብ መልስ/ሺ፡፡

1= አጥብቄ አልስማማም 2= አልስማማም 3= አልወሰንኩም 4= እስማማለሁ 5= አጥብቄእስማማለሁ

#	ዐ/ነገር	1	2	3	4	5
q 7	በክፍል ዉስጥ የተማርኩትን የሂሳብ ትምህርት ይዘት ሙሉ በሙሉ የመረዳት እቅድ አለኝ፡፡	1	2	3	4	5
q 9	የሂባብን ትምህርት በምችለው እቅም የመማር ዓላማ አለኝ፡፡	1	2	3	4	5
q 10	የሂሳብ ትምህርትን በተቻለጥ መጠን በጥልቀት ለመረዳት አጠንክሬ እተጋለሁ፡፡	1	2	3	4	5
q 19	በሂባብ ትምህርት ደህና በመሥራት ከሌሎች ይልቅ ቆራጥ ነኝ፡፡	1	2	3	4	5
q 25	በሂሳብ ትምህርት ከምችለዉ አቅም በታች ያለመሥራት ዓላማ አለኝ፡፡	1	2	3	4	5
q 26	በሂሳብ ትምህርት ከሚገባኝ በታች ያለመሆን ዓላማ አለኝ ፡፡.	1	2	3	4	5
q 30	የሂሳብ ትምህርት በከፊል መረዳትን ለመተው እጥራለሁ፡፡	1	2	3	4	5
q 31	ላለመዉደቅ ሂሳብን በዝርዝር መረዳት ጠቃሚ ነዉ ፡፡	1	2	3	4	5
q 35	የሂሳብ ትምህርትን አስመልክቶ ከሌሎች ተማሪዎች የከፋ ላለመሥራት አጠንክሬ እጥራለሁ፡፡	1	2	3	4	5
q 38	በሂሳብ ትምህርት አሉታዊ ግብረ-መልስ ያለማግኘት ዓለማ አለኝ	1	2	3	4	5
q 39	በሂሳብ ትምህርት ከሌሎች ተማርዎች ባነሰ መልኩ ዉጤታማ ያለመሆን ዓላማ አለኝ፡፡	1	2	3	4	5
q 43	የሂሳብን መልመጃ የምሰራዉ ያልሞከርኪቸዉን ሥልቶች ተምሬ ስለምደሰትበት ነዉ፡፡	1	2	3	4	5
q 44	የሂሳብን መልመጃ የምሰራዉ አስቸጋሪ ሐሳቦችን ማስተር ሳደርግ ለሚሰጠኝ የግል እርካታ ነዉ፡፡	1	2	3	4	5
q 48	የሂሳብን መልመጃ የምሰራዉ አዲስ እዉቀት ሳገኝ	1	2	3	4	5

	ስለሚፈጥርብኝ ደስታ ነዉ።					
q 49	የሂሳብን መልመጃ የምሰራዉ ስለምማረዉ ትምህርት ብዙ ስለሚያሳዉቅ ነዉ ።	1	2	3	4	5
q 50	የሂሳብን መልመጃ የምሰራዉ በቴስት እንድሳካልኝ አዲስ ስልት ስለሚያሳይ ነዉ ።	1	2	3	4	5
q 51	የሂሳብን መልመጃ የምሰራዉ አዲስ የመፍትሔ ስልት ስለሚያሳይ ነዉ።	1	2	3	4	5
q56	የሂሳብን መልመጃ መሥራት ያስደስተኛል፤ ሂሳብ ያዝናናኛል።	1	2	3	4	5
q57	ሂሳብ በጣም አስደሳች እንደሆነ እገልጻለሁ ።	1	2	3	4	5
q61	አጠቃለይ ግሬድ ማሻሻል ስለምፈልግ በሂሳብ ትምህርት ጥሩ ግሬድ ማግኘት ለእኔ ትልቁ ጉዳዬ ነዉ።	1	2	3	4	5
q64	የሂሳብ መልመጃ የምሰራዉ በሂሳብ ጥሩ እንደሆነኩ ለማሰብ የግድ መሥራት ስላለብኝ ነዉ።	1	2	3	4	5
q66	የሂሳብ መልመጃ የምሰራዉ ሌለሎች ምን ያህል በሂሳብ ጎበዝ እንደሆንኩ ለማሳየት ነዉ።	1	2	3	4	5
q67	የሂሳብ መልመጃ የምሰራዉ ከእኩዮቼ ጋር ጥሩ ግኑኝነት እንዲኖረኝ ስለሚያደርግ ነዉ።	1	2	3	4	5
q73	የሂሳብ መልመጃ የምሰራዉ ዓለምን ለመረዳት ሂሳብን መማር በእጅጉ አስፈላጊ በመሆኑ ነዉ።	1	2	3	4	5
q76	በሂሳብ ትምህርት ሁሌም ስኬታማ ነኝ።	1	2	3	4	5
q77	ምንም እንኳ ጠንክሬ ባጠናም በሂሳብ ዉጤታማ አልሆንም።	1	2	3	4	5
q81	ታላላቆቼ በሂሳብ ጠንክሮ ሲሠሩ ማየት እኔም እነሱን አይቼ እንድበረታ ያደርገኛል ።	1	2	3	4	5
q82	የሂሳብ መምህሬ ጥያቄ ሲሠሩ ማየት እኔም በዚያ አኳኋን እንድሠራ ያደርገኛል።	1	2	3	4	5
q87	በሂሳብ ትምህርት ደህና መሆኔን መምህራኖቼ ይነግሩኛል።	1	2	3	4	5
q90	በሂሳብ ችሎታዬ ምስጉን ነኝ።	1	2	3	4	5
q91	በሂሳብ ትምህርት ጥሩ መሆኔን ሌሎች ተማሪዎች ነግረዉኛል።	1	2	3	4	5
q95	ሂሳብ መሥራት ስጀምር መጨነቅ እጀምራለሁ።	1	2	3	4	5
q96	ሂሳብ መሥራት ስጀምር አዕምሮዬ ባዶ ሆኖ በግልጽ ማሰብ አልችልም።	1	2	3	4	5
q101	ጠንክሬ ብሞክር ሂሳብን እረዳለሁ ብዬ እገምታለሁ።።	1	2	3	4	5

q111	ሂሳብን የምሠራዉ የሂሳብ ትምህርት ለወደፊቱ ዓላማ አወንታዊ ሚና ስላለዉ ነዉ።	1	2	3	4	5
q115	ሂሳብን የምሠራዉ የሚፈልጉትን ሰዉ ለመሆን ሂሳብ ማወቅ በማስፈለጉ ነዉ።	1	2	3	4	5
q116	የተማርኩትን ሂሳብ መጠቀም እችላለሁ ብዬ አስባለሁ።	1	2	3	4	5
q120	ሂሳብን እወዳለሁ።	1	2	3	4	5
q121	ሂሳብን መረዳት ለእኔ በጣም አስፈላጊ ነዉ።	1	2	3	4	5
q125	በሂሳብ ትምህርት ባለኝ ችሎታ በራስ መተማመን ይሰማኛል።	1	2	3	4	5
q131	ሁሉም የሂሳብ ጥያቄዎች የሚመለሱ ናቸዉ	1	2	3	4	5
q133	ሂሳብ ሌሎች ትምህርቶችን እንድረዳ ይረዳኛል	1	2	3	4	5
q135	በሂሳብ ትምህርት ጥሩ ነኝ	1	2	3	4	5
q140	ሂሳብ የግል ችግሮቼን ሰፋ ባለ መንገድ እንድፈታ ይረዳኛል	1	2	3	4	5
q144	ሂሳብን ለመማር ተጨማሪ ተግባራትን አከናዉናለሁ	1	2	3	4	5
q145	ሂሳብን ለመማር ተጨማሪ ተግባራትን አከናዉናለሁ	1	2	3	4	5
q149	በሂሳብ ትምህርት ስኬታማነትና በችሎታዬ ላይ የተሻለ አዎንታዊ ግንዛቤ አለኝ።	1	2	3	4	5
q150	በሂሳብ ክፍለ ጊዜ የቡድን ሥራ ይመቸኛል።	1	2	3	4	5
q154	በሂሳብ የተሻለ ብቃት እንዳለኝ አምናለሁ።	1	2	3	4	5
q155	በሂሳብ ክፍለ ጊዜ ትኩረት እንደማላገኝና ከሌሎች ጋር ስነጻጸር በእኩል እንደማልሳተፍ ይሰማኛል።.					

ተጨማሪ ሐሳብ (ካለ)
_____
_____
_____
_____

Apendix 5: Item_total Correlation

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
q7	199.8919	2974.988	.841	.945
q9	200.1081	3023.266	.680	.946
q10	199.7027	3028.159	.514	.946
q19	199.6757	3013.559	.727	.946
q25	199.7297	3007.536	.714	.946
q26	199.5405	3027.589	.589	.946
q29	200.2162	3013.396	.621	.946
q30	200.1351	3014.287	.469	.946
q31	199.6486	3029.679	.838	.946
q34	200.1892	2994.213	.699	.946
q35	199.7568	2997.134	.747	.946
q38	200.0270	2987.805	.724	.946
q39	200.0541	3004.830	.623	.946
q43	200.0270	2972.471	.796	.945
q44	200.0541	3014.219	.792	.946
q48	200.2162	2949.785	.801	.945
q49	200.0270	2984.860	.708	.946
q50	199.9189	2977.021	.843	.945
q51	200.4054	2980.692	.633	.946
q56	199.7568	2992.967	.677	.946
q57	199.7838	3022.785	.607	.946
q61	199.7027	2988.992	.632	.946
q63	199.4054	3029.803	.513	.946
q64	199.4595	3042.422	.493	.947
q66	199.9189	2978.354	.888	.945

q67	199.5946	3034.748	.440	.947
q73	200.0811	3017.188	.530	.946
q76	200.4595	2951.144	.839	.945
q77	199.9459	3020.997	.650	.946
q78	200.0000	3045.167	.511	.947
q81	200.1351	2969.231	.916	.945
q82	200.0811	2984.521	.755	.946
q87	197.1622	2482.973	.660	.958
q90	200.5676	3003.086	.683	.946
q91	200.2162	2993.341	.609	.946
q95	199.8108	3011.769	.735	.946
q96	199.7838	3009.008	.530	.946
q99	199.3784	3041.464	.590	.947
q101	200.1081	3008.155	.630	.946
q110	200.0000	3024.722	.581	.946
q111	200.2973	2978.381	.772	.945
q115	200.0270	3028.805	.758	.946
q116	200.2703	2967.203	.862	.945
q120	199.6216	2996.575	.614	.946
q121	199.9730	2965.249	.804	.945
q125	199.7838	2998.396	.674	.946
q131	200.2703	2947.925	.758	.945
q133	197.7297	2522.036	.598	.959
q135	200.4324	3008.086	.535	.946
q140	200.3784	3012.020	.533	.946
q143	200.1351	3050.898	.268	.947
q144	200.1351	3017.231	.725	.946
q145	200.4865	2978.312	.867	.945
q149	199.7568	2992.356	.600	.946
q150	200.4595	2994.755	.681	.946
q154	199.8378	3003.140	.712	.946
q155	199.5676	2992.863	.667	.946
q159	199.4865	3064.979	.207	.947
q160	199.4865	3051.812	.296	.947

Appendix 6 A: items retained: English Version

q 7 My goal is to fully understand the mathematics contents taught in class

q 9 My goal is to learn mathematics as much as I can

q 10 I try very hard to understand as deep as possible in mathematics subject matter.

q 19 I am determined to do mathematics well when compared to other

q 25 My goal is to avoid learning less in mathematics than my capability

q 26 My goal is to avoid learning less in mathematics than what it should be

q 30 I try to avoid partially understanding of the subject in mathematics

q 31 To avoid failure, it's important to me that I thoroughly understand mathematics

q 35 I try hard to avoid producing worse work than others concerning mathematics.

q38 My goal is to avoid getting negative feedback concerning mathematics

q 39 My goal is to avoid being less effective in mathematics than other students

q 43 I do mathematics for the pleasure that I feel while learning techniques that I have never tried before.

q 44 I do mathematics because I feel a lot of personal satisfaction while mastering certain difficult concepts.

q 48 I do mathematics for the pleasure I feel in discovering new knowledge.

q 49 I do mathematics for the pleasure it gives me to know more about the concepts I am studying.

q 50 I do mathematics for the pleasure of discovering new strategies to be successful on tests.

q 51 I do mathematics for the pleasure of discovering new solution strategies.

q56 I enjoy doing mathematics very much. Mathematics is fun to do.

q57 I would describe mathematics as very interesting.

q61 The most important thing for me right now is improving my overall grade point average, so my main concern in my math courses has been getting a good grade.

q64 I do mathematics because I must do it to feel good about myself.

q66 I do mathematics to show others how good I am at it.

q67 I do mathematics because it helps me maintain good relationships with my peers.

q73 I do mathematics because it is absolutely necessary to do mathematics if one wants to understand the world.

q76 I have always been successful with math.

q77 Even when I study very hard, I do poorly in my math.

q81 Seeing adults do well in my math pushes me to do better.

q82 When I see how my math teacher solves a problem, I can picture myself solving the problem in the same way.

q87 My math teachers have told that I am good at learning math.

q90 I have been praised for my ability in my math.

q91 Other students have told me that I'm good at learning math.

q95 I start to feel stressed-out as soon as I begin my math work.

q96 My mind goes blank and I am unable to think clearly when doing math work.

q101 When I try hard enough, then I understand mathematics.

q111 I do mathematics because learning math plays a role in reaching my future goals.

q115 I do mathematics because understanding math is important for becoming the person I want to be.

q116 I think I will be able to use the mathematics I learn.

q120 I like mathematics.

q121 Understanding mathematics is very important to me.

q125 I feel esteem for myself (dignity, achievement, mastery, independence) in math subject.

q131 Every question in Mathematics is answerable

q133 Mathematics improves my understanding of other subjects

q135 I am good at Mathematics as a subject

q140 Mathematics encourages me to apply detailed steps to solving my personal Problems

q144 I do extra work to learn Mathematics

q145 Mathematics is important in my future career

q149 I have more positive perceptions of my abilities and expectations for success in mathematics than others

q150 I feel that I use group work in mathematics class.

q154 I believe that I have better mathematical Proficiency.

q155 I feel I get less attention and I was not involved in mathematics classroom communications to the same degree with others.

As the Amharic version of the scale is very useful to measure the performance a student concerning mathematics learning motivation in the case of Ethiopia, the researcher found it very useful to include the Amharic version findings of the scale. Readers who do not read Amharic can use the English version only. Thus the Amharic version scale is given below:

Appendix 6B: Items retained the Amharic Version

q 7 በክፍል ዉስጥ የተማርኩትን የሂሳብ ትምህርት ይዘት ሙሉ በሙሉ የመረዳት እቅድ አለኝ።

q 9 የሂባብን ትምህርት በምችለው እቅም የመማር ዓላማ አለኝ።

q 10 የሂሳብ ትምህርትን በተቻለጥ መጠን በጥልቀት ለመረዳት አጠንክሬ እተጋለሁ።

q 19 በሂባብ ትምህርት ደህና በመሥራት ከሌሎች ይልቅ ቆራጥ ነኝ።

q 25 በሂሳብ ትምህርት ከምችለዉ አቅም በታች ያለመሥራት ዓላማ አለኝ።

q 26 በሂሳብ ትምህርት ከሚገባኝ በታች ያለመሆን ዓላማ አለኝ ።.

q 30 የሂሳብ ትምህርት በከፊል መረዳትን ለመተው እጥራለሁ።

q 31 ላለመዉደቅ ሂሳብን በዝርዝር መረዳት ጠቃሚ ነዉ ።

q 35 የሂሳብ ትምህርትን አስመልክቶ ከሌሎች ተማሪዎች የከፋ ላለመሥራት አጠንክሬ እጥራለሁ።

q 38 በሂሳብ ትምህርት አሉታዊ ግብረ-መልስ ያለማግኘት ዓለማ አለኝ

q 39 በሂሳብ ትምህርት ከሌሎች ተማርዎች ባነሰ መልኩ ዉጤታማ ያለመሆን ዓላማ አለኝ።

q 43 የሂሳብን መልመጃ የምሰራዉ ያልሞከርኪቸዉን ሥልቶች ተምሬ ስለምደሰትበት ነዉ።

q 44 የሂሳብን መልመጃ የምሰራዉ አስቸጋሪ ሐሳቦችን ማስተር ሳደርግ ለሚሰጠኝ የግል እርካታ ነዉ።

q 48 የሂሳብን መልመጃ የምሰራዉ አዲስ እዉቀት ሳገኝ ስለሚፈጥርብኝ ደስታ ነዉ።

q 49 የሂሳብን መልመጃ የምሰራዉ ስለምማረዉ ትምህርት ብዙ ስለሚያሳዉቅ ነዉ ።

q 50 የሂሳብን መልመጃ የምሰራዉ በቴስት እንድሳካልኝ አዲስ ስልት ስለሚያሳይ ነዉ ።

q 51 የሂሳብን መልመጃ የምሰራዉ አዲስ የመፍትሔ ስልት ስለሚያሳይ ነዉ።

q56 የሂሳብን መልመጃ መሥራት ያስደስተኛል፤ ሂሳብ ያዝናናኛል።

q57 ሂሳብ በጣም አስደሳች እንደሆነ እገልጻለሁ ።

q61 አጠቃለይ ግሬድ ማሻሻል ስለምፈልግ በሂሳብ ትምህርት ጥሩ ግሬድ ማግኘት ለእኔ ትልቁ ጉዳዬ ነዉ።

q64 የሂሳብ መልመጃ የምሰራዉ በሂሳብ ጥሩ እንደሆነኩ ለማሰብ የግድ መሥራት ስላለብኝ ነዉ።

q66 የሂሳብ መልመጃ የምሰራዉ ሌለሎች ምን ያህል በሂሳብ ጎበዝ እንደሆንኩ ለማሳየት ነዉ።

q67 የሂሳብ መልመጃ የምሰራዉ ከእኩዮቼ ጋር ጥሩ ግኑኝነት እንዲኖረኝ ስለሚያደርግ ነዉ።

q73 የሂሳብ መልመጃ የምሰራዉ ዓለምን ለመረዳት ሂሳብን መማር በእጅጉ አስፈላጊ በመሆኑ ነዉ።

q76 በሂሳብ ትምህርት ሁሌም ስኬታማ ነኝ።

q77 ምንም እንኳ ጠንክሬ ባጠናም በሂሳብ ዉጤታማ አልሆንም።

q81 ታላላቆቼ በሂሳብ ጠንክሮ ሲሠሩ ማየት እኔም እነሱን አይቼ እንድበረታ ያደርገኛል ።

q82 የሂሳብ መምህሬ ጥያቄ ሲሠሩ ማየት እኔም በዚያ አኳኋን እንድሠራ ያደርገኛል።

q87 በሂሳብ ትምህርት ደህና መሆኔን መምህራኖቼ ይነግሩኛል።

q90 በሂሳብ ችሎታዬ ምስጉን ነኝ።

q91 በሂሳብ ትምህርት ጥሩ መሆኔን ሌሎች ተማሪዎች ነግረዉኛል።

q95 ሂሳብ መሥራት ስጀምር መጨነቅ እጀምራለሁ።

q96 ሂሳብ መሥራት ስጀምር አዕምሮዬ ባዶ ሆኖ በግልጽ ማሰብ አልችልም።

q101 ጠንክሬ ብሞክር ሂሳብን እረዳለሁ ብዬ እገምታለሁ።።

q111 ሂሳብን የምሠራዉ የሂሳብ ትምህርት ለወደፊቱ ዓላማ አወንታዊ ሚና ስላለዉ ነዉ።

q115 ሂሳብን የምሠራዉ የሚፈልጉትን ሰዉ ለመሆን ሂሳብ ማወቅ በማስፈለጉ ነዉ።

q116 የተማርኩትን ሂሳብ መጠቀም እችላለሁ ብዬ አስባለሁ።

q120 ሂሳብን እወዳለሁ።

q121 ሂሳብን መረዳት ለእኔ በጣም አስፈላጊ ነዉ።

q125 በሂሳብ ትምህርት ባለኝ ችሎታ በራስ መተማመን ይሰማኛል።

q131 ሁሉም የሂሳብ ጥያቄዎች የሚመለሱ ናቸዉ

q133 ሂሳብ ሌሎች ትምህርቶችን እንድረዳ ይረዳኛል

q135 በሂሳብ ትምህርት ጥሩ ነኝ

q140 ሂሳብ የግል ችግሮቼን ሰፋ ባለ መንገድ እንድፈታ ይረዳኛል

q144 ሂሳብን ለመማር ተጨማሪ ተግባራትን አከናዉናለሁ

q145 ሂሳብን ለመማር ተጨማሪ ተግባራትን አከናዉናለሁ

q149 በሂሳብ ትምህርት ስኬታማነትና በችሎታዬ ላይ የተሻለ አዎንታዊ ግንዛቤ አለኝ

q150 በሂሳብ ክፍለ ጊዜ የቡድን ሥራ ይመቸኛል

q154 በሂሳብ የተሻለ ብቃት እንዳለኝ አምናለሁ

q155 በሂሳብ ክፍለ ጊዜ ትኩረት እንደማላገኝና ከሌሎች ጋር ስነጻጸር በእኩል እንደማልሳተፍ ይሰማኛል

Appenix-7: Pre testing the Discrimination Indices of Mathematics Achievement Test: the case of University students in Ethiopia (Application of IRT)

A Pilot test of instrument for dissertation for Partial Fulfillment of the Requirement for PhD Degree in Measurement and Evaluation

By : Belay Bekele

Advisor: Tesfaye Semela (Professor)

Co-advisor: Abrham Tulu (Associate Prof.)
Hawassa University
College Teacher Education
Hawassa, Ethiopia
June , 2022

Abstract

The purpose of this study was to test the discriminating indices of Mathematics Achievement Test. 150 third year science and mathematics students from Bonga University (Male=86, Female=64) were randomly selected and participated on test Administration. The data was analyzed by using experts' review, cognitive interview, item characteristic curve(ICC), test information curve, difficulty and discrimination indices by using the application of IRT. 9 experts: 3 experts from the measurement and evaluation field, 3 experts from the psychology field, and 3 experts from the mathematics field were participated on experts' review of the items. The results of experts review reveal that all the 31 items have good face validity; 5 students were participated in cognitive interview of type group debriefing. The results of cognitive interview revealed that all the 31 items match with the intended meaning to measure the construct; the item discrimination indices and item difficulty indices by using the application of IRT results to suppressed 5 item from the list. Thus 25 items were retained for further data collection tool. The ICC and the test information indicted all the 25 items were considerably acceptable. Accordingly, 25 items were retained for the main data collection. The main data should be collected by this pre-tested achievement test and further multivariate analysis should be performed so as to check the dimensionality and validity of the scale in detail.

Introduction

According to Rhemtulla et al (2012), two theories, Classical Test Theory (CTT) and the Item Response Theory (IRT), underpin scale development. CTT is considered the traditional test theory and IRT the modern test theory; both function to produce latent constructs. Whether the researcher is using CTT or IRT, the primary goal is to obtain functional items (i.e., items that are correlated with each other, discriminate between individual cases, underscore a single or multidimensional domain, and contribute significantly to the construct). According to Messick (1995), CTT allows the prediction of outcomes of constructs and the difficulty of items. CTT models assume that items forming constructs in their observed, manifest forms consist of a true score on the domain of interest and a random error (which is the differences between the true score and a set of observed scores by an individual) (Campbell and Fiske,1959). IRT seeks to model the way in which constructs manifest themselves in terms of observable item response (Dennis, 1999). Comparatively, the IRT approach to scale development has the advantage of allowing the researcher to determine the effect of adding or deleting a given item or set of items by examining the item information and standard error functions for the item pool (Dennis, 1999).

Item response theory (IRT) is a second contemporary alternative to classical test theory (CTT). Although the roots of IRT have a long history (e.g., Lord, 1953; Rasch, 1960), IRT has emerged relatively recently as an alternative way of conceptualizing and analyzing measurement in the behavioral sciences. IRT is more computationally complex than CTT, but proponents of IRT suggest that this complexity is offset by several important advantages of IRT over CTT.

At its heart, IRT is a psychometric approach emphasizing the fact that an individual's response to a particular test item is influenced by qualities of the individual and by qualities of the item. IRT provides procedures for obtaining information about individuals, items, and tests. Advocates of IRT state that these procedures produce information that is superior to the information produced by CTT. Various forms of IRT exist, representing different degrees of complexity or different applicability to various kinds of tests. Thus IRT was applied in this study.

In this regard, the item difficulty level and discrimination indexes were calculated. The results of difficulty and discrimination indexes show that 25 items were considerably acceptable. (table 1).

Moreover, Psychometricians who use IRT often examine item characteristic curves to present and evaluate characteristics of the items on a test. Item characteristic curves, reflect the probabilities with which individuals across a range of trait levels are likely to answer each item correctly. The items characteristic curves are drawn based (in our case, the equation for the Rasch model) indicate the probability that participants with different trait level will answer the item correctly. The line connecting these probabilities reflects the test characteristic curve (TCC). Thus from the TCC we observe that individuals with any type of trait level can answer the questions correctly.

From the perspective of CTT, reliability was an important psychometric consideration for a test. Recall that, from the perspective of CTT, we were able to obtain an estimate of the reliability of the test. For example, we might compute coefficient alpha as an estimate of the test's reliability. An important point to note is that we would compute only one reliability estimate for a test, and that estimate would indicate the degree to which observed test scores are correlated with true scores. The idea that there is a single reliability for a particular test is an important way in which CTT differs from IRT. From the perspective of IRT, a test does not have a single "reliability." Instead, a test might have stronger psychometric quality for some people than for others. That is, a test might provide better information at some trait levels than at other trait levels. (Dennis, 1999).

A test information curve is useful for illustrating the degree to which a test provides different quality of information at different trait levels.

In this study the application IRT such as item discrimination index, item difficulty index, test information curve and test characteristic curves were used.

Methods

Sampling plan and Technique

150 third year science and mathematics students (male =86 Female= 64) in Bonga University, were students on whom the pilot test were employed. The students were selected randomly from 320 third year science and mathematics (Mathematics, Physics, Chemistry, and Biology) students.

Research Instruments and Data Collection procedures

31 multiple choice type achievement test were administered(see appendix-1). Nine experts were participated in reviewing this test. The experts were from the field of measurement and evaluation, Psychology, and Mathematics. three experts were Psychometric experts, three experts were from Mathematics field and the remaining three were psychology experts. The reason to combine these experts from the three fields was to get the Psychometric experts as well as expert who have know-how on mathematical and psychological constructs.

Methods of Data Analysis

The researcher has employed a quantitative method. Data that was collected through questionnaire was presented by using statistical tools. Frequency & percentage were the descriptive statistics used to describe demographic characteristics of respondents. To analyze the discrimination index of items: the *experts' review, cognitive interview, item characteristic curve(ICC), test information curve, difficulty and discrimination indices by using the application of IRT* were used.

Results and discussion

Evaluation by Experts

According to Rubio et al., 2003, face validity is the extent to which a measure, item, or indicator reflects what it is meant to measure and the face validity of the survey is then assessed by judges who possess expertise in the field of research being conducted. Ngo & O'Cass (2009) suggest that experts were also given the conceptual definitions of the focal constructs and the items measuring those constructs, as well as a set of instructions for making their judgments. As suggested by Ngo & O'Cass (2012), experts were also asked to comment on the consistencies between the measurement of the focal constructs and their respective definitions, as well as their relevance for the purpose of the study. Accordingly the nine experts in this study were asked to rate each item as either 1=Very weakly represents the Construct, 2= somewhat weakly represents the Construct, 3= Unsure, 4=

Somewhat Strongly represents the Construct, 5= Very strongly represents the Construct. (See appendix 2A).

Yusoff(2019) suggests that the content validity evidence can be represented by the content validity index (CVI). More over as per Yusoff(2019) there are two forms of CVI, in which CVI for item (I-CVI) and CVI for scale (S-CVI). Two methods for calculating S-CVI, in which the average of the I-CVI scores for all items on the scale (S-CVI/Ave) and the proportion of items on the scale that achieve a relevance scale of 4 or 5 by all experts (S-CVI/UA). The calculation of CVI, the relevance rating must be recorded as 1 (relevance scale of 4 or 5) or 0 (relevance scale of 1, 2 or 3) as shown in appendix 2B. In this study items with all the experts agreed up on as relevant, which are items with I-CVI = 1 and universal agreement (UA=1), were accepted for the next step (see appendix 2 B). Accordingly, the 31 items were accepted to fit the content.

Cognitive interview

Five students who were taken the test were asked to determine items with confusing meaning and which needs modification and deletion. Students were respond that there is no such item whose meanings are not match with the intended meaning to measure the construct and which are confusing. Thus the cognitive interview result indicated that all the 31 items has to be retained.

Item difficulty and discrimination index

Two parameter IRT model was employed to determine items' difficulty and discrimination indices. The result indicate that all items except five items, item1, item3, item 5, item7, item19, and 1tem23, have acceptable degree of discrimination and difficulty indices. Thus only 25 items, namely: item2, item4, item6, item8, item9, item10, item11, item12, item13, item14, item15, item16, item17, item18, item20, item21, item22, item24, item25, item26, item27, item28, item29, item30, and item31 are retained for final data collection. (see table 1 below).

Table 1: item discrimination and difficulty indices

.

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Discrim	1.949053	.1323764	14.72	0.000	1.6896	2.208506
Item1 Diff	.0823546	.1402456	0.59	0.557	-.1925217	.3572309
Item2 Diff	.3865283	.1422731	2.72	0.007	.1076781	.6653785
Item3 Diff	-.0937328	.1401771	-0.67	0.504	-.3684747	.1810092
Item4 Diff	.7217876	.1478387	4.88	0.000	.432029	1.011546
Item5 Diff	.2086929	.1407931	1.48	0.138	-.0672565	.4846422
Item6 Diff	.3610449	.142007	2.54	0.011	.0827163	.6393735
Item7 Diff	.0823546	.1402456	0.59	0.557	-.1925217	.3572309
Item8 Diff	.4631682	.1431925	3.23	0.001	.182516	.7438204
Item9 Diff	.4375876	.1428652	3.06	0.002	.157577	.7175981
Item10 Diff	.6435164	.1461523	4.40	0.000	.3570632	.9299696
Item11 Diff	1.780374	.207493	8.58	0.000	1.373695	2.187053
Item12 Diff	1.526691	.1854815	8.23	0.000	1.163154	1.890228
Item13 Diff	.3610449	.142007	2.54	0.011	.0827163	.6393735
Item14 Diff	.4887866	.1435418	3.41	0.001	.2074498	.7701235
Item15 Diff	.3610449	.142007	2.54	0.011	.0827163	.6393735
Item16 Diff	1.688631	.1988317	8.49	0.000	1.298928	2.078334
Item17 Diff	.4887866	.1435418	3.41	0.001	.2074498	.7701235
Item18 Diff	1.384214	.1755824	7.88	0.000	1.040079	1.728349

.

Item19	Diff	.107581	.1403224	0.77	0.443	-.1674459	.3826078
Item20	Diff	.5917135	.1451772	4.08	0.000	.3071715	.8762556
Item21	Diff	1.254532	.1679282	7.47	0.000	.925399	1.583665
Item22	Diff	-2.990779	.425614	-7.03	0.000	-3.824967	-2.156591
Item23	Diff	-.1439209	.1403168	-1.03	0.305	-.4189368	.1310949
Item24	Diff	2.913206	.4211094	6.92	0.000	2.087847	3.738566
Item25	Diff	1.318068	.1715242	7.68	0.000	.9818867	1.654249
Item26	Diff	-.4202239	.1425772	-2.95	0.003	-.6996701	-.1407778
Item27	Diff	-1.417411	.1799719	-7.88	0.000	-1.77015	-1.064673
Item28	Diff	1.075587	.1592891	6.75	0.000	.7633864	1.387788
Item29	Diff	1.318068	.1715242	7.68	0.000	.9818867	1.654249
Item30	Diff	.5401509	.1443099	3.74	0.000	.2573086	.8229932
Item31	Diff	1.938413	.224512	8.63	0.000	1.498378	2.378448

.

From the TCC we observe that individuals with any type of trait level can answer the questions correctly. (See figure 1).

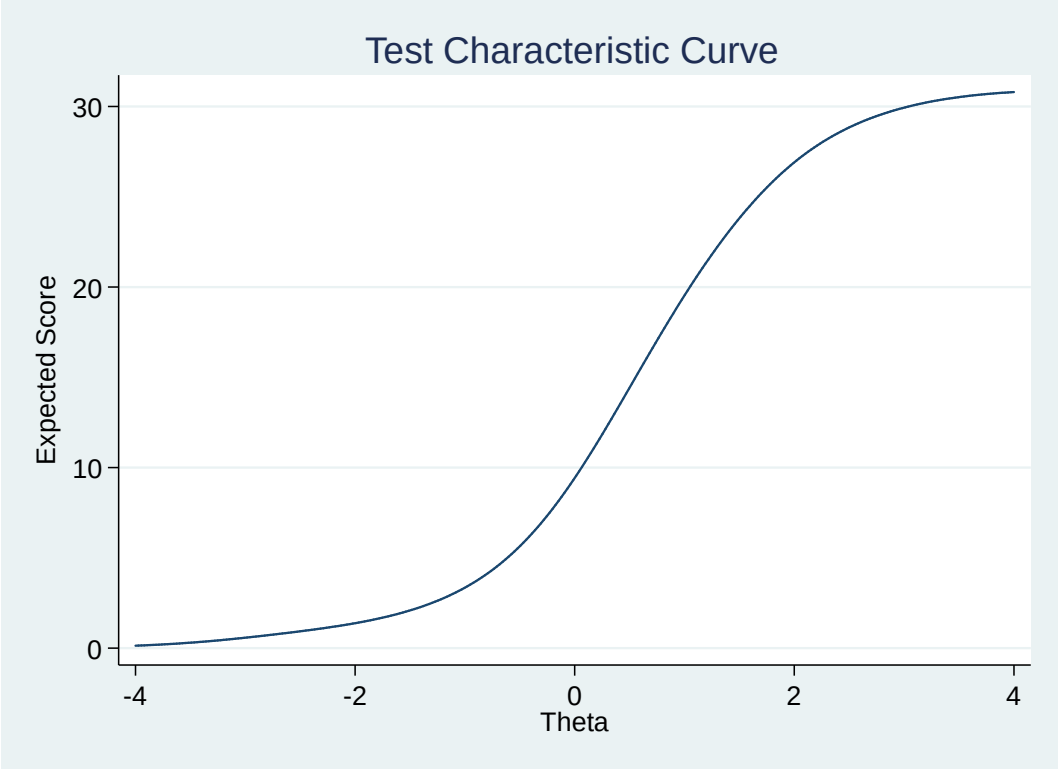


Fig. 1: Test characteristic curve

A test information function curve is useful for illustrating the degree to which a test provides different quality of information at different trait levels. Since the curve was bell shaped, as depicted in figure-2 indicate that the test was differentiating well among people with different trait level.

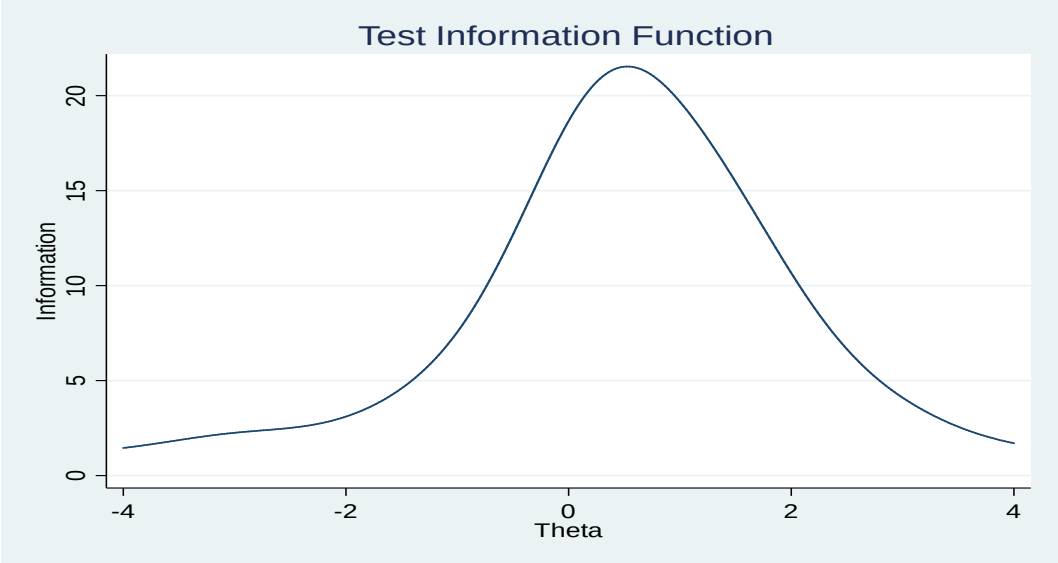


Fig. 2: Test information function curve

Conclusion and Recommendation

This section includes the conclusion of the pilot testing on discrimination indices of Mathematics achievement test items and recommends on further analysis by using main data collection and the application of factor analysis.

Conclusion

The main purpose of this study was to pilot testing the discrimination index of items to measure mathematics achievement test. Accordingly the item experts' review, cognitive interview, discrimination and difficulty indices, test characteristic curve and item information function cures were used. The finding indelicate that 25 items were retained to collect reliable data on mathematics achievement test. The items retained were given as follows:

2. There is a set A with exactly one proper subset.

○ True ○ False

4. The graph of a rational function can't cross its vertical asymptote.

○ True ○ False

6. If the function $f'(x) = 0$ at c, then f has local extreme at c.

○ True ○ False

8. -2 $\in$ natural numbers

○ True ○ False

9. -6 $\in$ { x: x is a solution to the equation $x^2=36$}

○ True ○ False

10. It is impossible to multiply 3x2 matrix by 3x2 matrix.

○ True ○ False

11. Which of the following option is true?

○ a. if 2 is an even number, then 3 is a multiple of 6.

○ b. -1 > 3 and 3 is a positive integer.

○ c. 7+2< 8 if 5-2 =9

○ d. -2 > 3 or 3 is a negative integer

12. The preposition $p \vee \neg q$ is _____.

○ a. logically equivalent to $\neg p \wedge q$

○ b. a tautology

○ c. a contradiction

○ d. logically equivalent to $q \Rightarrow p$

13. Which of the following statements is an open proposition?

○ a. X is odd prime number

○ b. Get me a glass of milkshake.

c. God bless you!

d. What is the time now?

14.If A and B are sets, and $A \cup B = A$, then, _____.

a. A=B b. $A \subseteq B$ c. A/B =A d. $B \subseteq A$

15. If A and B are sets such that $n(A) = 15$, $n(B) = 25$, and $n(A \cap B) = 5$; then $n(A \cup B)$ equal to

a. 25 b. 45 c.35 d.40

16. Which of the following is always correct if $a \leq b$?

a. -a $\leq -b$ b. a-4 $\leq b-4$ c. $a^2 \leq ab$ d. $a^2 \leq a^2 b$

17. What is the value of x such that $3^x = 243$?

a. 5 b. 4 c. ϕ d. 9

18. What is the value of x such that $x = \log_{\frac{1}{2}}^{32}$?

a. -5 b. 5 c. 8 d. 16

20. A diagonal matrix in which all the diagonal elements are one is _____.

a column matrix

c. a scalar matrix

b. An identity matrix

d . none of these

21. The function f(x) is said to be continuous at x =2, if $\lim_{x \to 2} f(x)$ is equal to _____

a. f(-2) b. 2 c. f($\frac{1}{2}$) d. f(2)

22. The derivative of $\sqrt[3]{x}$ with respect to x is _____.

a. $\frac{1}{3}\frac{1}{\sqrt[3]{x^2}}$ b. $\frac{1}{3}x^{\frac{2}{3}}$ c. $\frac{1}{3}x^{-\frac{3}{2}}$ d. $\frac{1}{3\sqrt{x}}$

24. If r= " Mario is Italian" and t= " Bob is English" write the following sentence in symbolic form : " Either Mario is Italian and Bob is English , or neither Mario is Italian nor Bob is English" _____.

a. $(r \wedge t) \vee (\neg r \wedge \neg t)$

b. $(r \wedge t) \vee (\neg r \vee \neg t)$

c. $(r \vee t) \vee (\neg r \vee \neg t)$

d. $(r \vee t) \vee (\neg r \wedge \neg t)$

25. $\lim_{x\to\infty}\left(\frac{1+x}{x}\right)^{\frac{-x}{2}}$=_____

a. e^{-2} b. e^{2} c. $e^{\frac{1}{2}}$ d. $e^{-\frac{1}{2}}$

26. $\lim_{x\to\infty}\left(\frac{2x^2-3x+1}{3(x+1)^2}\right)$=_____

a. $\frac{3}{2}$ b. 1 c. $\frac{1}{3}$ d. $\frac{2}{3}$

27. $\int \pi dx$ =_____

a. n-c b. 0 c. π x +c d. π +c

28. If $\int_1^6 f(x)dx = 9$ and $\int_1^3 f(x)dx = 4$ then, $\int_3^6 f(x)dx$ = _____

a.5 b.4 c.-5 d.13

29. Let $\int_a^b f(x)dx = 6$, then - $\int_b^a f(x)dx$ = _____

a.-6 b.12 c.0 d. 6

30. What is the center of circle with equation x^2+y^2 =100

a. (0, 0) b. (10,0) c. (0,10) d. (10,10)

31. What is the imagery and real part respectively of a complex number $\frac{1-i}{1+i}$?

a. 0 and 1 b. 0 and -1 c. 1 and 0 d. -1 and 0

Recommendation

In this study, the item analysis of mathematics achievement test with the application of IRT were employed; I recommend that further application of multivariate statistics should applied to test the dimensionality the tests.

References

Campbell DT, Fiske DW. (1959). Convergent and discriminant validity by the multitrait-multi method matrix. *Psychol Bull.* 56:81–105.

Dennis C. (1999). Theoretical underpinnings of breastfeeding confidence: a self-efficacy framework. *J Hum Lact.* 15:195–201.

Graham, M., Milanowski, A., & Miller, J. (2012). Measuring and Promoting Inter-Rater Agreement of Teacher and Principal Performance Ratings. *Online Submission.*

Lord, F. M. (1953). The relation of test score to the trait underlying the test. *Educational and psychological measurement*, *13*(4), 517-549.

Messick S. (1995). Validity of psychological assessment: validation of inferences from persons' responses and performance as scientifica inquiry into score meaning. *Am Psychol.* 50:741–9.

Ngo, L. V., & O'Cass, A. (2009). Creating value offerings via operant resource-based capabilities. *Industrial marketing management*, *38*(1), 45-59.

Ngo, L. V., & O'Cass, A. (2012). In search of innovation and customer-related performance superiority: The role of market orientation, marketing capability, and innovation capability interactions. *Journal of Product Innovation Management*, *29*(5), 861-877.

Rasch, G. (1960). ON GENERAL LAWS AND THE MEANING OF MEASUREMENT IN. In *Proceedings of the Fourth Berkeley Symposium on Mathematical Statistics and Probability: Held at the Statistical Laboratory, University of California, June 20-July 30, 1960* (Vol. 4, p. 321). Univ of California Press.

Rhemtulla M, Brosseau-Liard PÉ, Savalei V (2012). When can categorical variables be treated as continuous? A comparison of robust continuous and categorical SEM estimation methods under suboptimal conditions. *Psychol Methods*, 17:354–73

Rubio, D. M., Berg-Weger, M., Tebb, S. S., Lee, E. S., & Rauch, S. (2003). Objectifying content validity: Conducting a content validity study in social work research. *Social work 1research*, *27*(2), 94-104.

Appenix-7.1 : Mathematics Achievement test (MAT)

I. Students Demographic Information:

Write the need information in the blank space Tick in the box that correspond to your demographic information

Student ID:_____ Department _____

Year: _____ Cumulative GPA_____

Sex: Male ☐ Female ☐

University: Addis Ababa ☐ Hawassa ☐ Jimma ☐ Bonga ☐

II. For question 1-31 select one from given options

1. $(\exists x \in \mathrm{N})(x+1=0)$ is true.

○ True ○ False

2. There is a set A with exactly one proper subset.

○ True ○ False

3. Consider the function f(x)= x^2 from S={-1,0,1,2} in to N. Then , f is one-to-one.

○ True ○ False

4. The graph of a rational function can't cross its vertical asymptote.

○ True ○ False

5. If we multiply 3x2 matrix by 2x3 we get 3x3 matrix.

○ True ○ False

6. If the function $f'(x)=0$ at c, then f has local extreme at c.

○ True ○ False

7. If the function f is differentiable at a point, then f is continuous at this point

○ True ○ False

8. -2 ∈ natural numbers

○ True ○ False

9. -6 ∈ { x: x is a solution to the equation x^2=36}

○ True ○ False

10. It is impossible to multiply 3x2 matrix by 3x2 matrix.

○ True ○ False

11. Which of the following option is true?

○ a. if 2 is an even number, then 3 is a multiple of 6.
○ b. -1 > 3 and 3 is a positive integer.
○ c. 7+2< 8 if 5-2 =9
○ d. -2 > 3 or 3 is a negative integer

12. The preposition $p \vee \neg q$ is _____.

○ a. logically equivalent to $\neg p \wedge q$
○ b. a tautology
○ c. a contradiction
○ d. logically equivalent to $q \Rightarrow p$

13. Which of the following statements is an open proposition?

○ a. X is odd prime number
○ b. Get me a glass of milkshake.
○ c. God bless you!
○ d. What is the time now?

14.If A and B are sets, and $A \cup B = A$, then, _____.

a. A=B b. $A \subseteq B$ c. A/B =A d. $B \subseteq A$

15. If A and B are sets such that $n(A) = 15$, $n(B) = 25$, and $n(A \cap B) = 5$; then $n(A \cup B)$ equal to

a. 25 b. 45 c.35 d.40

16. Which of the following is always correct if $a \le b$?

a. -a $\le -b$ b. a-4 $\le b - 4$ c. $a^2 \le ab$ d. $a^2 \le a^2 b$

17. What is the value of x such that $3^x = 243$?

a. 5 b. 4 c. ϕ d. 9

18. What is the value of x such that $x = \log_{\frac{1}{2}}^{32}$?

a. -5 b. 5 c. 8 d. 16

19. If the number of rows and the number of columns of a matrix are equal, then, a matrix is:

a. a square matrix
b. a null matrix
c. a column matrix
d. a row matrix

20. A diagonal matrix in which all the diagonal elements are one is _____.

a column matrix
b. An identity matrix
c. a scalar matrix
d . none of these

21. The function f(x) is said to be continuous at x =2, if $\lim_{x \to 2} f(x)$ is equal to _____

a. f(-2) b. 2 c. f($\frac{1}{2}$) d. f(2)

22. The derivative of $\sqrt[3]{x}$ with respect to x is _____.

a. $\frac{1}{3}\frac{1}{\sqrt[3]{x^2}}$ b. $\frac{1}{3}x^{\frac{2}{3}}$ c. $\frac{1}{3}x^{-\frac{3}{2}}$ d. $\frac{1}{3\sqrt{x}}$

23. Which of the following is equal to $\int \frac{x}{x^2+1} dx$?

a. $(x^2+1)^2 + \frac{1}{x+1} + c$
b. $\ln|x^2+1| + c$
c. $\ln|(x^2+1)x| + c$
d. $\frac{1}{2}\ln|x^2+1| + c$

24. If r= " Mario is Italian" and t= " Bob is English" write the following sentence in symbolic form : " Either Mario is Italian and Bob is English , or neither Mario is Italian nor Bob is English" _____.

a. $(r \wedge t) \vee (\neg r \wedge \neg t)$
b. $(r \wedge t) \vee (\neg r \vee \neg t)$
c. $(r \vee t) \vee (\neg r \vee \neg t)$
d. $(r \vee t) \vee (\neg r \wedge \neg t)$

25. $\lim_{x\to\infty}\left(\frac{1+x}{x}\right)^{\frac{-x}{2}}$ =_____

a. e^{-2} b. e^{2} c. $e^{\frac{1}{2}}$ d. $e^{-\frac{1}{2}}$

26. $\lim_{x\to\infty}\left(\frac{2x^2-3x+1}{3(x+1)^2}\right)$ =_____

a. $\frac{3}{2}$ b. 1 c. $\frac{1}{3}$ d. $\frac{2}{3}$

27. $\int \pi dx$ =_____

a. n-c b. 0 c. π x +c d. π +c

28. If $\int_1^6 f(x)dx = 9$ and $\int_1^3 f(x)dx = 4$ then, $\int_3^6 f(x)dx$ = _____

a.5 b.4 c.-5 d.13

29. Let $\int_a^b f(x)dx = 6$, then -$\int_b^a f(x)dx$ = _____

a.-6 b.12 c.0 d. 6

30. What is the center of circle with equation x^2+y^2 =100

a. (0, 0) b. (10,0) c. (0,10) d. (10,10)

31. What is the imagery and real part respectively of a complex number $\frac{1-i}{1+i}$?

a. 0 and 1 b. 0 and -1 c. 1 and 0 d. -1 and 0

Appendix-7.2 : The experts Review For MAT

1=Very weakly represents the Construct, 2= somewhat weakly represents the Construct, 3= Unsure, 4= Somewhat Strongly represents the Construct, 5= Very strongly represents the Construct.

Item No.	Epert-1	Expert-2	Expert-3	Expert-4	Expert-5	Expert-6	Expert-7	Exper-8	Expert_9	Comment
1	4	5	5	5	5	5	5	5	5	
2	4	4	5	5	4	5	4	5	4	
3	4	5	4	5	5	5	4	4	4	
4	5	4	5	5	4	5	5	4	5	
5	4	5	4	3	5	5	5	5	4	
6	4	4	5	5	5	5	5	5	5	
7	4	4	5	5	5	5	5	5	5	
8	4	5	4	4	5	4	4	5	4	
9	4	5	4	4	4	4	4	5	5	
10	5	4	4	5	5	4	4	5	4	
11	4	5	4	4	4	4	4	5	5	
12	4	5	5	5	4	4	5	5	4	
13	4	4	5	4	4	5	5	5	5	
14	4	5	4	5	4	4	4	4	5	
15	4	5	5	5	5	4	4	5	5	
16	4	5	5	4	4	4	4	5	4	
17	5	4	5	5	4	4	5	5	5	

18	4	4	5	5	4	5	4	5	5	
19	5	5	5	4	4	4	5	4	4	
20	4	4	4	5	5	4	5	5	4	
21	4	5	5	4	4	4	4	4	5	
22	4	5	5	5	4	4	4	4	4	
23	4	5	5	5	4	4	5	5	5	
24	4	5	4	5	5	4	5	5	4	
25	5	5	4	4	5	4	5	5	4	
26	5	5	5	4	4	4	5	5	5	
27	4	4	4	5	5	4	5	4	5	
28	4	5	5	4	4	5	5	4	4	
29	4	4	4	5	5	5	4	5	5	
30	4	4	4	4	5	4	4	4	5	
31	4	5	4	4	5	4	5	5	4	

Appendix 7.3 : Content validity index(CVI)for each item for MAT

Item No.	Epert-1	Expert-2	Expert-3	Expert-4	Expert-5	Expert-6	Expert-7	Exper-8	Expert_9		Experts in agreement	I-CVI	UA
1	1	1	1	1	1	1	1	1	1		9	1.00	1
2	1	1	1	1	1	1	1	1	1		9	1.00	1
3	1	1	1	1	1	1	1	1	1		9	1.00	1
4	1	1	1	1	1	1	1	1	1		9	1.00	1
5	1	1	1	1	1	1	1	1	1		9	1.00	1
6	1	1	1	1	1	1	1	1	1		9	1.00	1
7	1	1	1	1	1	1	1	1	1		9	1.00	1
8	1	1	1	1	1	1	1	1	1		9	1.00	1
9	1	1	1	1	1	1	1	1	1		9	1.00	1
10	1	1	1	1	1	1	1	1	1		9	1.00	1
11	1	1	1	1	1	1	1	1	1		9	1.00	1
12	1	1	1	1	1	1	1	1	1		9	1.00	1
13	1	1	1	1	1	1	1	1	1		9	1.00	1
14	1	1	1	1	1	1	1	1	1		9	1.00	1
15	1	1	1	1	1	1	1	1	1		9	1.00	1
16	1	1	1	1	1	1	1	1	1		9	1.00	1
17	1	1	1	1	1	1	1	1	1		9	1.00	1
18	1	1	1	1	1	1	1	1	1		9	1.00	1
19	1	1	1	1	1	1	1	1	1		9	1.00	1
20	1	1	1	1	1	1	1	1	1		9	1.00	1
21	1	1	1	1	1	1	1	1	1		9	1.00	1
22	1	1	1	1	1	1	1	1	1		9	1.00	1
23	1	1	1	1	1	1	1	1	1		9	1.00	1
24	1	1	1	1	1	1	1	1	1		9	1.00	1
25	1	1	1	1	1	1	1	1	1		9	1.00	1
26	1	1	1	1	1	1	1	1	1		9	1.00	1
27	1	1	1	1	1	1	1	1	1		9	1.00	1
28	1	1	1	1	1	1	1	1	1		9	1.00	1
29	1	1	1	1	1	1	1	1	1		9	1.00	1
30	1	1	1	1	1	1	1	1	1		9	1.00	1
31	1	1	1	1	1	1	1	1	1		9	1.00	1

Appendix 7.4 : The **25 items retained by the item analysis procedure**

2. There is a set A with exactly one proper subset.

True False

4. The graph of a rational function can't cross its vertical asymptote.

True False

6. If the function $f'(x) = 0$ at c, then f has local extreme at c.

True False

8. -2 $\in$ natural numbers

True False

9. -6 $\in$ { x: x is a solution to the equation x^2=36}

True False

10. It is impossible to multiply 3x2 matrix by 3x2 matrix.

True False

11. Which of the following option is true?

a. if 2 is an even number, then 3 is a multiple of 6.

b. -1 > 3 and 3 is a positive integer.

c. 7+2< 8 if 5-2 =9

d. -2 > 3 or 3 is a negative integer

12. The preposition $p \vee \neg q$ is _____.

a. logically equivalent to $\neg p \wedge q$

b. a tautology

c. a contradiction

d. logically equivalent to $q \Rightarrow p$

13. Which of the following statements is an open proposition?

a. X is odd prime number

b. Get me a glass of milkshake.

c. God bless you!

d. What is the time now?

14.If A and B are sets, and $A \cup B = A$, then, _____.

a. A=B b. $A \subseteq B$ c. A/B =A d. $B \subseteq A$

15. If A and B are sets such that $n(A) = 15$, $n(B) = 25$, and $n(A \cap B) = 5$; then $n(A \cup B)$ equal to

a. 25 b. 45 c.35 d.40

16. Which of the following is always correct if $a \le b$?

a. $-a \le -b$ b. $a-4 \le b-4$ c. $a^2 \le ab$ d. $a^2 \le a^2 b$

17. What is the value of x such that $3^x = 243$?

a. 5 b. 4 c. ϕ d. 9

18. What is the value of x such that $x = \log_{\frac{1}{2}}^{32}$?

a. -5 b. 5 c. 8 d. 16

20. A diagonal matrix in which all the diagonal elements are one is _____.

a column matrix c. a scalar matrix

b. An identity matrix d . none of these

21. The function f(x) is said to be continuous at x =2, if $\lim_{x \to 2} f(x)$ is equal to _____

a. f(-2) b. 2 c. $f(\frac{1}{2})$ d. f(2)

22. The derivative of $\sqrt[3]{x}$ with respect to x is _____.

a. $\frac{1}{3}\frac{1}{\sqrt[3]{x^2}}$ b. $\frac{1}{3}x^{\frac{2}{3}}$ c. $\frac{1}{3}x^{-\frac{3}{2}}$ d. $\frac{1}{3\sqrt{x}}$

24. If r= " Mario is Italian" and t= " Bob is English" write the following sentence in symbolic form : " Either Mario is Italian and Bob is English , or neither Mario is Italian nor Bob is English" _____.

a. $(r \wedge t) \vee (\neg r \wedge \neg t)$ c. $(r \vee t) \vee (\neg r \vee \neg t)$

b. $(r \wedge t) \vee (\neg r \vee \neg t)$ d. $(r \vee t) \vee (\neg r \wedge \neg t)$

Appenix 8: Modification indices

	MI	df	P>MI	EPC	Standard EPC
Measurement					
q57					
Achievment_Goal	13.432	1	0.00	.4081224	.1904172
Self_Efficacy	6.125	1	0.01	-.1395594	-.1122777
q154					
Achievment_Goal	11.030	1	0.00	-.354005	-.1893009
q56					
Achievment_Goal	4.828	1	0.03	.2533216	.1196908
Self_Efficacy	5.791	1	0.02	-.1406489	-.1145892
q140					
Self_Efficacy	14.311	1	0.00	.2241315	.1908102
q121					
Achievment_Goal	10.611	1	0.00	.3387794	.1932786
q26					
Self_Concept	8.719	1	0.00	-.2691111	-.1821064
q35					
Self_Concept	4.651	1	0.03	-.1929385	-.1372081
q82					
Self_Concept	8.513	1	0.00	.2258299	.1749617
q95					
Self_Concept	15.726	1	0.00	-.5113728	-.3322592
q66					
Self_Concept	30.784	1	0.00	.4879279	.3149953

cov(e.q125,e.q57)	9.155	1	0.00	-.1123217	-.1793097
cov(e.q125,e.q154)	23.564	1	0.00	.1706362	.2753304
cov(e.q125,e.q10)	4.469	1	0.03	.0656892	.1262856
cov(e.q125,e.q81)	5.459	1	0.02	-.0909518	-.1273262
cov(e.q135,e.q154)	28.417	1	0.00	.1919418	.2970976
cov(e.q135,e.q140)	6.761	1	0.01	-.1024692	-.144353
cov(e.q135,e.q116)	4.842	1	0.03	-.0788499	-.1222174
cov(e.q135,e.q76)	9.151	1	0.00	.1171107	.1663429
cov(e.q135,e.q144)	10.460	1	0.00	-.1310239	-.1749727
cov(e.q135,e.q121)	4.434	1	0.04	-.0738003	-.115829
cov(e.q135,e.q81)	4.329	1	0.04	-.0834013	-.112002
cov(e.q57,e.q154)	26.218	1	0.00	-.2101423	-.2892339
cov(e.q57,e.q56)	83.836	1	0.00	.408201	.5270217
cov(e.q57,e.q140)	6.542	1	0.01	-.1148593	-.1438815
cov(e.q57,e.q144)	6.033	1	0.01	-.1132283	-.1344563
cov(e.q57,e.q9)	8.282	1	0.00	.110331	.1681862
cov(e.q57,e.q7)	5.262	1	0.02	.0895383	.12926
cov(e.q57,e.q25)	4.820	1	0.03	-.1228958	-.1182089
cov(e.q154,e.q149)	16.705	1	0.00	.1535896	.2224023
cov(e.q154,e.q133)	10.040	1	0.00	-.1205473	-.1728959
cov(e.q154,e.q76)	4.643	1	0.03	.0908001	.1159159
cov(e.q154,e.q121)	11.345	1	0.00	-.1284918	-.1812522
cov(e.q154,e.q81)	14.588	1	0.00	-.1675871	-.2022754
cov(e.q149,e.q38)	4.626	1	0.03	.0985398	.1139773
cov(e.q56,e.q140)	16.222	1	0.00	-.1869398	-.2220252
cov(e.q56,e.q116)	17.121	1	0.00	-.1746241	-.2281939
cov(e.q56,e.q76)	7.872	1	0.01	.1279625	.1532351
cov(e.q56,e.q121)	5.354	1	0.02	-.0955323	-.1264087
cov(e.q140,e.q133)	12.543	1	0.00	.1475198	.1925664
cov(e.q140,e.q116)	25.898	1	0.00	.2171445	.2753171
cov(e.q140,e.q76)	6.091	1	0.01	-.1138946	-.1323315
cov(e.q140,e.q144)	40.777	1	0.00	.3089516	.3374913
cov(e.q140,e.q121)	10.254	1	0.00	.1337774	.1717489
cov(e.q140,e.q26)	10.841	1	0.00	-.1674776	-.1746193
cov(e.q140,e.q82)	7.344	1	0.01	.1162746	.1453434
cov(e.q140,e.q96)	5.961	1	0.01	.1203653	.1521787
cov(e.q140,e.q66)	4.614	1	0.03	.1253034	.1115656
cov(e.q133,e.q76)	6.784	1	0.01	-.1066624	-.1403836
cov(e.q133,e.q35)	5.613	1	0.02	-.1054729	-.1248491
cov(e.q133,e.q82)	4.243	1	0.04	.0783341	.1109191
cov(e.q133,e.q81)	6.791	1	0.01	.1110664	.1382081
cov(e.q116,e.q76)	10.328	1	0.00	-.1348482	-.1723869
cov(e.q116,e.q121)	20.631	1	0.00	.1725319	.2437135
cov(e.q116,e.q82)	10.672	1	0.00	.1274355	.175267
cov(e.q116,e.q81)	8.616	1	0.00	.1283357	.1551145
cov(e.q76,e.q121)	7.191	1	0.01	-.1102051	-.1426553
cov(e.q76,e.q25)	5.693	1	0.02	.1391451	.1241373
cov(e.q76,e.q82)	6.240	1	0.01	-.1056535	-.1331586

cov(e.q144,e.q26)	5.563	1	0.02	-.1244713	-.1230246
cov(e.q121,e.q7)	4.461	1	0.03	-.07771	-.1149753
cov(e.q121,e.q82)	4.054	1	0.04	.0770803	.1073446
cov(e.q121,e.q81)	8.829	1	0.00	.1275044	.1560475
cov(e.q121,e.q95)	3.956	1	0.05	.080307	.1358017
cov(e.q26,e.q38)	4.691	1	0.03	.1268079	.1160401
cov(e.q26,e.q25)	99.731	1	0.00	.6581674	.5269218
cov(e.q26,e.q35)	5.458	1	0.02	.1309122	.1237742
cov(e.q26,e.q95)	6.335	1	0.01	.1253867	.1721979
cov(e.q26,e.q96)	17.177	1	0.00	-.2247323	-.2570802
cov(e.q26,e.q66)	18.644	1	0.00	-.2771944	-.223307
cov(e.q10,e.q9)	12.192	1	0.00	.1412707	.259337
cov(e.q10,e.q38)	3.853	1	0.05	-.0907057	-.1200934
cov(e.q10,e.q96)	7.682	1	0.01	.1139618	.1886191
cov(e.q9,e.q25)	9.332	1	0.00	-.1645831	-.1772142
cov(e.q7,e.q81)	6.181	1	0.01	-.1101687	-.1394698
cov(e.q38,e.q25)	11.427	1	0.00	.2288121	.1776906
cov(e.q38,e.q35)	29.018	1	0.00	.3099897	.2842973
cov(e.q38,e.q82)	8.887	1	0.00	-.1480291	-.1623992
cov(e.q25,e.q35)	15.736	1	0.00	.2572576	.2064153
cov(e.q25,e.q82)	5.758	1	0.02	-.1339433	-.12856
cov(e.q25,e.q81)	5.059	1	0.02	-.1399543	-.1180501
cov(e.q25,e.q95)	5.848	1	0.02	.1399416	.1630974
cov(e.q25,e.q96)	7.386	1	0.01	-.1712654	-.1662634
cov(e.q35,e.q82)	9.627	1	0.00	-.1473123	-.1669798
cov(e.q35,e.q95)	5.319	1	0.02	.1133585	.156025
cov(e.q82,e.q81)	81.169	1	0.00	.4111574	.4899357
cov(e.q95,e.q96)	23.290	1	0.00	-2.742483	-4.56707
cov(e.q96,e.q66)	10.617	1	0.00	.2543448	.2484609

EPC = expected parameter change

Apendix -9: MANCOVA Assumptions

Assumptions:

1. **Independent Observations** : all observations are considered to be independent.
2. **Random sampling**: Data was randomly sampled from the population of interest and measured at an interval level.
3. **Multivariate normality**

Table 1 Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	172.1564	365.5928	272.0375	49.77754	400
Std. Predicted Value	-2.007	1.879	.000	1.000	400
Standard Error of Predicted Value	7.296	18.849	11.926	2.755	400
Adjusted Predicted Value	170.1436	365.7713	272.0322	49.79674	400
Residual	-340.48361	264.92389	.00000	140.97301	400
Std. Residual	-2.409	1.875	.000	.997	400
Stud. Residual	-2.421	1.887	.000	1.001	400
Deleted Residual	-343.86041	268.34216	.00529	142.02471	400
Stud. Deleted Residual	-2.436	1.893	.000	1.003	400
Mahal. Distance	.066	6.100	1.995	1.386	400
Cook's Distance	.000	.019	.002	.003	400
Centered Leverage Value	.000	.015	.005	.003	400

a. Dependent Variable: ID

From the table 1 we observe that the maximum value of Mahala nobi Distance = 6.100 which is less than 7.81, the critical chi-squre value with degree of freedom three(number of factors) and significance level .05. Hence we conclude that there is multivariate normality.

4. **Homogeneity of variance/covarience matrices across groups *(test using Box's M or Levene's statistic)***

(i) Equality of variance

H0: group variances are significantly different.

Ha: group variances are not significantly different.

Table 2: Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
Math_Achievement	1.197	368	31	.279
Academic_Acheievement	1.488	368	31	.090

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Age + Gender + University + College + Year + Mother_Education + Father_Education + Father_Employement + Mother_Employment + Mother_Pofession_in_Science + Father_Profession_in_Science + Self_Concept + Anxiety + Achievement_Goal + Self_Concept * Anxiety + Self_Concept * Achievement_Goal + Anxiety * Achievement_Goal + Self_Concept * Anxiety * Achievement_Goal

From table 2, we observe that the variances are equal (and therefore the assumption of equality of variance is met). That is the Levene's test statistic is *non-significant for each dependent variable.* Hence, the variances of groups are equal and the assumption is tenable.

(ii) Equality of covariance

H0: the covariance matrices are the same for all the three groups

Ha: the covariance matrices are different for at least one of the groups.

Table 3: Box's Test of Equality of Covariance Matrices[a]

Box's M	7.489
F	1.594
df1	3
df2	6480.000
Sig.	.189

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept + Age + Gender + University + College + Year + Mother_Education + Father_Education + Father_Employement + Mother_Employment + Mother_Pofession_in_Science + Father_Profession_in_Science + Self_Concept + Anxiety + Achievement_Goal + Self_Concept * Anxiety + Self_Concept * Achievement_Goal + Anxiety * Achievement_Goal + Self_Concept * Anxiety * Achievement_Goal

From table 3, we observe that the matrices are equal (and therefore the assumption of homogeneity is met). That is the Box's test statistic is *non-significant (P= .189 which is greater than .05)*: Hence, the covariance matrices are equal and the assumption is tenable.

Appendix 10: Translation Quality Assessment Rubric

Dear respondent:

This Rubric is developed to assess the overall quality of translation in Mathematics Learning Motivation (MLM) instrument. Your rate will be used the researcher to determine the quality of the translation. To that end, your careful completion of the rubric will definitely contribute to obtaining real data, which is crucial for more accurate findings. The information you reveal to us is kept confidential and would be used only for research purposes.

A. Please mark the part that best matches your status.

Gender: Male ☐ Female ☐

Institution: Bonga Education College ☐ Bonga University ☐

Your level of qualification: PhD ☐ M.A. ☐

Years of translation experiences: Below 5 years ☐ 5-10 years ☐ more than 10 years ☐

Field of teaching: TEFL ☐ English ☐ English Literature ☐ Others ☐

B. Respond to each statement below according to the following 4-point Likert scale:

Superior = Score 4, Advanced= Score 3, Fair = Score 2, and Poor = Score 1

Rater's Code: ……

Items	Rate by the Raters			
	1	2	3	4
1. Grammar (Word Form/ Part of Speech, Word Order, Syntax …)				
2. Usage				
3. (No) Addition				
4. (No) Omission				
5. Completeness				
6. Punctuation				
7. Terminology/False friend Terminology				
8. Spelling				
9. Capitalization/ Italicization Rules				
10. Faithfulness/literalness				
11. Register/Tone				
12. Genre (Text Style, Text Type)				
13. Cohesion/Coherence, Consistency				
14. Accuracy				
15. Fluency)Naturalness, Readability, No Ambiguity, No Mistranslation)				
Total				

Appendix 11: Back Translation

#	Sentence	1	2	3	4	5
q1	Though I get error from math exercise, I like to learn from my mistake	1	2	3	4	5
q2	I do mathematics because I learn new things from it	1	2	3	4	5
q3	I like math lesson more if it makes me to think more	1	2	3	4	5
q4	I do mathematics for sake of good score on it	1	2	3	4	5
q5	I do mathematics for sake of enjoying it	1	2	3	4	5
q 6	I do mathematics because I need it	1	2	3	4	5
q 7	I plan to cover all mathematics contents I have gone though in the class	1	2	3	4	5
q 8	One of my goal is to learn mathematics as much as I can	1	2	3	4	5
q 9	I want to learn math as much as I can	1	2	3	4	5
q 10	I try to have deep undesigning on math lesson as much as I can	1	2	3	4	5
q 11	I need to improve my math skill this year	1	2	3	4	5
q 12	I feel good if I respond to my math teacher than other students	1	2	3	4	5
q 13	I want to perform in math better than other students	1	2	3	4	5
q 14	I feel I succeed in math if I do better than other students	1	2	3	4	5
q 15	I want to show my teacher that I am clever than other students	1	2	3	4	5
q 16	I need to perform better in math than other students	1	2	3	4	5
q 17	Other students should think that I am good in math	1	2	3	4	5
q 18	One of my goal is to show others that I am good at math	1	2	3	4	5
q 19	I am committed enough than others to perform well in math	1	2	3	4	5
q 20*	One of my goal is to be good at math than other students	1	2	3	4	5
q 21*	It is mandatory for me to be good at math than other students	1	2	3	4	5
q 22	It is mandatory to try hard in math not to get failure	1	2	3	4	5
q 23	It is mandatory to show improvement in math not to get failure.	1	2	3	4	5
q 24	Understanding math is fundamental not to get failure	1	2	3	4	5
q 25	I have a goal not to act upon under my performance	1	2	3	4	5
q 26	I have a goal not to perform less in math than I could	1	2	3	4	5
q 27*	I never bother for my error a much as I learned of it and avid failure	1	2	3	4	5
q 28	I have a goal to work hard in math not to get failure	1	2	3	4	5
q 29	understanding new concepts is advisable to avoid failure in math	1	2	3	4	5
q 30	I try to avoid partial understanding in math	1	2	3	4	5
q 31	Understanding every math concepts is important to avid failure	1	2	3	4	5
q 32	Learning a lot of new concepts in mat is useful to avid failure in math	1	2	3	4	5
q 33	One of my goals is to lean new math concepts so as to avoid failure in math	1	2	3	4	5
q 34	My goal is not to perform less in math as compared to of other students	1	2	3	4	5
q 35	I work ard in math not to perfom less in math as compared to others	1	2	3	4	5
q 36	Scoring high in math test is useful no to perform less in math	1	2	3	4	5
q 37*	My goal is no to perform less in math as compared to other students	1	2	3	4	5
q 38*	My goal is not to get negative feedback in math	1	2	3	4	5
q 39	My goal not achieve less in math as compared to others	1	2	3	4	5
q 40	My goal is to practice math no to achieve less in math as compared to others	1	2	3	4	5
q 41	I learn math because it helps my work fast and perfect	1	2	3	4	5
q 42	I do math exercises because I enjoy in doing challenging exercises	1	2	3	4	5
q 43	I do math exercises because I enjoy in different methods that I didn't try	1	2	3	4	5
q 44	I do math exercises because I enjoy in mastering challenig ideas	1	2	3	4	5
q 45	I do math exercises because it gives me appreciation and good feeling	1	2	3	4	5

q 46	I do math exercises because it gives good feeling when I do exercises I like	1	2	3	4	5
q 47	I do math exercises because immersing in it gives me good feeling	1	2	3	4	5
q 48	I do math exercises because I in joy in getting new ideas	1	2	3	4	5
q 49	I do math exercises because it gives best ideas to the subject I am learning	1	2	3	4	5
q 50	I do math exercises because it gives good way to succeed in test	1	2	3	4	5
q 51	I do math exercises because it gives new solution strategies	1	2	3	4	5
q 52	In math subject, I prefer challenging assignments because I learn new things	1	2	3	4	5
q 53	In math subject I favor assignment which initiates to learn though it is challenging	1	2	3	4	5
q 54	Understanding math contents as much as possible is helpful	1	2	3	4	5
q55*	In math subject I favor assignment which initiates to learn though I didn't score good grade on it	1	2	3	4	5
q56	I enjoy in doing math exercises; I relax in math	1	2	3	4	5
q57	I portray that mathematics as very interesting	1	2	3	4	5
q58	I believe mathematics is pleasurable	1	2	3	4	5
q59	While doing mathematics, I imagine about how much I take pleasure in it.	1	2	3	4	5
q60*	Receiving a excellent score in my math subject was most rewarding thing for me.	1	2	3	4	5
q61	The most significant thing for me is improving my cumulative grade point average, so my major worry in my math courses will be achieving a good grade.	1	2	3	4	5
q62*	I would better get good grades in my math courses than most of the other students.	1	2	3	4	5
q63	I would like to perform well in math because it is significant to demonstrate my skill to my family, friends, employer, or others.	1	2	3	4	5
q64	I perform in math because I ought to perform it to suffer good for myself.	1	2	3	4	5
q65	I perform in math because people around me think it is significant to be clever.	1	2	3	4	5
q66	I perform in math to demonstrate others how excellent I am in it.	1	2	3	4	5
q67	I perform in math because it assists me in continuing good contact with my friends.	1	2	3	4	5
q68	I perform in math because it lets me to be well respected by people that I know.	1	2	3	4	5
q69*	I perform in math because, in my belief, it is a good way to meet people.	1	2	3	4	5
q70	I do mathematics because I would feel awful if I was not taking time to accomplish it.	1	2	3	4	5
q71	I do mathematics because it is one of the most excellent means to widen other facets for myself.	1	2	3	4	5
q72	I do mathematics because it is a good way to learn important ideas which are useful in other areas of my life.	1	2	3	4	5
q73	I do mathematics because it helps to understand the world.	1	2	3	4	5
q74	I do mathematics for the kudos of being mathematically knowledgeable.	1	2	3	4	5
q75	I score outstanding score on math examination.	1	2	3	4	5
q76	I always succeed in math subject.	1	2	3	4	5
q77	Though I am studying hard, I perform unsuccessfully in my math subject.	1	2	3	4	5
q78*	I got good grades in my math subject at the end.	1	2	3	4	5
q79	I accomplish well on math assignments.	1	2	3	4	5
q80*	I execute well on nearly all the difficult math assignments.	1	2	3	4	5
q81	Bearing in mind adults do well in my math moves forward me to perform better.	1	2	3	4	5
q82	Observing how my math teacher works out a problem, initiates myself solving the problem in similar fashion.	1	2	3	4	5
q83	Observing children do better than me in math initiates me to do better.	1	2	3	4	5
q84	Observing how another student solves a math problem, initiates me to solve the problem in the same way.	1	2	3	4	5

q85	I consider myself that I can do difficult math problems in point of fact.	1	2	3	4	5
q86	I struggle with myself in my math subject.	1	2	3	4	5
q87	My math teachers told that I am good at math.	1	2	3	4	5
q88	People informed me I am talented in math.	1	2	3	4	5
q89*	Adults in my family announced me that I am good at math.	1	2	3	4	5
q90	I am honored by capability in math.	1	2	3	4	5
q91	Other students informed me that I am m good at learning math.	1	2	3	4	5
q92	My classmates favor to work math exercises with me because they believe that I am good at math.	1	2	3	4	5
q93	I feel stressed and nervous in math class	1	2	3	4	5
q94*	I lose my energy when I am doing math	1	2	3	4	5
q95	I feel anxious when I start doing math	1	2	3	4	5
q96	My mind becomes blank and I am unable to think clearly when I am doing math	1	2	3	4	5
q97	I will become unhappy when I imagine about learning math.	1	2	3	4	5
q98	All my body become stressed when I start doing math	1	2	3	4	5
q99*	I consider myself that I will perform good at math if I study math properly	1	2	3	4	5
q100	It is by my fault that I am not learning math properly	1	2	3	4	5
q101	I consider myself that I can understand math if I learn and try it hard.	1	2	3	4	5
q102*	I am not learning math properly because I didn't try it hard.	1	2	3	4	5
q103	I believe to score good score in math	1	2	3	4	5
q104	I am sure that I can understand what ever difficult math in the class.	1	2	3	4	5
q105	I am confident that I understand basic concepts of math	1	2	3	4	5
q106	I am m confident I can understand the most difficult math content presented in the class.	1	2	3	4	5
q107	I am confident that I score good results in math tests and math assignments	1	2	3	4	5
*q108	I think I perform well in math class	1	2	3	4	5
q109	I am sure I can master the contents I have learnt in math class	1	2	3	4	5
q110	I do well a math class by taking in account the difficulty of mathematics and my skills	1	2	3	4	5
q111	I learn math because it helps me in reaching my future targets.	1	2	3	4	5
*q112	I learn math because it helps me in achieving my dreams.	1	2	3	4	5
q113	I learn math because good achievement in it is important for me to reach my dream.	2	3	4	5	
*q114	I perform in math because good achievement in it is important for achieve my goal	2	3	4	5	
q115	I perform in math because it is mandatory to know math to be the person I want to be	1	2	3	4	5
q116	I consider myself that I can use the mathematics I have learnt	1	2	3	4	5
*q117	Learning math is important to me	1	2	3	4	5
q118	I am happy in math	1	2	3	4	5
q119	I think learning math is helpful to me	1	2	3	4	5
q120	I like mathematics	1	2	3	4	5
q121	It is important to me to understand math	1	2	3	4	5
q122	I am happy in math because my need for food, water, shelter, clothing, comfort, rest or sleep, was satisfied	1	2	3	4	5
q123	I am happy in math class because my safety need of to be protected from danger, physical and social circumstances was satisfied	1	2	3	4	5

q124	I sense love in math class room.	1	2	3	4	5
q125	I feel confident by my math ability	1	2	3	4	5
q126	I like to get respect and appreciation by people concerning my math ability	1	2	3	4	5
q127	I want to reach where others were reached by my math ability	1	2	3	4	5
q128	Math subject is simple to learn	1	2	3	4	5
q129	Math subject is simple to be promoted	1	2	3	4	5
q130	Math helps me to do things in different ways	1	2	3	4	5
q131	All math questions can be solved	1	2	3	4	5
q132	I satisfied by math subject	1	2	3	4	5
q133	Math helps me to understand other subjects	1	2	3	4	5
q134	Math improves my ability of learning and imagination	1	2	3	4	5
q135	I am good at learning math	1	2	3	4	5
q136	I am capable to score good in math	1	2	3	4	5
q137	I feel happy if I answer math questions	1	2	3	4	5
q138	Math helps me to study by myself	1	2	3	4	5
q139	Math is convent only for talented students	1	2	3	4	5
q140	Math helps me to solve my personal problems broadly	1	2	3	4	5
q141	Math makes me to imagine quickly	1	2	3	4	5
q142	My ability in math is high	1	2	3	4	5
q143	Math helps me to perform things perfectly	1	2	3	4	5
*q144	I perform additional tasks to learn math	1	2	3	4	5
q145	Math is important for my future profession	1	2	3	4	5
q146	I feel comfortable in math subject	1	2	3	4	5
*q147	My being successful in my is related to my math ability	1	2	3	4	5
q148	I have negative response on competition style of learning math	1	2	3	4	5
q149	I have positive perceptions of my abilities and my success in mathematics	1	2	3	4	5
q150	I favor group work during math class	1	2	3	4	5
q151	I feel that I have an influence on mathematics content and I much participation on math lesson	1	2	3	4	5
q152	I crate much interaction with my math teacher during math lesson	1	2	3	4	5
q153	I often learn math by solving different problems and studying by myself	1	2	3	4	5
q154	I believe that I have good ability in math	1	2	3	4	5
q155	I feel that I get less attention and I participate less in math lesson as compared to other students in the class	1	2	3	4	5
q156*	I believe math is very important	1	2	3	4	5
q157	I value math result and good knowledge.	1	2	3	4	5
q158	I learn mathematics to be capable of professions such as engineering, architecture or scientist.	1	2	3	4	5
q159	I think math is difficult subject so that I did not participate in the class	1	2	3	4	5
q160	I am not confident by my math ability.	1	2	3	4	5