Differential Effect of Meta-Cognitive Strategy Use on Mathematics Achievement among College Juniors: Mediating Effects Of Mathematics and English Language Ability Self Beliefs

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Abstract

This study was conducted to investigate the differential effect metacognitive use on mathematics achievement mediated by mathematical and English ability self belief of university undergraduate students using structural equation model. Sample was consisted of 264 undergraduate junior students who completed a self-reported questionnaire related to self regulated leaning and beliefs on mathematics and English ability. This study indicated that there at least four metacognitive strategies that account about 64% variability of students mathematics results. The effect metacognitive use on mathematics achievement was found to be less than the mediated effect to show that math ability self belief is paramount important on any thoughts about empowering mathematics than self belief of English ability.

Most of the Metacognitive variables: proactive cognitive regulation (pm) rehearsal, interest showed direct significant effect on Mathematics evaluated grade at beta b=-1.7, 0.32 and 1.38 respectively. Conversely, among these variables, PM and interest have indicated direct effect on EEEE at beta 1.34 and -1.17 in their order. It was also found that there are significant mediating effect of Math and English self beliefs to the met cognitive use. For instance the direct effect of certainty on evaluated grade is 0.55 when it is mediated by math self belief it -0.3 which reduce the total effect to 0.25. It was concluded that Meta cognitive use has noticeable differential effect on college junior’s mathematics achievement. Among others Proactive Meta cognitive regulation played the greatest role on changing student’s mathematics achievement. Equally the mediating factors mathematics and English language ability self beliefs in general and math ability self belief in particular should be given particular attention.

Introduction

The basic notion of learner-centered approach, especially in science and mathematics (MOE-ESDP-IV, 2010), demands the inclusion of self-regulated learning strategies instilled in students as well as their teachers. Permitting and supporting educational context that students get freedom to develop and use own strategy [1] is also of necessity. The 70: 30 percent placement plans adopted in 2008/09 favoring for sciences & technology (S&T) (MoE- ESDP 2010) which mathematics is underlining to all needs knowledge of identifying contributing factors to its successful accomplishment in general mathematics results in particular. The strategies selected and used and, value that students have hold about their capability of the subject and the medium of instruction are important in achieving ones intrinsic goal [2]. Bandura's concept of self efficacy is vital to students effective self regulated learning (which is also an earlier direction of Ethiopian education) and tied with healthy self esteem - a belief of capability that become instrumental to the goals they pursue. Similarly devising and using different problem solving and learning strategies are based on higher self efficacy in higher education where mostly students are self dependant than their earlier educational era. Students self efficacy in science-mathematics and English together with meta-cognitive use of mathematics have been critical issue in the field of educational psychology. They are linked to independent thinking and problem solving or to intelligence in general and enhanced academic performance [3,4].

Three milestones are identified as factors that affect students’ mathematics achievement, one is students self evaluation about
math. second students belief about the medium of instruction and last but not least students use of meta-cognitive strategies in math learning. It is proven that students’ beliefs about the nature of knowledge and learning influence the strategies they use for several purposes such as learning, developing the confidence ability, humanizing the critical and creative thinking, improving the problem solving methods and more diversify the self-regulated learning, which in turn, affects their academic achievement in mathematics Hofer 1999. In the same vein learners’ perceived self-efficacy and beliefs on English language are important components of quality education these days more than ever. Recent research studies conducted in relation to the language and learning are pointing out that, learners’ beliefs about English language show variations on their learning achievement particularly in multilingual grounded education system [5].

This clearly indicate that the issue is timely important in our education system where the issue of mother tongue oriented education is laid at the basement of primary education. English the second language, sometimes third language, as medium of instruction is practiced in most regions of our country is only since secondary school level other than being taught as a subject in the proceeding grades of public school. A research conducted by Suthar and Khooharo (2013) on 86 undergraduate Tandojam University students of Pakistan found out that students’ beliefs and self-regulation strategies influence the students’ mathematics achievement. According to this study, indicated that further research should be initiated to examine the influence of beliefs on the mathematics ability. So such decentralized approaches to educational instruction need learners who developed and use various independent and collaborative problem solving strategies and esteemed self efficacy. This can be justified as in the process of problem-solving, the individual learner requires use both cognitive abilities and practical skills, which include Meta-cognitive activities such as analyzing, synthesis and evaluation [6]. The focus on learning strategies of mathematics, achievement and related variables therefore in this research is because immature beliefs and inappropriate self-regulations have strong impact on students’ critical thinking, problem-solving performance, and their approach to learning through innovative skills and engagement with future career challenging situations. Better performance and achievements in mathematics is core for the new orientation of the country towards science and technology this concern will pave clear understanding on factors contributing factors of mathematics subject results since it is central to the seventy percent declaration of the Ethiopian education sector.

National Context of Mathematics Education

The national demand and focus on mathematics is appreciable because mathematics is a fundamental science [7]. Our ESDP-IV has also stressed the importance in such a way that within general education (grades 1-12), science and mathematics education is essential for cultivating a generation of scientists and for poverty reduction of the population. Greater understanding of the relevance of science and mathematics education for development is the foundation of any effort to improve science and mathematics. The purpose is to prepare students as citizens who make decisions about social issues that involve science and technology and as workers whose occupations increasingly involve science and technology (ESDP-IV, 2010). Nevertheless the need and practical performance and the actual achievement are far apart. Our education is in context of mourning that our science natural science education is dying while its society and the government are highly needy of that because of global demand.

The Ministry of Ethiopian education admits this problem by presenting students achievement. The ministry recorded reports three achievement results in different academic years and different grade levels. For instance grade four composite achievement results of English and Mathematics showed sharp decline from 47.9% in 2000/1 to 40.9 in 2007/8 academic year. The worst of this is grade eight composite results of math, English biology, chemistry and physics that dropped from 41.1% in 2000/1 to 35.6% within seven years. A mathematics survey exam containing 20 items was given to 545 (303 female and 242 male) students on mathematics prototype topics of all grades to grades one through four revealed only 43% of the students to cross the failing line 50% (Adwa college of teaches RPO in 2014 unpublished report). The common response to low achievement in the education sector is not harmonious. The ministry of education blamed teachers, teacher education centers and leaders (ESDPIV 2010). Others blame the policy and policy makers. All may not be wrong and all may not be right. Here we present some specific scientific concern about the achievement, differential factors and mediating variables which will be paramount important for practitioners. The second phase growth and transformation plan(GTP) stated that fully implementing the Math and Science strategy; raising student awareness and motivation for improved learning in math and science and achieving better results in these subjects. “This requires investigation of differential factors so that the desired outcome will approach the distal objective of the country. 2. Literature Review”.

The literature here will review the existing knowledge learners self regulated mathematics learning and its direct and mediated effect on students mathematics achievement. The relationship among main variable (mathematics self regulated learning) and mediator variables (mathematics and English ability self belief) will be reviewed next to this. The different dimensions (components) of self regulated learning as are discussed to the extent available articles allowed. After reviewing the influence of these variables on mathematics achievement, the general and specific models will be presented as a summary.
of the literature review and conceptual and empirical framework for this research toward the end.

Learning strategies are an individual’s advancement to an educational task Anderman 2009. They are how a student organizes and uses a set of skills to learn content or to accomplish a particular task more effectively and efficiently either in or out of school [8] regardless of the difference subject matter [9]. According to NICHCY 1997, learning strategies include what we think about (e.g. planning before writing, realizing when we are not understanding something, remembering what we have learned previously on the topic under study) and what we physically do (e.g., taking notes, rereading to clear up confusion, making a chart, table, or story map to capture the most important information). These altogether are what Brown 1978 called them the knowledge of cognition particularly the conditional cognition. Conceptually these also are components applicable to mathematics learning strategies that may have impact one mathematics achievement.

Mathematics learning strategies can mean in this similar vein. Students who use different learning strategies how to learn and how to be successful in and out of the academic setting seem better than who do not. Learning strategies give students a way to think through and plan the solution to a problem. Students who use learning strategies become more effective and independent self regulated learners. Students with mathematics difficulties often do not learn these strategies naturally [10]. They switch from strategy to strategy because they do not know how to use them effectively [11]. Describes self-regulated learning as an active, constructive process whereby learners set goals for their learning plan actions and monitor, regulate and control their cognition, motivation and behavior. These actions are guided and constrained both by their goals and the contextual framework and can mediate the relationships between individuals and the context and their overall achievement [12].

To Perry, Phillips & Hutchinson characterized Self Regulated Learning as the combination of knowledge, drive, and autonomy to achieve goals. It reflects the ability to go beyond the educational benchmarks proposed for each grade level and age. The concept of SRL also indicates the presence of students’ independence to pursue their educational and life goals in an effective way Perry 2006. It is a cyclical process because the tasks previously performed served as a reference to adjust current performance [12]. It also requires a “deliberate, judgmental, and adaptive process” where students cyclically adjust their ways to approach tasks that they perform at different times and in different contexts Butler and Winne 1995.

Students’ self-regulatory skills according to [13] is learners’ skill enable to participate meta-cognitively, motivationally, and behaviorally active in their own learning. Self-regulatory skills are related to self efficacy, Bandura’s [2] concept that represents people’s beliefs about their capabilities. Bandura further explains that people with a strong sense of self-efficacy view challenging problems as tasks to be mastered, develop deeper interest in the activities in which they participate, form a stronger sense of commitment to their interests and activities, and recover quickly from setbacks and disappointments [2]. Learners with strong sense of self efficacy are committed to wards their interest. Such learners clearly will device different strategies to tackle the challenges in front of them.

Pintrich et al. [14] stated that there are four communal assumptions between the models of Self Regulated Learning. The first assumption is that learners are active in their own learning. That is, self-regulated learners set up their own goals, and select the strategies to implement toward the achievement of their goals. The second assumption is that students monitor, control, and regulate their cognitive abilities, motivation, behavior; and their environment. The third assumption is that goals, criteria, and standards are part of the self-regulation process because students evaluate the progress they’ve made in comparison to their goals, criteria and standards. The last assumption is that it is not just the personality of the students, the context (e.g. classroom), or the culture of the student that determines self-regulation but also the students self-regulated cognition, motivation and behavior.

Mathematics learning strategy needs self regulation is the observation and adjustment of the conditions in the environment. Self regulation requires the monitoring and adjustment of cognitive and affective states like imagery to remember and relax [12]. Effective mathematics learning strategy is unthinkable without self-efficacy. Self-regulatory efficacy is the beliefs of one’s capability for planning and management. Self-regulatory skills are important in the self-regulation of learning together with the person motivation to use self-regulatory skills. When students have self regulatory skills, they can modify their performance based on their personal characteristics and environmental conditions [12].

Another aspect of mathematics self regulated learning is self-evaluative judgments that relates to the attributions students make about their task performances. These judgments can be attributed to the students’ own assessment of their ability or effort required to sufficiently accomplish the tasks and respond well to the challenges of task demands [12]. Control of cognition and regulation encompasses the types of cognitive and Meta cognitive actions people take to change their cognition. Self-regulation of cognition occurs when a person monitors his/her performance in comparison with the established goals. Similarly, as students have the ability to regulate their cognition, they can also regulate their motivation and affect [14].

One of the key components of controlling and regulating cognition is using different cognitive strategies to memorize, learn reason, solve problems, and think. The regulation of one’s behavior is a feature of Self regulated learning that includes
Achievement self regulated learning strategies, self belief and the keys for effective mathematics learning strategies.

abilities on the task cited [22]. Technically speaking these are Evaluation includes analysis of the end products and personal indented goals. Monitoring includes regulations or periodic Planning includes selection of necessary strategies to attain evaluation constructs. one’s own thinking and learning. The regulation of cognition refers to awareness that learners have about their general academic strengths and weaknesses and of the cognitive resources they can apply to meet the demands of particular tasks, and second, to their knowledge and skill about how to regulate engagement in tasks to optimize learning process and outcomes” SAMI 2009.

This further leads to another cognitive concept: the meta-cognition. Meta-cognition refers to awareness that learners have about their general academic strengths and weaknesses and of the cognitive resources they can apply to meet the demands of particular tasks, and second, to their knowledge and skill about how to regulate engagement in tasks to optimize learning process and outcomes. It has also been reported that one’s attempt to control his/her external behavior. Another way behavior can be regulated for learning is through the seeking of help [15]. Mathematics self regulated learning strategy generally includes a component of motivation. People get motivated to start an activity in order to accomplish their goals. The assessment of one’s progress helps people keep themselves motivated. People can use this assessment to decide whether to continue working on the activity, switch to another activity or in an extreme case quit Sansone and Thoman 2005.

Components of Self Regulated Learning

Studying self-regulatory skills of learning such as meta-cognition and their effects on achievement have been the interest of many researchers [16-19]. Flavell [20] proposed a framework of Meta cognition that contains Meta cognition of knowledge and experience. Flavell’s cognition of knowledge includes task, person, and strategy components. Meta-cognitive experiences include feelings of understanding and may be implementation of appropriate strategy. However Meta cognition of learning strategies of mathematics seem more demanding to be decomposed into more components. For instance in the literature many dimensions from two broad theories such that knowledge of cognition and regulation of cognition were explained by Brown [21], Sperling et al. [17].

Brown’s framework knowledge of cognition refers to what individuals know about their own cognition and contains declarative, procedural, and conditional knowledge in it [3,22]. From these the declarative knowledge includes knowledge about factors that may influence individual’s performance. Procedural knowledge includes knowledge about the way skills are applied. Conditional knowledge includes knowledge about when and why to apply different cognitive actions. Whereas regulation of cognition refers to meta-cognitive activities that help control one’s own thinking and learning. The regulation of cognition includes planning, monitoring, and evaluation constructs. Planning includes selection of necessary strategies to attain indented goals. Monitoring includes regulations or periodic self-testing of individuals’ actions during task performance. Evaluation includes analysis of the end products and personal abilities on the task cited [22]. Technically speaking these are the keys for effective mathematics learning strategies.

Self Regulated Learning Strategies, Self Belief and Achievement

Self-regulation has been found to be positively correlated to achievement, with highly self-regulated students being more motivated to use planning, organizational, and self-monitoring strategies than low self-regulated students [23]. Pintrich [15] have articulated a model of student cognition, which argued that students regulate their cognition by using motivational strategies in addition to cognitive and Meta cognitive strategies. Pintrich [15] found a positive correlation between motivational beliefs and self-regulated learning and furthermore, all affective components were related to academic performance. In line with these findings, Schunk and Zimmerman [24] reported that there was a positive relationship between self-efficacy and academic achievement and that if students are trained to have higher self-efficacy beliefs their academic performance also improves.

Many literatures support mathematics problem solving strategies are unique and inspiring for other subjects. The learner needs meta-cognition skills, in addition to cognitive components, to regulate and monitor the problem-solving process. These skills help the learner to define and identify the problem, choose the right strategy, monitor the effectiveness of the solution strategy, and organize the thinking process and the task of the solution. Problem-solving requires three main conditions: the first is thinking about the problem and steering behavior toward the goal, then searching for a law or strategy that can help in reaching the desired goal, and finally to try these laws or strategies by putting them in action. In this phase, one must identify and set sub-goals in accordance with the type of the problem, then solving the problem and achieving the goal Kafadar 2012.

Research Frame Work

Mathematics achievement according to [11,25] influenced by affective motivational beliefs factors and use of self-regulation strategies. Contexts of mathematics learning influence development of positive motivational beliefs especially self-efficacy. Pintrich’s [11] research indicated that there are strong relationships between motivational beliefs and self-regulation strategies use. More specifically, in terms of self-efficacy, literatures stated that positive correlations between self-efficacy and self-regulated learning [14]. That is students who felt more efficacious with respect to a certain task or course were more likely to report using all types of cognitive strategies to succeed in pursuing the task. It has also been reported that self-efficacy was positively related to self-regulatory strategies use and strongly related to academic performance.

In addition, task value beliefs were correlated positively with cognitive strategy use including elaboration, and organizational strategy. Task value was also correlated to performance, albeit these relations were not as strong as those for self-efficacy [11]. So a question is raised if task vales in mathematics and the medium of instruction English what we have referred as self belief can affect mathematics result and the learning strategy used by the student. Research results in the field of educational psychology show goal orientation resulted inconsistent relations between the different goals and self-regulation [26].
As reported by Pintrich [11] mastery goal orientation was positively related to the use of cognitive strategies as well as self-regulatory strategies. In addition, mastery goal orientation was positively related to actual performance in the class. On the contrary, extrinsic goal orientation was consistently found to be negatively related to self-regulated learning and performance.

Theoretically it is hypothesized that self-efficacy and self-regulation strategies use affect directly mathematics achievement Peklaj and Pecjak 2002. That is cognitive strategy increase with academic achievement. It is further assumed that achievement is related to the cognitive strategies that students use to learn and that motivational beliefs and self-regulation strategies [25]. Research findings by Ayotolaa & Adedeji (2009) revealed that there is a strong positive relationship between mathematics self-efficacy and achievement in mathematics. Math self-efficacy is also a stronger predictor of math performance. The model above shows that there is a direct effect of Math learning strategy on students’ mathematics achievement Peklaj and Pecjak 2002. Taraban, Rynearson and Kerr 2000 found that college students’ comprehension strategy use was significantly related to higher levels of academic performance.

According to van Kraayenoord and Schneider 1999, meta-cognition affected reading comprehension scores of the participants. Theoretical assumptions stated that there is an indirect effect of math self belief and English language self belief. According to [27] mathematics self-efficacy and mathematics achievement were positively related. From these research, the relationship seems bidirectional. Students with high mathematics self efficacy predict mathematics achievement. Reciprocally, reports of survey linear regression analysis in [27] indicated that mathematics achievement could be significantly predicted by mathematics self-efficacy. This finding suggests that students who were confident of their performance in mathematics tended to have better mathematics achievement.

Of course the quantification is not enough. Mathematics problem solving strategy in many literatures seems a construct with many components and many other sub levels. Pintrich [15] present two model self-regulated learning. The first refers to self-regulation strategies use and the second to motivational beliefs. The sublevels of self-regulation strategies involve cognitive learning strategies and self-regulatory strategies to control cognition [15]. These concepts technically mean meta-cognitive learning strategies. Cognitive learning strategies consisted of elaboration and organizational strategies. Elaboration strategies include paraphrasing or summarizing the material to be learned, creating analogies, generative note taking and connecting ideas in students’ notes. The organizational strategies include behaviors such as selecting the main idea from text, outlining the text or material to be learned, and using a variety of specific techniques for selecting and organizing the ideas in the material [15].

Students’ meta-cognitive and self-regulatory strategies can have an important influence upon their achievement. Self-regulation would then refer to students’ ability to setting goals planning activities, monitoring progress, controlling, and regulating their own cognitive activities and actual behaviour [15]. Expecting the range of the solution for a specific mathematical problem can be taken as a short term goal which also is part of specifying the problem solving strategy. Planning activities as part of the problem solving mechanism include analysis of the task, choosing strategies and making decisions on specific behaviors. Monitoring stands for comparing progress against goals or standards in order to guide the following actions. For instance, a type of self-regulatory strategy for reading occurs when a student slows the pace when confronted with more difficult or less familiar text [26].

Other writers considered mathematics learning strategy in simple mechanics such as SQR (Survey, Question, Read), Frayer Vocabulary Model, mnemonic devices, graphic Organizers, paraphrase, visualize, cooperate learning groups and analyze information. In a survey process the student reads the problem and paraphrase in own words. The Question part includes inquiring purpose of the problem; looking into what is being asked and the ultimate goal (solution) to determine. Conversely, activities related with Reading are reread the question to determine the exact information learners are looking to eliminate unnecessary information and prepare to devise a plan for solving the problem.

The Frayer model is a concept map which enables students to make relational connections with vocabulary words that make the meaning of the problem. The students identify and redefine the word in the problem to characterize and grasp picture of the problem. Mnemonic devices are strategies that students and teachers can create to help students remember content. They are memory aids in which specific words are used to remember a concept or a list. The verbal information promotes recall of unfamiliar information and content [8]. Letter strategies include acronyms and acrostics (or sentence mnemonics) (mnemonics-FIRST, RIDE). Graphic organizers are diagrammatic illustrations designed to assist students in representing patterns, interpreting data, and analyzing information relevant to problem-solving [28]. The Paraphrasing Strategy is designed to help students restate the math problem in their own words, therefore strengthening their comprehension of the problem [10].

It can be argued that there dimensions of mathematics learning strategies that differently affect students mathematics achievement. For this we can propose the following final model for this research considers the components of Math learning strategy into account. Therefore the one presented below although it is clear from the literature that there are different predicting factors of mathematics learning strategy to achievement they are not empirically framed in the way
The issue of language is sensitive in non-English speaking states that use English as a medium of instruction. Thinking mathematical achievement is unthinkable without English language, the medium of instruction in higher institutions [29]. Test items are constructed in English language where linguistic complexity other than the subject could be an inherent obstacle [30]. Abedi et al. [30] reviewed that students’ performance in mathematics and science can be confounded by language, though it seems irrelevant to the construct. Math test items need reading proficiency, which is a critical component of language proficiency, especially in the context of taking a multiple-choice test [31]. This could be part of the long-standing myth in mathematics education that the level of English proficiency of students is not an issue in instruction because mathematics is a «universal language.» As a result, many educators assume that a student’s English proficiency has a minimal effect on mathematics achievement for non-native English speakers in the college preparatory track, than it is for non-native English speakers in the general track. This may be worry some in education systems where English itself is taught by mother tongue languages such as Amharic or Tigrigna.

Empirical findings by Yesuf 2011 revealed that there was direct effect of self-efficacy and indirect influence of achievement motivation and self learning strategies on participants’ academic accomplishment. Additionally, the analysis of direct and indirect results indicated the meditational role of self-efficacy on achievement motivation and learning strategies. The highest statistical significant effect was between respondents’ self-efficacy and CGPA suggesting neither the achievement motivation, nor was the learning strategies the strongest cause of the respondents’ academic achievement.

The above findings were similar to the existing literature on self-efficacy, achievement motivation, learning strategies in relation to the students’ academic achievement. It is clear that self-efficacy affected performance almost exclusively directly rather at 0.545 than indirectly through the mediating variables [33]. According to [7] 8.1% of the variance in mathematics ability can be explained by beliefs and self-regulated learning variables. Similar reports were reviewed from [27] who suggested that mathematics score increased as students’ mathematics self-efficacy increased for about 12.9% by which the total variance in mathematics achievement was explained. Pajares [1] synthesize different research literatures math-specific self-concept is compared with achievement. In the same domain (e.g., math self-concept with math achievement), reported on a number of studies in which correlations between mathematics self-concept and mathematics achievement indexes ranged from .17 to .66. Other studies report higher correlations, generally ranging from .40 to .70. Typical is a study by Marsh et al. 1988, which depicted a correlation of .55 between high school students’ mathematics self-concept and their subsequent mathematics grades. Path analyses revealed direct effects of self-concept on GPA (.60 to .66). Researchers have also been successful in demonstrating that self-efficacy beliefs are positively related to and influence academic achievement and that these beliefs mediate the effect of skills, previous experience, mental ability, or other self-beliefs on subsequent achievement (Torres and Solberg, 2001).

**Research questions**

i. There are different dimensions of learning strategies.

ii. There will be no significant relationship between the dimensions of mathematics learning strategies and self reported achievement of first year students.

iii. There will be no significant relationship between the use of self-regulated learning strategies, Mathematics
learning self belief and the level of English language self belief of students.

iv. English Language self belief, mathematics self belief and use different components of self regulated mathematics learning strategies will not significantly directly predict mathematics achievement students.

v. English Language self belief, mathematics self belief and use different components of self regulated mathematics learning strategies will not significantly indirectly predict mathematics achievement students.

Definition of Terms Variables

a) Mathematics learning strategies: Are a group of deliberate action practiced by the student during mathematics learning and problem solving.

b) Mathematics self belief: Group six self report items that measure students mathematics ability.

c) English self belief: Group five self report items that measure students’ English ability sufficiently enough to comprehend the English language consistent with their grade level.

d) Mathematics achievement: students’ self reported mathematics result on national university entrance exam and self evaluated math ability from high achiever to low achiever.

Research Methods and Design

Participants from three college natural science, computational science and engineering of Bahirdar University were selected at random basis after quota for each college was assigned based on their total number of junior students. 360 questionnaire were distributed, however there was around 27% (Table 1) attrition which makes the actual sample to be 264 (123 female and 141 male).

Table 1: Sampling

| College                  | Population | No. of questionnaire distributed | Return Rate % | Actual Sample | Percent |
|--------------------------|------------|---------------------------------|---------------|---------------|---------|
| Natural science          | 1000       | 100                             | 70            | 70            | 26.5    |
| Computational science    | 1700       | 195                             | 77.9          | 152           | 57.6    |
| Engineering              | 650        | 65                              | 64.6          | 42            | 15.9    |
| Total                    | 3350       | 360                             | 73.3          | 264           | 100.0   |

A sample 264 was randomly selected from first year students in the college of natural science and computational sciences (see sampling adequacy from the result section). A questionnaire adapted by Tesfaye Semala 2015 was distributed to respondents after translated into Amharic language. Three professionals agreed on the content and face validity of Amharic version. The questionnaire has four parts including the demographic information contains variables like age sex learning department maths achieved result and math self evaluated ability. In the present study we have focused on three general constructs that are assumed to be related with mathematics achievement in first year students of Bahirdar University. We were not much focused on the demographic characteristics for less difference exists (showed poor relationship with achievement variables). List of mathematical problems solving strategies is one construct presented as one to be decomposed or reduced into different components after measuring them by 26 liker type items (before screening). The items have particular intention to measure the same construct which has different dimensions within it. For instance from the contents knowledge of the strategies and the outcome seems one dimension. Some others are related with the specific tactics what the student do when the challenge faces.

The self-efficacy beliefs of both mathematics self belief and English self belief are another two constructs which may have mediatory effect (each of which in this research measured by 5 and 6 items respectively). The construct self-efficacy beliefs stand for a student’s sense of ability to plan and execute actions to achieve an academic goal [2]. Self-efficacy also represents students’ confidence in their cognitive and learning skills in performing a task. Task value beliefs refer to students’ evaluations about the importance and usefulness of the task. The second category is mathematics learning and problem solving strategies are 25 liker type items. High value of all which is five indicates the respondent choose and use the strategy however the twenty third item seems negative towards mathematics and therefore was computed to the same direction with the others. The third group of variables is students’ belief (six items) in mathematics and students’ belief in English (five items). However note that all items measuring mathematics learning were manipulated as one facet so that explorative factor analysis will identify them into components.

Methods of Data Analysis

Both descriptive and higher order univariate and multivariate inferential statistics were applied. The descriptive statistics was used for assessing univariate and multivariate assumptions such as normality, linearity, collinearity, and univariate outliers. Regression analysis was also conducted to check the multivariate
outliers, and to address issues preliminary factor analyses were performed. Of course the bivariate correlation analysis was conducted to identify the adequacy of relationship among variables for higher order inferential statistics such as factor analysis and structural equation modeling. SPSS and AMOS version 20 were used to analyze the relationships, and influences of variables. Furthermore the psychometric characteristics of adequacy of items and variance component explained by the measuring scales were checked as follows.

Therefore the matrices design was P x I crossed random design simple pattern - by which the sources of variance are assumed to be the respondents; the items or the interaction of the two. The psychometric characteristics assessed by IRT and variance component GT in addition to Crombach alpha (where all the 36 items were greater than 0.90 and the scale reliability is α =0.917). This is almost similar with alpha coefficient computed by variance component approach which was α = 0.92. The alpha reliability value was consistent even after imputation of missed values; avoidance of multivariate outliers and after factor analysis

### Table 1a: Psychometric characteristics of the instrument.

| M. Square | Expected mean square | Variance component estimators | Abs error variation | Relative variation | G coefficient d |
|-----------|----------------------|-------------------------------|---------------------|-------------------|-----------------|
| MsP=11.9  | E(Msp) = σ²RES + niσ²p (0.9+36*11.9) | ‘σ²p= MSp - σ²RES/ni (11.9-0.9)/36 =0.31 | 0.9/36=0.025 RES/items | (0.1+0.9)/36= 0.17 item effect+res/items | R=0.99 A= 0.97 |
| MsI=12.8  | E(Msi ) = σ²RES + npσ²i (0.9+264*12.8) | ‘σ²i= Msi - σ²RES/np (12.8-0.9)/264 =01 | 0.1+0.9) /36= 0.17 item effect+res/items | (0.1+0.9)/36= 0.17 item effect+res/items | R=0.99 A= 0.97 |
| MsRes=0.9 | E(MSRES) = σ²RES | ‘σ²RES= MSRES =0.9 | 0.9/36=0.025 RES/items | (0.1+0.9)/36= 0.17 item effect+res/items | R=0.99 A= 0.97 |

### Table 1b: Maximum number of items number of items was sampled.

| No | Sub-scales               | Mean | SD   | No. items | Crom. alpha |
|----|-------------------------|------|------|-----------|-------------|
| 1  | Math self               | 90.258 | 15.56 | 25 | 0.909         |
| 2  | Math ability self-beliefs | 12.58 | 12.66 | 4  | 0.769         |
| 3  | English ability self-belief | 10.36 | 2.3  | 3  | 0.71          |
| 4  | Previous Math Ach (HEEE Score) | 51.3 | 13.3 | 1  | 0.7 split half spearman-brown |
| 5  | Evaluated previous ability | 3.3   | 0.77 | 1  | 0.67 split half |

From the table it can also be concluded that the maximum number of items number of items were sampled to measure mathematics learning related factors which led to a decreased estimates of both relative and absolute errors. Similarly the generalizability coefficient is close to one which hints the admissible range of coefficients (Table 1b).

### Results and Data Analysis

This section contains three main analysis results. The first part deals with screening cases and variables for the purpose of ensuring fulfillment of assumptions for multivariate analysis. In the second part exploratory factor analysis by which dimensions of Meta cognitive strategies (mathematics self regulated learning strategies) are identified is presented. The last part includes the factor analysis that tests the functionality of the proposed model.

### Exploratory Factor Analysis

#### The dimension of learning strategies

Before running actual principal factor analysis preliminary analysis were carried out for checking assumptions using 264 respondents and all the variables. The MVA analysis showed that there were missing value that looks like missing values that were not at random in the data and therefore MVA was a need to run imputing such missing data. Using EM (expectation maximization method) cases with missed values in each variable were imputed. With regard to normality: Many of the variables

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are negatively skewed except few positively skewed. Many of the variables show statistical values for skewness and kurtosis checked by SPSS analyze descriptive statistics explore are not much greater than the minus or plus one (an evidence for normality) to perform further transformation of the variables. Similarly, SPSS graphics scatter plot showed most of the variables are linear. Moreover the dependent variable higher education entrance exam score was found linear and normally distributed.

Both the descriptive analysis saved standardized score and Factor scores produced in SPSS factor analysis saved Anderson Rubin was used to detect univariate outliers, taking both sides of three (-3 or +3) minimum requirement outliers hence none of the case were found to be outliers. Seven of the 264 cases (217, 100, 110, 12, 258, 114 and 193 with Mahalanobis distance of ranged from 98.53 to 72.46 in descending order respectively) were found to be multivariate outliers for these were above the critical value for Chai square with $X^2_{df=6}=7.98\text{ at }p=0.001$. These seven cases were deleted according to the recommendations of Field 2007, Tabachnic and Fiedel 2007, and Gamst et al. 2008, and their deletion does not much affect the reliability, factorability and measure of sampling adequacy and even the components to be extracted except in change of items load in the communality.

Next to these, the magnitude of inter item correlation was checked from the preliminary principal factor analysis. The communalities with all cases included to the analysis and after the outliers excluded satisfy the criteria of being greater than 0.50. Conversely the pattern of loadings for both analyses is the same. The outliers do not have an effect which supports their exclusion from the analysis. In this iteration assessment of required correlation magnitude, adequacy of sampling, communality (common variance of variables), estimate number of factors, presence of outliers, absence of multi-collinearity, factorability of the correlation matrices and others criteria for factor analysis thoroughly checked. Here the numbers of participant case were reduced to 257 due to the deletion of multivariate outliers while there was no change in the number of items.

To identify items with acceptable range of inter correlation an in depth observation on values of the 36 by 36 correlation matrices was conducted. Many researcher in higher order multivariate analysis recommend that factor analysis needs an inter item correlation $R$ of $\pm 0.30$ and beyond but not higher than 0.85 or 0.90. The preliminary analysis focusing on the correlation matrices come up with different number of items. According to the recommendations of Gamst et al. 2008, Tabachnic and Fiedel 2007; Field 2007, both poor correlation and extremely high correlations are of concerns in principal component analysis. Thus, coefficients less than absolute value of 0.3 ($\pm 0.3$) and 0.85 ($\pm 0.85$) and above, were to be eliminated. However, in this study, many of the items that were poorly correlated (i.e. with $r$ less than 0.3) had been excluded to identify better performing items for further analysis. Thus, two items: L2 and L23 had been discarded as they failed to meet the criteria. Similarly, items: BM1 and BM4 from Math self-belief scale and; items BE7, BEB, and BE10, from the English Self Belief Scale respectively had been dropped. Exclusion of these items slightly raised the scale reliability - from 0.91 to 0.92) and the number of factors explaining the total variance.

None of the items’ correlation was susceptible for Multicollinearity problems from the R of correlation matrices. Of course this issue was also when assessing low correlation in bivariate correlation and multivariate outlier identification step of simple regression collinearity diagnosis tolerance (SAC subtracted from one) and VIF; had shown no indication of collinearity problems. Furthermore the determinant of the correlation matrices was found to be 0.005 which gives guarantee for absence of Multicollinearity and singularity (perfect relationship) problems Field 2009.

The sample measure adequacy was assessed from the anti image correlation matrices—the reversed partial correlation. Hence most diagonal values of anti image correlation matrices were all greater than 0.5. These results ascertain that the required Measure of Sampling Adequacy (MSA) was achieved Tabachnic and Fiedel 2007. A test for the requirements MSA was also supported by insuring by Bartlett’s Test of Sphericity and Kaiser–Meyer–Olkin (KMO) and then in Principal factor analysis the probability associated with Bartlett’s Test of Sphericity and (KMO) measures of sampling adequacy gave a considered value. Therefore the overall KMO for the set of variables included in the analysis of all iterations was above 0.8, which exceeds the minimum requirement of 0.50 stated by Gamst et al. 2008 for overall minimum sample adequacy. Bartlett’s Test of Sphericity was also tested to be less than the level of significance. The probability associated with the Bartlett test is $<0.001$, which satisfies this requirement Gamst et al. 2008 and Tabachnic and Fiedel 2007 as presented below.

| Table 2: KMO and Bartlett’s Test |
|----------------------------------|
| Kaiser-Meyer-Olkin | Measure of Sampling Adequacy | .892 |
| Bartlett’s Test of Sphericity | Approx. Chi-Square | 2681.746 |
| | Df | 351 |
| | Sig. | .000 |

Some of the variables were screened out depending by running principal factor analysis with the retained 29 items and 257 cases for the second iteration. The primary purpose of this iteration was to look at the factorability of variables and adequacy of number of factors. The produced SPSS communality(sum of squared loadings (SSL) for a variable across factors) Table 2 showed that of the following items (L6, L11, L15, L16, L24, L25 AND BE 6) which show low common variance or communality were send back from analysis. Dropping these seven items left us with only 22 items deleting 14(32%) out of the total 36 item. All 22 items with acceptable factorability index were used for
further analysis. Another iteration of factor analysis with these 14 items scanned enable us to extract six factors which explain total variance of greater than 63% which is better than the previous and tolerable communality coefficients of all variables. The residual correlation matrix of reproduced data and original data is not worrisome because only few values (36%) are greater than 0.05 Field 2009. This tells that number factor explaining sufficient portion of can be extracted from this analysis. Hence the average communalities for all of the variables included on the components were greater than or equals to 0.611, which is by far greater than 0.50, a minimum requirement for factorability stated by Gamst et al.2008 as a cut off point for sufficiency of the variance proportion explained. See Table 3 below.

Table 3: Factorability of variables.

| Initial | Extraction |
|---------|------------|
| I know how well I have understood a subject I have studied. SE | 1.000 | .588 |
| I try to use ways of studying that had been proved to be successful | 1.000 | .559 |
| I can learn more about a subject on which I have previous knowledge. | 1.000 | .684 |
| I can learn more about a subject on which I have special interest. | 1.000 | .737 |
| I define specific goals before my attempt to learn something. | 1.000 | .571 |
| After I finish my work I wonder whether there was an easier way to do it. | 1.000 | .607 |
| After I finish my work I repeat the most important points in order to be sure I have learned them | 1.000 | .591 |
| I use different ways to learn something according to the subject. | 1.000 | .607 |
| For the better understanding of a subject I use my own examples. | 1.000 | .498 |
| I know ways to remember knowledge I have learned in Mathematics. | 1.000 | .600 |
| When read a problem I know whether I can solve it. | 1.000 | .594 |
| When I try to solve a problem I pose questions to myself in order to concentrate my attention on it | 1.000 | .612 |
| When I encounter a difficulty on problem solving I reread the problem. Mc | 1.000 | .724 |
| When I encounter a difficulty that confuse me in my attempt to solve a problem I try to resolve it | 1.000 | .633 |
| While I am solving a problem I wonder whether I answer its major question. | 1.000 | .662 |
| Before I present the final solution of a problem I try to find some other solutions as well. | 1.000 | .694 |
| After I finish my work I know how well I performed on it. | 1.000 | .544 |
| Bm2 | 1.000 | .678 |
| Bm3 | 1.000 | .747 |
| Bm5 | 1.000 | .598 |
| BE9 | 1.000 | .729 |
| BE11 | 1.000 | .697 |

Extraction Method: Principal Component Analysis.

Eigen value of one and above was taken as criteria to select a factor Gamst et al. 2008, Tabachnic and Fiedel 2007; Gamst et al. 2008. FA for dimension reduction KMO the Barters test for sphericity and other criteria were met the assumption of factor analysis. However there were some items with low communality value for the factorability. Removal of these items from the Factor analysis increase the total variance explained to around 64% from 60.01%, and the communality values of all variables to each respective factor to average of 0.648 from 0.61. Factors of high Eigen value greater than one in each Eigen vector regressed by items of high loading (correlation of each item with the predicted value of respective factor) greater than 0.4 and diminishing return of the screen plot were extracted (Figure 3).

Screen Plot

Hence here again after dropping poor variables; SPSS printed outputs 22 components could have explaining 100% the variance but only six components out of them explain 63.4% with reasonably predicting number of items. At the default 25th iteration, minimum 0.4 extraction loading coefficient for every item Eigen value greater than one was common criteria for all components. And finally by the varimax rotation extractions the
following six factors that explain 63.43 % of the variation were extracted. Of course this seems lower than variance explained to be 70 to 80 percent of the variation the recommendations of field (2009) but much better to explain this much of variance using fewer items [34-40].

**Table 4:** Extraction Method: Principal Component Analysis.

| Component | Initial Eigen values | Extraction Sums of Squared Loadings | Rotation Sums of Squared Loadings |
|-----------|----------------------|-------------------------------------|---------------------------------|
|           | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1         | 7.748 | 35.217        | 35.217       | 7.748 | 35.217        | 35.217       | 3.391 | 15.413        | 15.413       |
| 2         | 1.606 | 7.299        | 42.516       | 1.606 | 7.299        | 42.516       | 2.986 | 13.572        | 28.985       |
| 3         | 1.317 | 5.987        | 48.503       | 1.317 | 5.987        | 48.503       | 2.183 | 9.923         | 38.908       |
| 4         | 1.169 | 5.315        | 53.818       | 1.169 | 5.315        | 53.818       | 2.033 | 9.243         | 48.151       |
| 5         | 1.107 | 5.030        | 58.848       | 1.107 | 5.030        | 58.848       | 1.774 | 8.064         | 56.214       |
| 6         | 1.008 | 4.580        | 63.428       | 1.008 | 4.580        | 63.428       | 1.587 | 7.214         | 63.428       |
| 7         | .803  | 3.648        | 67.076       | .803  | 3.648        | 67.076       | .384  | 1.745         | 94.405       |
| 8         | .752  | 3.419        | 70.496       | .752  | 3.419        | 70.496       | .690  | 3.138         | 73.634       |
| 9         |       |              |              |       |              |              |       |              |              |
| ..... 18  |       |              |              |       |              |              |       |              |              |
| 19        | .331  | 1.507        | 95.911       | .331  | 1.507        | 95.911       | .319  | 1.452         | 97.363       |
| 20        | .303  | 1.379        | 98.742       | .303  | 1.379        | 98.742       |       |              |              |
| 21        | .277  | 1.258        | 100.000      | .277  | 1.258        | 100.000      |       |              |              |

**Table 5:** Measure of Sampling Adequacy.

| Components | Rotated Component Matrixa | Loading | Mean response |
|------------|---------------------------|---------|--------------|
| Monitoring-cognitive regulations (15.4%) | L8, After I finish my work I wonder whether there was an easier way to do it**. | .682 | 3.54 |
|            | L9, After I finish my work I repeat the most important points in order to be sure I have learned them** | .648 | 3.30 |
|            | L10, I use different ways to learn something according to the subject**. | .613 | 3.53 |
|            | L12, For the better understanding of a subject I use my own examples*. | .588 | 3.55 |
|            | L3, I try to use ways of studying that had been proved to be successful | .587 | 3.64 |
|            | L7, I define specific goals before my attempt to learn something**. | .581 | 3.74 |
|            | L1, I know how well I have understood a subject I have studied*. | .522 | 3.65 |
| Rehearsal (13.6) | L18, When I encounter a difficulty on problem solving I reread the problem. | .802 | 3.96 |
|            | L19, When I encounter a difficulty that confuse me in my attempt to solve a problem I try to resolve it | .707 | 3.77 |
|            | L20, While I am solving a problem I wonder whether I answer its major question*. | .654 | 3.58 |
|            | L17, When I try to solve a problem I pose questions to myself in order to concentrate my attention on it | .643 | 3.82 |
| Math anxa & confidence (9.923%) | Bm3 Compared with others, how confident do you feel in your mathematical abilities? ** | .808 | 3.3 |
|            | Bm2 (Do you often think of yourself as good at mathematical problems?)** | .745 | 3.3 |
|            | Bm5 How confident do you feel about your ability to do well on a standardized** achievement test with respect to the mathematics portion? | .652 | 3.3 |
### Relationship between the Dimensions of Mathematics Learning Strategies and Math Achievement

To understand more about the mathematics learning strategy variables that affect students' mathematics result, a descriptive statistical analysis was conducted. Each item in each component was related with each respondent's self-reported achievement and also each component with math result. All items in the first component except variable coded L3 (I try to use ways of studying that had been proved to be successful) are correlated with students' achievement. The mean response for L3 was 3.6: students try to use proven ways of study ranging from often to always but this was not enabled them to get good achievement result showing statistically insignificant relationship Maths result [40-42].

Remaining variables in this component are what most students applied in their math learning often to always (mean of 3.6 0 nearly 4 response score). Factor extraction prioritize the variables in steps in such a way: 1) looking for easier way as much as possible, 2) make sure the problem is up to your learning; 3) use different ways according to the area of subject, 4) for the betterment of understanding use own examples and 5) finally then have subject well understood 6) to define goal of the learning. This new finding has some common agenda with [34] cyclical process of mathematics learning strategy and Kafadar 2012 problem solving contents. Different scholars have given different names to math learning sub-strategies. Instance focused on self-regulated learning strategies that involve cognitive learning strategies and self-regulatory strategies to control cognition [27]. Stress on strategies of SQR. But all holding one or other name reflect almost similar applications.

Among the component of MLS coined in current research is proactive monitoring cognitive regulations strategy in learning mathematics. The bivariate correlation analysis of these variables with achievement showed that the more students use this strategy the more they got higher result with statistical alpha level of significant.

This proactive monitoring cognitive regulations strategy can be more elaborated as forethought effortful control over ones learning behavior. Often researchers use effortful control (EC), defined as “the efficiency of executive attention including the ability to inhibit a dominant response and/or to activate a subdominant response, to plan, and to detect errors” Rothbart and Bates 2006 as an index of children’s regulatory abilities. Individuals high in EC can control their attention and are able to avoid or engage in behavior to accomplish a goal, even if the individual would prefer to engage in another set of behaviors. Although EC is willful, it often may be executed automatically without much thought, and children are not always aware that their thoughts or actions are regulating emotion or behavior. Key to the study of academic competence, EC is hypothesized to regulate attention, emotion, and behavior Rothbart and Bates 2006. The authors of a National Academy of Sciences report noted that “self-regulation is a cornerstone of early childhood development that cuts across all domains of behavior” Shonkoff and Phillips 2000. Basic regulatory processes begin early in life and become more complex as children age. Infants mostly rely on caregivers to soothe their distress and are not able (classroom learning psychology p-357)

Principal factor analysis produced second component which explain 13.5% variation of rotation sums of squared loadings. The variables in this component are more repetitive that can be called rehearsal such as rereading (L18), resolving (L19), and posing question (L17). The mean score of respondents response ranges from 3.58 to 3.96 which means respondents often do either of them when learning mathematics. However 3 out of 4 these variables cannot be (accompanied) consistent with

### Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

- Rotation converged in 9 iterations
- **Item is significantly correlated with maths reported achievement.

### Correlation Matrix

| Component                          | Item                                                                 | L21 | L22 | L14 | L13 | L5  | L4  | BE9 | BE1 | BE6 |
|------------------------------------|----------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| **Confirmation Certainty (9.23%)** | L21 Before I present the final solution of a problem I try to find some other solutions as well*                      | 0.743 | 3.44 |      |     |     |     |     |     |     |
|                                    | L22 After I finish my work I know how well I performed on it**       | 0.588 | 3.46 |      |     |     |     |     |     |     |
|                                    | L14 When I read a problem I know whether I can solve it**            | 0.516 | 3.45 |      |     |     |     |     |     |     |
|                                    | L13 I know ways to remember knowledge I have learned in Mathematics**| 0.509 | 3.45 |      |     |     |     |     |     |     |
| **Interest (8.1)**                 | L5 I can learn more about a subject on which I have special interest. | 0.784 | 3.77 |      |     |     |     |     |     |     |
|                                    | L4 I can learn more about a subject on which I have previous knowledge.| 0.649 | 4.1  |      |     |     |     |     |     |     |
| **Belief on Medium of Instruction (7.2)** | BE9 How often do you feel you have thoroughly mastered material you have read in preparation for an exam?* | 0.771 | 3.45 |      |     |     |     |     |     |     |
|                                    | BE1 I When you have to write an essay to convincingly express your ideas, how confident do you feel that you have done a good job?* | 0.737 | 3.64 |      |     |     |     |     |     |     |
|                                    | BE6 Have you ever thought that you had a greater ability to read and absorb articles and textbooks than most people?* | -    | -   |      |     |     |     |     |     |     |

**L1** - Learning; **BE** - Beliefs; **L2** - Learning Psychology P-357; **EC** - Executive Control; **SQR** - Square Root.
respondents reported university entrance examination result rather than showing simple positive correlation. Contrary to this fact all the variables in this component are correlated at statistical alpha level of significance with respondents self evaluated ability. self reported university entrance examination result and self evaluated ability based on the previous performance should have been two faces of a coin showing correlation coefficient higher than 0.8 or 0.9 but there observed r=0.43**. There seems difference existed in reported the exact figure of HEEE as opposed to math performance based self evaluation. There seems a self presenting bias (psychology of classroom learning-p 357) with regard to reporting exact figure since self reported result is used.

**Mathematics Self Belief, English Language Self Belief of Students and Math Achievement**

Most respondents (48.1%) responded to the item Bm3 (Compared with others, how confident do you feel in your mathematical abilities) mode is 4 mean is 3.25 that they feel confident most often compared to others, this item is significantly correlated with achievement. that is with increasing learners confidence in math there is an increase in math achievement which also promote application of various MLS. Other two components are in this component (MB2= do you often think of yourself as good at mathematical problems) and (BM5=How confident do you feel about your ability to do well on a standardized achievement test with respect to the mathematics portion. The variable coded as bm2 is about confidence: how good the student is on the math standardized tests; regardless of correlation strength, respondents’ response is consistent with statistical significance to their university Entrance exam and confidence on self math ability.

The fourth component that explains 9.2% of the variation is of students in mathematics learning strategy is evidence or confirmatory certainty. It has four variables coded as L21, L22, L14 and L13. Exhaustively looking other solutions than the computed one, knowledge of the quality of performed output and some others are indicator variable. The average response score of respondents 3.5 which means students used to either or all of the items to help their learning mathematics often times. This is clearly positively associated with respondents self reported entrance exam achievement at significant statistical level. The fifth factor in this extraction is related with interest and previous experience on mathematics. Respondents responded to both of the items 3.77 and 4.1 on average. That is often of the times higher mathematics achievement is highly related with interest and previous experience on the subject mathematics. Interest was expected to be significantly correlated with HEEE result and self evaluated ability but it was only previous subject experience that showed positive significant correlation with self evaluated ability. Students’ belief in English comprehension and understanding ability were in the last component that account around seven percent of the variation in respondents’ response.

**Structural Equation Modeling**

**Determinants of Students Mathematics Achievement**

English Language self belief, mathematics self belief and use different components of mathematics learning strategies can directly or indirectly predict mathematics achievement students(research question 4). Moreover it is also assumed that Mathematics self belief and English self belief will play mediating role between MLS and math achievement in research questions 5. This part of the research will address these points through thorough analysis of Structural equation modeling. Note that variables that are coded as L1 to L25 are the items that are assumed to indicate different learning strategies. Second level components such as PM is proactive monitoring of cognitive regulation, rehearsal math task related activity; certainty the name given to the third component it refers to the process confirming the correctness of the solution. The fourth one is interest which refers to the long lasted passion on a subject. MLS is the mathematics learning strategy construct which is constructed by the aforementioned four independent factors.

BE for Believe in English Ability and BM belief in English. The dependant variables- HEEE Higher education entrance exam-direct report from respondent; and EVA.HS.GRADE= performance based evaluated self in mathematics ability to predict mathematics achievement. Except the dependant variable that are taken based on definitions as achievement in mathematics all other components are extracted from factor analysis (for the structural relationship of factor.

The measurement model of structural equation modeling with standardized estimate depicted here the proposed measurement models model (framework) (Figure 2) above claim that there are different mathematics learning strategies is accepted. Principal component analysis proved from the sample data that 4 principal factors of mathematics learning strategies and two believe components that may mediate the effect of mathematics learning strategy with that of respondents’ math achievement. Therefore the residual between sample covariance and population covariance by the implied model seems minimal which supports the estimating process was genuine.

Model fit the chi-square statistic which is a function of the differences between the observed covariance and the covariance implied by the model and it was significant in this case overruling the rule of thumb to be none significant Field 2009. However the chi-square statistic is a poor measure of overall goodness-of-fit. The main problem with it is that with large samples and even the smallest deviation of the data from the model being tested will yield a significant chi-square value Field 2009. For this reason the square root of the differences between actual variances and covariance generated assumes whether the model is true. Hence CMIN P value is significant showing that the sample model fits with population i.e. the default (sample model) model is correct, the probability of getting a discrepancy as large as 496.935 is
All the baseline model comparison indices revealed results close to one. For instance IFI (incremental fit index) and CFI (comparative fit index) are greater than delta 20.9. Moreover the random mean square error approximation RMSEA=0.05 showing adequacy of model fit see Figure 4.

All the observed variables in the Figure 3 above variables depend on the immediate respective sub factors. For instance L9 (focusing on the most important points After finishing mathematics work in order to be sure about )and L7(defining specific goals before my attempt to learn something) in proactive monitoring cognitive regulation sub factor of MLS contributes high (0.70 each)

The path from MLS to Mach (mathematics achievement) is accompanied with high loading when it was mediated through MatB (students mathematics self belief) than any other mediated or direct paths (Figure 4) review of [15] that self-efficacy was positively related to self-regulatory strategies use and strongly related to academic performance can be specified in this finding. The direct path from MLS to Mach is minimal as(r=0.13) as it is minimal with path from MLS to Mach through mediating factor Engbel which drop the indirect effect to zero (0.47*-0.01=-0.004) too small to consider. Matbel (Maths belief) plays a mediating role also between MLS and Engbel (English Belief) at r=0.63*0.26=0.164). Hence it only Matbel that affect mathematics achievement at beta=0.45, p=0.002 not the MLS not the Engbel which were not significant. Pintrich [14] discussed focusing on the importance task value to performance. Some variables in the MatBel are how the student values his working performance (confident of ability to do well on standardized tests). Although the effect of each variables are presented below; among the three types of task based MLS Pm (proactive monitoring of cognitive regulations) predicts mathematics achievement (beta=1.4, p=0.04) citrus paribus. This was masked by the broad construct MLS.

The tested measurement model assessed the fit of the latent scale scores on their respective latent subscales which loaded on to the individual items. The overall results of Amos printed output for the proposed model are presented then after. Mathematics learning strategy predict with statistical significance both mathematics ability self believe and English ability self belief and vice versa. That is an increase of MLS by one, increase BM and BE by 0.93 and 0.68 respectively as the BM and BE in turn directly affects Mathematics achievement. In the same course indirect effect of MLS on mathematics achievement is proved to be high when mediated through mathematics self belief than English ability self belief and even higher than the direct effect of MLS on Mach. The direct effect of MLS with Mach is in line with Liu [27] who stated positive relation though it failed to maintain statistical significance. The direct (unmediated) effect of MLS on Mach is 1.926. That is, when MLS goes up by 1, Mach goes up by 1.926). Hence the indirect (mediated) unstandardized effect of MLS on Mach is 4.071( the standardized indirect effect of MLS on Mach is the product of the standardized direct effects 0.63*0.45 =0.28). Therefore the total (direct and indirect) effect of MLS on Mach is 5.998. That is, due to both direct (unmediated) and indirect (mediated) effects of MLS on Mach, when MLS goes up by 1, Mach goes up by 5.998. Four of the different learning strategies also showed both direct and mediated effect on mathematics achievement related variables- entrance examination (HEEE) result and evaluated performance EVA HS.GRADE). For instance indirect (mediated) effects of certainty, rhersal and Pm on EVA. H.GRADE are -0.701, -0.285 and -1.219 respectively. Note: The negative values are because EVA.HS.GRADE scored in rank order). These similar variables affect much HEEE results say 8.4, 3.4 and 14.6 respectively. There it is also found that the individual total effect of different learning strategies on Mathematics achievement much interesting.

Separate analysis of AMOS direct from different learning strategies to different indicators of achievement rehearsal affects HEEE (b=-0.28, p=0.021). It is separate analysis conducted to assess the individual direct and indirect effect of MKS's on students mathematics result. Moreover standardized direct effect confirmatory certainty (b=-0.551), rehearsal (b=0.32), proactive monitoring(b=1.2) and interest(b=1.3) on eval Grade respectively by the magnitude in parenthesis and direct effect of these variables on the HEEE is 1.5, -0.8, 1.3 and -1.77, as they are stated order in above lines of this paragraph. When Engbel and Matbel are considered as mediators, the model also depicted that there is an indirect effect of these learning strategies on math result certainty for instance indirectly affects Eva. H.GRADE -0.3 and HEEE by -0.17. Conversely the rest of math learning strategy variables showed an effect on student math result though the magnitude of effect is not high. On the top of this, each variable, regardless of the correlation among them has a total effect on math achievement. Here it is important to note that some effects direct or indirect showed negative impacts. Although it needs further investigation and such research report are non existence, it is important to give some explanation. The negative signs with the evaluated high school mathematics Grade(Eva HS.
grade) are because low value, say 1 represents for very high and so on when it is transformed to its reverse it will be positive. Rehearsal and interest have shown negative total effect; this could be due to the respondents understanding of these two variables if rehearsal is taken as rot memory and interest is not persistent than naturalized mathematics learning strategy it will not be a factor to foster math result but addition of confusion. An important result in this analysis is the separate total effect of experience based interest on both Eva HS Grade (1.5) and HEEE (-1.17) see Figure 4a below.

**Discussion and Implications**

The greatest success of this research is that it reduced the dimensions of mathematics learning strategies into four and two believe factors: belief of the subject (mathematics) and belief of the medium (English language). These relate the math learning strategies and math result. We had the broadest statement in the literature [21,27] Fravel 1979, Brown 1979 and Tellez 2008 that the various typology and classification of mathematics learning strategy. Learning mathematics strategies that are categorized in this research through dimension reduction factor analysis of the types stated by the scholars mentioned above. In a more detailed manner the knowledge of cognition as a learning strategy includes declarative, procedural, and conditional knowledge. From these the declarative knowledge includes knowledge about factors that may influence individual’s performance. Procedural knowledge includes knowledge about the way skills are applied. Conditional knowledge includes knowledge about when and why to apply different cognitive actions.

In broader sense these items are proactive self reflection in nature and this research is in line with research findings of Paris, Lipson and Wixson 1983; Schraw and Moshman 1995 cited Mustafa Sami 2009 and NICHCY 1997. When mathematics related problem is coming student may have and use a chick list of these types ahead they face the challenge. Perveen [35] reviewed the guidelines of Sherreen 2006 and Poly'a 1945 planned problem-solving approach-heuristic steps of the problem-solving approach. Technically speaking these are the keys for effective mathematics learning strategies.

In the third component items that were named as monitoring were identified. Monitoring includes regulations or periodic self-testing of individuals’ actions during task performance. During mathematics problem solving process students inquire how they tackling it by raising different questions and compare with others as benchmark for their work collaboratively. In the second component four variables with Eigen value greater than 0.4 were appeared as measuring items. Subject specific motivational effort, strategy (ways), goals and subject specific self reliance. Alexander et al. [8] introduced the domain specific modeling of learning. Personal intrinsic mathematics specific knowledge of cognition is important component of MPSS. Rehearsal, ascertaining process are more of domain-specific
expertise, domain specific model of problem solving. This implies that in solving mathematical problems mathematics directed cognitive processing is important to have prolonged commitment. According to this new finding domain specific cognition lies somewhere between planning and monitoring knowledge of cognit.

The existing knowledge of students’ performance in mathematics science and language stand on two different stands. One considers that mathematics science performance is confounded by language [29,30] Thorndik (1912) cascaded this view in relation to assessment saying that Math test are reading and comprehension proficiency loaded. Garrison & Mora 1999, Moschovitch 1999 cited in Mosqueda and Téllez 2008 backed these views stating that English proficiency of learners plays a critical role in their learning of mathematics, particularly for ensuring that they are able to comprehend, and then apply, complex mathematical concepts. The second stand boldly contends that English proficiency of students is not an issue in mathematics instruction for the reason that mathematics is a «universal language.» As a result, many educators assume that a student’s English proficiency has a minimal effect on learning mathematics Flores 1997; Gutierrez 2002 cited in Mosqueda and Téllez 2008. In general this research is in line with later stand that the belief in linguistic variables showed minimal effect on student’s mathematics achievement. It has also revealed in this research Engbel (English ability belief) poorly predicts HEEE and Eval HS Grade separately.

The contentions that mathematics is "language independent or universal would not be wise argument to move the solution to its right place. It is rather better to reconsider mathematics has mathematical language that every human language must acknowledged. The variable that measure English ability belief are «thoroughly mastered material you have read in preparation for an exam», "to write an essay to «convincingly express your ideas» and «ability to read and absorb articles and textbooks» look pure English ability belief which are less to reflect math language. This hints that a linguistic ability beliefs factor to be predictive of subject performance has to be related with the subject. In a situation where English language and math language are confused with another third mother tongue language it would be much difficult think with little English ability belief.

**Conclusion**

To conclude findings of this research is consistent with Pintrich and De Groot [15] positive correlation between self beliefs and self-regulated learning and affective (interest) components to academic performance. The positive relationship between self-efficacy and academic performance [15] seems similar with the findings of current research. In addition to this as the MLS and subject self belief affect achievement also affect the MLS and math ability self belief serving one as a feedback to the other. Earlier findings of [25,29] are consistent with the current research in stating the reciprocally relation and effect of achievement to the cognitive strategies that students use to learn and that motivational beliefs and self-regulation strategies.

Here again results showed that students’ English self confidence cannot correlate be correlated with students math result as Taraban, Rynearson and Kerr 2000 have stated from previous research findings. That is, college students’ comprehension and performance, Kraayenood and Schneider (1999), meta-cognition and reading comprehension scores of the participants are correlated and predict each other. Liu [29], Marsh et al. 1988 and Torres and Solberg 2001 that all reported the relationship, effect or impact of language, previous experience self belief, self esteem and concept on achievement or GPA [1].

**Implication**

There Different Learning Strategies which are in the 70: 30 percent placement plan adopted in 2008/09 which also favoring for sciences & technology (S&T) (MoE- ESDP 2010) which mathematics is underlining to all needs knowledge of identifying contributing factors to its successful accomplishment mathematics results. Now come to identify different dimensions MLS and the extent to which these factors that affect mathematics achievement. in relation to the factors the confounding factors are also identified indicating that any actions carried out to improve mathematics learning achievement should not ignore promoting mathematics ability self belief. Schunk and Zimmerman [15] if students are trained to have higher self-efficacy beliefs their academic performance also improves. Interest based training on different dimensions such as proactive monitoring of cognitive regulation, rehearsal, confirmative certainty should be installed to students to make the self regulated learning. Instead of focusing on the general English language ability belief math specific language ability language ability seems better to enhance mathematical results.

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