

**RELATIONSHIPS OF GENDER AND MATHEMATICS SELF-
EFFICACY TO MATHEMATICS ACHIEVEMENT
AMONG GRADES 5 AND 9 STUDENTS**

BY

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**ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES**



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ABSTRACT

The study was conducted among 156 grade 5 students (78 girls and 78 boys) and 157 grade 9 students (77 girls and 80 boys) of the schools of Debre Birhan town. The main objective of the study was to examine the relationships of previous math experience, specific math self-efficacy, general math self-efficacy, and subsequent math achievement among students of grades 5 and 9. The major statistics used to achieve this end were chi-square, multiple linear regression and t-test. One of the principal findings gave a hint that goes with Bandura's (1977) contention that previous experience is the most influential source of self-efficacy development. At both grade levels, task specific math self-efficacy predicted subsequent math achievement well. Besides, previous math experience made weak but significant contribution in predicting subsequent math achievement among 9th graders, but not among 5th graders. However, sex and general math self-efficacy measures did not predict subsequent math achievement in either grade. Moreover, grade 5 students were found more confident than 9th graders.

The mean scores of boys and girls on all of the four variables were comparable among 5th graders. Boys and girls of grade 9 produced similar scores in previous math experience, specific math self-efficacy, and general math self-efficacy, but boys surpassed girls in subsequent math achievement. The gender gap observed in math achievement at high school level is a phenomenon repeatedly reported in many studies. Thus, high school teachers should do whatever they can to promote females' math achievement so as to develop self-efficacy in math.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Students' self-perceptions (e.g., self-esteem, self-concept, and self-efficacy) and academic related variables have been areas of research especially in recent years. Among the sense of self-perceptions, students' academic self-efficacy has taken the attention of variety of researchers from different parts of the world.

The forerunner self-efficacy theorist Bandura (1986) defined self-efficacy as people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performance. Similarly, Dembo (1994) stated that self-efficacy is the belief that one successfully executes the behavior required to produce a particular outcome.

Scholars argue that academic self-efficacy influences the thought and motivation of students in their learning activities. Bandura (1989) maintained that self-efficacy beliefs affect thought patterns that may be self-aiding or self-hindering. In connection with this, Pajares (1997) stated that students' self-efficacy beliefs correlate with other motivation constructs and with their academic performances and achievements. Schunk (1987) also explained that self-efficacy can affect choice of activities. Students who have a low sense of efficacy for learning cognitive skills may attempt to avoid tasks, whereas those who judge themselves more efficacious may participate more eagerly. Bandura (1986) elaborated that self-efficacy determines that strategies students employ to attain the level of performance they expect, the nature of goals they set to reach, the amount of effort they exert on the

task, the amount of time allocated to challenge the given task, their steadfastness in engaged activities, and their vigilance to exercise the task.

Once again, Pajares (1997) explained that the beliefs that students develop about their academic capabilities help determine what they do with the knowledge and skills they have learned. Confidence in doing a task and the confidence in one's ability in an area of endeavor are critical factors for motivation and persistence (McCombs & Whisler, 1989) as cited in Randhawa, *et al.*, (1993).

The aforementioned explanations about self-efficacy enable to develop a leading statement that students' math self efficacy and performance would have relationship. Most researchers investigating the relationship between math self-efficacy and performance had reported a strong correspondence (Pajares & Miller, 1994). However, Norwich (1987) reported that math self-concept and prior math performance made significant contributions to predicting subsequent task performance but task specific self-efficacy did not. In contrast, Pajares & Miller (1994) found that math self-efficacy was more predictive of problem solving than was math self-concepts, perceived usefulness of math, and prior experience with math or gender. In addition, (Randhawa, *et al.*, 1993; Yalaw, 1997; Chemers, *et al.*, 2001; Pietsch, *et al.*, 2003) reported that students' self-efficacy is powerful predictor of performance in math and related subjects. Collins (1982), as cited in Pajares & Miller (1994), found that, even when prior performance was controlled, children with high self-efficacy outperformed children with low self-efficacy in the completion of novel math problems, showed greater effort, and persisted longer in reworking incorrect problems.

Four major sources of information for efficacy development are identified. These are prior performances, vicarious experience, verbal persuasion, and physiological states (Bandura, 1977). Among the four sources, the most

influential one is performance accomplishment or mastery experience. The most important source of efficacy information is personal mastery experience (Bong, 1997).

Mastery experiences as main influential sources of efficacy expectations, successes are likely to raise the level of self- efficacy where as repeated failures lower it. Concerning this idea Schultz (1986) explained that prior achievements demonstrate our capabilities and in the process, strengthen our feelings of self-efficacy. Prior failures particularly repeated ones lower our sense of efficacy.

The relationship of mastery experiences and self-efficacy tends to imply that this psychological construct may show variation developmentally. Students who have longer experiences in math are expected to have higher sense of math self-efficacy than less experienced ones. Hence, differences in academic experiences may account for the variation of students' self-efficacy level in academic endeavors. Bong (2001) stated that high school students are believed to hold more differentiated task value beliefs compared with middle school students for the former are concerned with future college majors and career choices and have more academic experiences than the latter. Similarly, Zimmerman & Martinez-Pons (1990) reported that high school students' academic efficacy surpassed that of junior high school youngsters, and the efficacy of junior high school students, in turn, surpassed that of elementary school children.

Like grade level, gender variation on students' self-efficacy deserves attention of researchers. In high school level boys (men) excelled girls (women) in math self-efficacy (e.g., Bong, 1997; Randhawa, *et al.*, 1993). In the same manner, Pajares and Miller (1994) found that men surpassed women in math self-efficacy and performance among under graduate university students.

On the other hand, Zimmerman & Martinez-Pons (1990) who studied among elementary and high school students reported comparable mathematical self-efficacy between girls (women) and boys (men). Gender differences in math achievement are also contradictory. Early findings showed that children did not differ in their math performance due to gender during elementary school but the difference began to appear in middle school and increased with time and schooling (Pajares & Miller, 1994). However, Mills, *et al.*, (1993) indicated that boys performed better than girls in math in elementary schools. In contrast, other studies have reported equal mean scores in math for boys and girls in the elementary school (e.g., Hilton & Berglund, 1974; Beller & Gafni, 1996). The issues raised so far imply that the problems in relation to math self-efficacy and math achievement are not yet well settled. Particularly, in Ethiopia very limited surveys are made in this area. Hence the investigator starts to examine this area among elementary and high school students.

1.2 Statement of the Problem

Finally, having cited and acknowledged about the theoretical background of self-efficacy and the present status of the relationship of math self-efficacy and achievement across grade level and gender, the researcher is in a position to formulate the following four leading questions of the study.

- Do students of grades 5 and 9 differ with respect to the influence of the sources of math self-efficacy development?
- Do sex, previous math experience and math self-efficacy predict subsequent math achievement among 5th and 9th graders?
- Do 9th graders differ significantly from 5th graders in math self-efficacy?
- Do girls and boys of grades 5 and 9 differ significantly in math self-efficacy and achievement?

1.3 Purposes of the Research

The objectives of this study are:

1. surveying the agreement of students on the sources of math self-efficacy development,
2. investigating relationships of math self-efficacy and achievement, and
3. assessing variation of math self-efficacy and achievement on the basis of gender .

1.4 Significances of the Research

The paramount significance of this research would be making teachers and school practitioners be aware so that they contribute their share in enhancing students' sense of math self-efficacy because perceptions of inefficacy in math would lead learners to reduced levels of motivation and lessen their engagement in math and math related courses (Randhawa *et al.*,1993). The awareness of math self-efficacy development beginning from elementary school is of great importance. Pajares and Miller (1994) pointed that if self-efficacy assessments were to begin early in a student's academic career, inaccurate perceptions could also be identified early and appropriate interventions undertaken. Moreover, the study can suggest how gender gap (if any) on math self efficacy and achievement might be reduced through variety of interventions and counseling procedures. The sources of efficacy that this study identifies would be starting points to design interventions. Surveying the sources of math self-efficacy development is worthwhile for concerned bodies to devise mechanisms to enhance the students' math confidence.

1.5 Delimitation of the Research

This study was delimited to 5th and 9th graders. The two grade levels were considered purposely. Primarily, grade 5 was taken because it is a stage where students start the second cycle of primary level after completing the

first cycle. For self- efficacy is hypothesized to be highly influenced by previous personal accomplishments it is the researcher's hope that grade 5 students would report their math self-efficacy meaningfully based on their cumulative experiences from former years of their learning. Besides, 5th graders were taken because younger learners from lower grades cannot judge their math confidence objectively. Due to this reason the study involved 5th graders so that interpretable and dependable data would be hopefully reported.

Secondly, the researcher took students from grade 9 because it is a level that students join a secondary school after completing the second cycle of primary level. Students of this grade level would report their math self-efficacy based on their former second cycle primary level and part of secondary school experiences more than 5th graders. Finally, comparisons on the variables were made to see how differences on math experience influence both math self-efficacy and achievement.

The study was also restricted to be conducted in elementary and secondary schools of Debre Birhan town. The researcher has no any other reason in making the mentioned town as target area of the research than the simple reason that he is familiar with some officials and residents since he had been visiting the place every week ends for accomplishing teaching tasks. This enabled him to collect the data at ease.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 The What of Self-efficacy

The psychological construct self-efficacy, as a variable that has influence on human behavior, has been first come into publication by Bandura (1977) in his work "Self- efficacy : Toward a Unifying Theory of Behavioral Change". Some years later Bandura (1986) defined self-efficacy as people's judgments of their capabilities to organize and exercise courses of action required in attaining designated types of performance. Just to add, Organ (1986) defined self-efficacy as it is the judgment of one's capabilities to organize and execute the behavioral elements that need to attain a specific type of performance. Similarly, Dembo (1994) stated that self-efficacy is the belief on one's ability that one can successfully execute the behavior required to produce a particular outcome.

Even though there is no any contradiction among scholars who give the theoretical definition of self-efficacy, there is further a need of giving operational definition of the construct which is relevant to this study. Since the focus of this literature is to deal with math self-efficacy, the working definition of the variable is presented here under.

Pajares and Miller (1994) operationally defined math self-efficacy as a student's judgment in his/her belief on his/her ability to solve math problems. They considered task specific self-efficacy. Hence a student's math self-efficacy refers to his/her beliefs about his/her capabilities to use the already acquired knowledge and developed skills effectively and thereby can solve the problems successfully. It is in this essence that the present research considers the variable math self-efficacy. This approach is recommended by Bong (2001) as the standard method used in self-efficacy

research is to assess students' confidence towards specific tasks and examine how well this perception predicts performance on the very tasks.

The essence of self-efficacy has been conceptualized to have three dimensions, namely, magnitude (level), strength, and generality (Bandura, 1977 & 1986; Ivancevich & Matteson, 1990). The first dimension of self-efficacy - magnitude designates the number of activities that individuals judge themselves capable of performing to the expected level of efficacy strength. Magnitude tells whether people's efficacy perceptions involve only simple or easy tasks or include even the most demanding ones within a particular domain (Bong, 1997).

The second component of self-efficacy strength indicates whether the belief of individuals to the magnitude of self-efficacy is strong or weak (Ivancevich & Matteson, 1990). Persons with a strong sense of personal competence remain steadfast on occasional failures, whereas those with weak concepts of efficacy are quick to resign with self-debilitating expectations (Bandura, 1977; Bong, 1997).

Third, the extent to which judgments of competence relate to, or transfer across, different performance tasks or domains refers to generality (Pajares, 1997). Generality takes place when students perceive that tasks are similar and require nearly similar cognitive abilities or when they assure that necessary skills of accomplishing different activities are adequately acquired. For instance, Bong (1997) revealed that students' math and physics problems self-efficacy was generalized as they perceived greater similarity between the problems.

Among the three dimensions of self-efficacy, the present study is going to investigate how students' strength on their level of math problems self-efficacy predicts the criterion task-math subsequent achievement.

Investigating how students generalize their math self-efficacy across sub domains of math or across other related or non related subjects is not the concern of this study.

2.2 Sources of Self-efficacy Beliefs

Expectations of personal efficacy are based on four major sources of information: performance accomplishments, vicarious experience, verbal persuasion, and physiological states (Bandura, 1977).

2.2.1 Performance Accomplishments

Personal attainments indicate our degree of self-efficacy. Regarding this Schultz elaborated that:

Previous success experiences at various tasks provide direct indications of our level of mastery and competence. Prior achievements demonstrate our capabilities and in the process strengthen our feelings of self-efficacy. Prior failures particularly repeated ones lower our sense of efficacy (Schultz, 1986:389).

Prior mastery experiences are the most influential sources of self-efficacy development (Bandura, 1986; Ivancevich & Matteson, 1990; and Pietsch, *et al.*, 2003). Students who performed successfully on previous activities of a course tend to develop high self-efficacy towards the course. On the contrary, students who failed time and again in previous assignments of a course start to lose their sense of efficacy on their capabilities on related problems of the course. Thus previous performances in learning activities contribute much towards the establishment of academic self-efficacy.

2.2.2 Vicarious Experience

Vicarious experience refers to observational experience or modeling (Bandura, 1977). Seeing others successfully cope with perceived aversive events enhances our belief that we can also be effective and observing others fail decreases our belief that we can cope with adversity (Klein, 1987).

Modeling has been hypothesized to be influenced by variables like similarity of observers and models in important attributions (e.g., age, sex, and background), number of models, as well clarity of behavior being accomplished by the models. In connection with such factors Dembo (1994) summarized that observing a similar peer successfully performing a task well can promote a sense of efficacy in the observer. For instance, if a low achieving student observes another low achieving student successfully completing a math problem at the chalkboard, then the observer is likely to believe that he/she also could learn to solve the problem. It is also argued that instead of a single model, many models increase the chance of observers to perceive themselves as similar to at least one of the models. If people of widely differing characteristics can succeed, the observers have reasonable basis for increasing their own sense of self-efficacy (Bandura, 1977). Further, Bandura (1977) argued that modeled behavior with clear outcomes conveys more efficacy information than if the effects of the modeled actions remain ambiguous.

Vicarious experience contributes less to the development of self-efficacy as compared to mastery experiences (Pajares, 1997). Bandura (1977) put this argument as vicarious experience is a less dependable source of information about one's capabilities than is direct evidence of personal accomplishments. However, general perceptions of competence may rely more heavily on social comparisons rather than on prior experience in circumstances where the latter is not readily available (Skaalvik & Rankin, 1997, 1998) as cited in (Pietsch, *et al.*, 2003).

2.2.3 Verbal Persuasion

People are led, through suggestion; into believing that they can cope successfully with what has overwhelmed them in the past. Efficacy expectations induced in this manner like that of vicarious experience are

also likely to be weaker than those arising from one's own accomplishments because they do not provide an authentic experiential base for them (Bandura, 1977).

Persuasive information from teachers, parents and significant others can influence students' efficacy of learning. Verbal persuasion as source of students' academic self-efficacy is supposed to be effective when the persuasion is realistic and the persuader is credible (Schunk, 1987). By realistic it means if students are verbally persuaded as if they have the capability but actually they do not have the required ability the persuasion feels irony instead of promoting their efficacy. Moreover, credibility of the persuader means that students want to be persuaded by a trust worthy source particularly their teacher and one who has a detail knowledge for the task under consideration. In short, students may not take the advice of less credible source to judge their capabilities.

2.2.4 Physiological States

Physiological arousals influence our sense of competence; we feel less able to cope with an aversive event when we are agitated (Klein, 1987). Similarly, Bandura (1977) noted that people are more inclined to expect success when they are not beset by aversive arousals than if they are tense and viscerally agitated.

In case of physiological arousals sweating and heartbeat rate are common instances. If a student gets much sweating and increased heartbeat rate while to start working on a math test most frequently, then he/she starts to interpret that he/she lacks the required ability of doing the test. This implies that physiological symptoms can serve as cues for judging efficacy perceptions. In general, strong emotional reactions to a task provide cues about the anticipated success or failure of the outcome (Pajares, 1997).

2.3 Measurement of Self-efficacy

An important issue in self-efficacy research is concerning its measurement (Pajares & Miller, 1994; Bandura, 2001; Choi, *et al.*, 2001). Bandura (1986) argued that the predictive power of self-efficacy beliefs minimizes when there is lack of specificity of measurement and consistency with the criterion task. Pajares (1997) added that studies that report a lack of relationship between math self-efficacy and performance often suffer from similar conceptual or measurement flaws.

Bandura (2001) instructed that the construction of sound self-efficacy scales relies on an informative conceptual analysis of the factors governing the selected domain of functioning. In connection with this it has been claimed that the more task specific the measurement of self-efficacy, the better the predictive power self-efficacy is to play on the task specific outcomes of the required domain. In short, Bandura (1986) cautioned that capability assessed and capabilities tested should be similar.

Apart from the development of self-efficacy scales that match with the outcome expected, level of generality is another point of interest. The generality of the self-efficacy measurement should be in line with the outcome to be predicted. For example, to predict the overall academic achievement the self-efficacy assessment should be for the over all academic sphere. To predict math achievement students' math self-efficacy should be assessed and to predict students' performance at more specific topic, for instance, about probability, their belief on their ability to deal with problems of probability should be assessed. However, specificity of measurement of self-efficacy should be at optimum level. Pajares (1997) cautioned that judgments of competence need not be so microscopically operationalized that their assessment loses all sense of practical utility. He further noted that domain specificity should not be misunderstood as extreme situational

specificity, and there is no need to reduce efficacy assessments to atomistic proportions.

Another important point in self-efficacy measurement goes with the responses and verbal descriptors of scales. There is no consistency among researchers of this construct regarding rating scales and verbal descriptions. To mention some examples, Zimmerman and Martinez-Pons (1990) used 100-point scale in 10-unit differences that ranged from 0% (completely unsure) to 100% (completely sure). Randhawa, *et al.* (1993) asked students to indicate their confidence on a 10-point scale ranging from no confidence at all (1) to complete confidence (10). Bong (1997) asked students to rate their confidence on a scale ranging from 0 to 100 in 10-unit intervals where the descriptors were not sure (0) may be (40), pretty well (70), and real sure (100). In Bong's study every math problem was presented by an overhead projector for approximately 10 to 20 seconds thereby the students indicate their confidence level as to solve the problem later. (E.g, one item from algebra part was "If \square is defined by the equation $x \square y = x + xy + y$ for all numbers x and y , what is the value of z if $8 \square z = 3$?) Pajares and Miller (1994) used a Likert scale of 5-point ranging from 1 (no confidence), 2 (very little confidence), 3 (uncertain), 4 (much confidence), and 5 (complete confidence). In this study, students were asked to rate how they are confident that they can answer a specific math problem. (e.g., "There are three numbers. The second is twice of the first and the first is one third of the other number. Their sum is 48. Find the largest number. "). Once again, students were instructed not to attempt answering the problems but to indicate their confidence in solving only. Subsequently the items were presented so that the students could perform them.

Moreover, Pietsch, *et al.* (2003) used a scale that ranged from 0 (definitely not sure) to 6 (definitely sure). They assessed math self-efficacy at three levels. The three levels with corresponding sample items are presented.

Items like "I am able to achieve at least ok grades in mathematics" measured the more general math self-efficacy. Topic-specific percentages efficacy items were like "I am able to achieve at least 90% on a percentages test." Finally, problem specific percentages efficacy were assessed by instructing the students as, "please state how sure you are that you can answer the following questions correctly." (e.g., "How much is 15% of 300?").

In the final analysis, to avoid the discrepancies regarding self-efficacy measurement guidelines are forwarded from the distinguished scholars of the area. Pajares (1997) recommended that self-efficacy predicts well academic performances if theoretical instructions and procedures concerning specificity and correspondence are firmly followed. Moreover, he directed that items of self-efficacy should be worded in terms of can, a judgment of capability, rather than of will, a statement of intention.

Regarding the rating scale and verbal descriptors of efficacy measurements Bandura (2001) directed that the rating should be on a 100-point scale, ranging in 10-unit intervals. Starting from 0 ("cannot do") through intermediate degrees of assurance 50 ("moderately certain can do"); to complete assurance 100 ("certain can do"). Bandura, especially, stressed that 0 which represents a complete incapability should be included always. However, the ceiling (100) can be reduced to simple numbers like 10 with unit intervals depending on the age of respondents and other technical considerations.

2.4 The Prevalence of the Relationship of Self-efficacy and Achievement in Math

Recent research findings have consistently shown that task specific self-efficacy is strongly related to math achievement and it is an important

predictor of subsequent performance as compared to other related self-percepts. For example, Pajares and Miller (1994) demonstrated the mediation role of task specific math self-efficacy among variables: gender, prior math experience, math self-concept, perceived usefulness of math, and math performance in 229 women and 121 men undergraduates. The path coefficients revealed that math self-efficacy had strong correspondence with math performance. Generally speaking, task specific math self-efficacy as a powerful predictor of subsequent performance in math and related subjects is well documented (e.g., Randhawa, *et al.*, 1993; Pajares & Miller, 1994; Yalaw, 1997; Chemers, *et al.*, 2001; Pietsch, *et al.*, 2003).

However, Norwich (1987) who studied among elementary school students of ages 9 and 10 years reported a contradictory result to the common investigations. Employing multiple regression analysis, the researcher reached at a conclusion that math self-concept and prior math performance made significant contributions to predicting subsequent task performance but task specific self-efficacy did not. The sampled children (38 boys and 34 girls) were asked to rate their confidence in solving math problems like $75 \div 5 = \underline{\quad}$. The measurement of the variable math self-efficacy used in this research is similar to what others used. The observed contradiction might be because the younger the children the poorer they are able to report accurate self-efficacy that can reflect their true ability.

2.5 Developmental Perspective of Math Self-efficacy

The relationship of mastery experiences and self-efficacy tends to imply that this psychological construct may show variation developmentally. Students who have longer experiences in math are expected to have higher sense of math self-efficacy than less experienced ones. Bong (2001) hypothesized that high school students are believed to hold more specific task value beliefs as compared to middle school students for the former are concerned with future college majors and career choices and have more academic

experiences than the latter. And the hypothesis was confirmed by the finding that Korean high school students demonstrated more differentiated math self-efficacy than did middle school students across both sexes (Bong, 2001). Similarly Zimmerman and Martinez- Pons (1990) reported that high school students' academic efficacy surpassed that of junior high school youngsters, and the efficacy of junior high school students in turn, surpassed that of elementary school children on both sexes separately. Specifically, their investigation revealed that 11th graders math efficacy exceeded that of 8th graders though not statistically significant and the 8th grade students significantly surpassed 5th graders.

2.6 Gender Differences in Math Self-efficacy

Gender variation in math self-efficacy among elementary school students is not adequately researched as far as the knowledge of the present reviewer is concerned. Zimmerman and Martinez-Pons (1990), just to mention one, who studied among 5th graders in New York City schools reported comparable math self-efficacy between boys and girls. The measurement of math self-efficacy they used was similar to that of the recent researchers have been using. They asked students to rate their efficacy for solving 10 math problems arranged in increasing difficulty using 100-point scale. The final analysis they reached at signified no gender difference in math self-efficacy.

Regarding gender difference in math self-efficacy among high school students many studies have been conducted in different nations. Nearly invariably all the findings indicated that boys (men) surpassed girls (women) in math-based self-efficacy (e.g., Bong, 1997; Yalaw, 1997; Mittelberg & Lev-Ari, 1999; Randhawa, *et al.*, 1993). However, Zimmerman and Martinez-Pons (1990) reported that grade 11 boys didn't differ in math self- efficacy to their female counterparts. The researchers failed to give any explanation for the observed unexpected finding but suggested for the need of further research.

In general, the question of gender issue in math self-efficacy among elementary school learners seems unresolved. Whereas in high school students it seems well established that the difference of math self-efficacy is in favor of boys (men). Eccles (1983) as cited in Pajares (1997) stated that boys and girls report equal confidence in their math ability during the elementary years, but, by high school, boys are more confident and girls more likely underestimate their capability. In conclusion, the relationship between gender and self-efficacy in math requires further investigation since it has not been explored as thoroughly as that between gender and academic performance (Pajares, 1997).

2.7 Gender Differences in Math Achievement

The dispute of gender and math achievement is not the central part of this research. But, because it is intermingled within the research questions, it is better to present local and international research findings.

Recent local researches that have employed nearly the same methodologies reported similar observations invariably regardless of grade level differences. In all the cases, boys (men) were found to exceed girls (women) in math achievement. For instance, Seleshi (1995) studied among students of grade 8 through 11. And his analysis of variance for a total 515 boys and 332 girls at $p < .01$ revealed that boys' math achievement was better than that of the girls across the respective grade levels. Yoseph (1997), too, reported that among students of grades 6, 7, and 8 gender difference was found in math achievement in favor of boys at $p < .001$. Similarly, Adamu (2004) demonstrated that boys surpassed girls in math achievement in grades 5, 6, 7, and 8.

In foreign studies gender differences in math achievement in elementary school students are contradictory. Hilton and Berglund (1974) presented sequential test of educational progress (STEP) in math for elementary and high school students. They indicated that in STEP math, boys and girls were equal at the 5th grade. But beginning from grade 7 boys showed higher mean scores. To the contrary of this investigation, Marshall and Smith (1987) reported gender differences in grades 3 and 6. Their longitudinal study depicted that girls excelled in math performance in the third grade but failed to maintain that excellence in the sixth grade. In the sixth grade, girls were found to perform poorly as compared to boys. But, even beyond grade 6, Sherman (1980) reported no significant difference in grade 8 between the sexes in math performance. The researcher further noted that different tests were used and the non existed sex related difference in math performance among 8th graders is probably a genuine phenomenon; it is also consistent with large portion of the literature.

Once again, inconsistent with the findings mentioned earlier, Mills, *et al.* (1993) indicated that boys performed better than girls in math across 2nd, 3rd, 4th, 5th, and 6th graders. They studied 2,586 talented elementary school students of ages between 7 and 11 years and reported their findings employing ANOVA.

In summary, sex differences in math achievement that could be attributed to biological, sociological, psychological, and educational factors seem to appear in students of ages about 12 and 13 years. For instance, patterns of course taking, attitudes toward math, differences in the achievement motivation of boys and girls, and some characteristics of the tests themselves may contribute to some of the differences but fail to explain all of them (Beller & Gafni, 1996). These scholars studied gender differences in math and science among 9 and 13 year olds across 14 and 20 countries, respectively, as well as within 7 selected countries. The reported effect sizes

tended to increase with age in favor of boys. The overall gender effect sizes on the international assessment of educational progress (IAEP) math assessment were small, especially among 9-year-olds, among whom there was essentially no performance gap between boys and girls. At age 13 years, a somewhat larger positive effect (i.e., boys performing on the average better than girls) was found across all participating countries. The findings suggested that gender gap becomes wider as age increases.

However, gender differences in math achievement appear to be consistent among high school students. Nearly in all literatures reviewed gender differences in math achievement are in favor of boys (men) (e.g., Hilton and Berglund, 1974; Sherman, 1980; Randhawa, *et al.*, 1993).

CHAPTER THREE

RESEARCH METHOD

3.1 Participants and Sampling Procedures

Participants of this study constituted 5th and 9th graders of the governmental schools of Debre Birhan town. Debre Birhan is the city of North Shoa Zone of Amhara Region and it is located at 130 km away from Addis Ababa.

Initially, all the seven elementary schools located in side the town were taken as target of the study. The information collected from the city 'woreda' education office enabled the researcher to group the schools in to two. The first includes the schools that run from grade 1 to 6. The second group includes those that run from grade 1 to 8. Two schools ('Baso' and 'Biruh Tesfa') were taken employing lottery method from the two groups. The 5th graders were attending their lessons in 4 and 6 sections in 'Baso' and 'Biruh tesfa', respectively. The number of students in a class averaged 55 and 51 in 'Baso' and 'Biruh Tesfa', respectively.

The majority of the students of the two sections (5_A and 5_C) of the later school were participants of pre-piloting and piloting programs. Hence, these two sections were excluded during the main study. Finally, four sections from the above two schools, that is, two from four sections of each school were taken. Finally, 160 students (81 girls and 79 boys) from the total 527 took part in the study.

At high school level, 9th graders were sampled from the only one general secondary school, namely, Debre Birhan General Secondary School. There were 3035 students (1433 girls and 1602 boys) in 34 sections at this school.

The number of the students in each section averaged 89 and the number of males and females was nearly proportional.

Among the 34 sections, students of the 10 sections have been attending their lessons in classrooms belonging to another elementary school called 'Atse Zerayacob'. The researcher, therefore, targeted the 24 sections of the "main campus" so that the administration could be managed conveniently. Two sections (9₆ and 9₁₄) were excluded from the main study because the majority of the students participated during pre-pilot and pilot study. Then four sections (9₂, 9₄, 9₁₁, and 9₁₃ from 12 sections of the afternoon shift) and other four sections (9₁₆, 9₁₉, 9₂₀, and 9₂₂ from 10 sections of the morning shift) were selected. Totally eight sections from the total 22 sections were taken. The selection of the sections was accomplished as follows. As the head of Math Department told the researcher, four teachers have been assigned to cover the 24 sections. This implies that a teacher contacts six sections. Based on this evidence and other technical considerations as mentioned above, two sections taught by each teacher were selected using lottery method. All these steps were taken with the help of the Head of the Department.

All the students of the selected sections were asked to fill pieces of background information on a form. The form requests a student to write name, sex, the years that he/she attended grades 6 and 7, the school and section that he/she attended grades 6 and 7, and the average math scores that he/ she achieved at the end of the year at each grade level (if he/she could remember). Though many failed to recall and report the last information, the other evidences were reported because the students were systematically convinced to do so through their math teachers from the very start. These activities were done during the pilot study.

Eventually, to carry out subsequent activities students who attended grades 6 and 7 in the recent years 1995 and 1996 E.C. from either 'Biruh Tesfa' or 'Atse Zerayacob' general elementary schools were selected. Proportionality of sex was considered in the selection. The number of students selected was 173 (89 girls and 84 boys). However, 157 of them (77 girls and 80 boys) responded to the instruments administered later and the analysis was made using their data.

A summary of the number of sampled students from the selected schools is presented below.

Table 3-1 Summary of the sample schools and number of students sampled

No.	Sample School	Number of Students in each School			Number of Sample Students		
		Girls	Boys	Total	Girls	Boys	Total
1	Baso Elementary School :5 th graders	135	84	219	48	29	77
2	Biruh Tesfa General Elementary School : 5 th graders	168	140	308	33	50	83
3	Debre Birhan General Secondary School : 9 th graders	1433	1602	3035	77	80	157
Total		1736	1826	3562	158	159	317

Finally, the analysis was done on 313 students (155 girls and 158 boys). Three girls and a boy from 5th grade failed to complete the instruments as required.

3.2 Family Background of the Participants

To have some information about the families of the students some items that ask about parents' residence (urban or rural), educational status, and occupation were attached with the main instruments.

The majority of the students 285 (91%) reported that their parents (either mother or father or both) are urban dwellers (living in the zonal town).

Based on this data it can be said that residence as source of variation is largely controlled because only less than 9% of the students' parents are rural residents (living in the rural area apart from the zonal town).

The parents' educational _ and occupational level are indicated in the tables below.

Table 3-2 Summary of the educational status of the students' parents

Parent	Educational Level					
	Illiterate and Basic Education n (%)	Elementary School n (%)	Secondary School n (%)	Certificate (10+1,12+1) n(%)	Diploma and Above n(%)	Not Reported n(%)
Mother	121(38.7)	56(17.9)	91(29.1)	27(8.6)	15(4.8)	3(1.0)
Father	80(25.6)	48(15.3)	74(23.6)	61(19.5)	48(15.3)	2(.64)

Table 3-3 Summary of the occupational status of the students' parents

Parent	Occupational category				
	House wife (Farmer) n (%)	Merchant n (%)	NGO worker n (%)	GO worker n(%)	Not reported n(%)
Mother	167 (53.4)	71 (22.7)	11(3.5)	61 (19.5)	3(1.0)
Father	24 (7.7)	112 (35.5)	27 (8.6)	143 (45.7)	7(2.2)

Note. NGO = Non governmental organization; GO = Governmental organization

3.3 The Principal Variables and Procedures of Data Collection

Based on the theoretical guidelines and empirical guidance, the researcher applied a 6-point scale. This kind of scaling was chosen for the researcher

thought that it would not be cumbersome for the youngsters of grades 5 and 9. The students were asked to rate their confidence at subject (math) level and topic level as that of Pietsch, *et al.* (2003). The verbal descriptors were 0 (not sure at all), 1 (less sure), 2 (some what sure), 3 (moderately sure), 4 (sure), 5 (very sure), and 6 (completely sure).

The definitions of the various variables included in the study are as follows.

Variables:

Gender: Sex of the student. The codes were included in the first part of the questionnaires. The codes (sections and roll numbers) served to match the scores of the individuals gathered through different instruments at different times. For the analysis part a girl was coded as 0 and a boy as 1.

Sources of math self-efficacy: Theoretically postulated sources of efficacy development were composed in six items. Students were asked to rate the degree of the influences of these theoretically proposed sources on their already developed math self-efficacy on a 3-point scale 1 (low), 2 (medium), and 3 (high).

Previous math experience (PRME): PRME of a 5th grader was the average of his/her math scores recorded when he/she was in the 2nd and 3rd grade. The data were collected from the record offices of the schools. PRME for a 9th grader was also taken as the average of math scores achieved in 6th and 7th grades. Previous math results at 4th grade level for the present 5th graders and that of 8th grade level for the present 9th graders were not considered due to the following reason. The results of 8th graders collected from classroom tests were assumed not to reflect the true performance of the students because the promotion is determined by region-wide exams, and the students may be careless at classroom tests. And 4th graders' results were not taken to keep polarity. The data

of PRME of 9th graders were, then, collected from the record offices of the already selected schools ('Biruh Tesfa' and 'Atse Zerayacob' general elementary schools). The respective record officers of the schools accomplished the collection of the information of PRME with occasional supervision of the researcher.

Math self-efficacy: This variable was treated at two levels. The first level was called specific math self-efficacy scale (SMSES) and the second level was general math self-efficacy scale (GMSES). For the SMSES topic level statements were developed based on the contents covered through the first semester of the current year for both 5th and 9th graders. The chapters covered in the grade levels were identified with the help of the subject teachers. A student was asked to rate his/her confidence as to how he/she can deal with the problem that was stated on a rating scale that ranged from 0 (not sure at all) to 6 (completely sure) through 3 (moderately sure). The items were 29. Secondly, GMSES was measured using 5 subject level items and they were presented together with that of SMSES but at the end.

Subsequent math achievement (SMAT): This variable was measured using 30 items (25 multiple choice and 5 short answer items) for each grade level. The 30 items of SMAT were developed basing the 29 items of SMSES. In other words, it was assumed that one item in the SMAT represents one item in the SMSES. However, two items of SMAT (especially the 25th item in the multiple choice part and the 3rd in the completion part) were assumed to correspond with the 29th item of SMSES.

3.4 Procedures of Data Collection

In this part the procedures applied in collecting data regarding math self-efficacy and subsequent achievement are presented in detail.

The measures were administered in-group during the last two weeks of March in the opposite shift of the students. Students of both grade levels were adequately instructed by the researcher as to how to fill and complete the items. The instruction was presented orally by writing the alternatives of the scales on the blackboard and supporting with examples. In short, the presentation was a kind of short-term training. The students were also free to ask any ambiguity and the researcher was frequently supervising the progress of the activities. Because students sometimes overlook in responding to items, teachers assigned as invigilators made strict follow up so that any item would not be skipped. This rigorous administration of the measures helped minimize possible mistakes.

Papers of the achievement test were administered in the same session but following the completion of the measures of efficacy scales as Pajares and Miller (1994) did. The respondents were not obliged to complete the test within the time prescribed. Instead, they were allowed to work on the test relatively for the time they can so long as any test taking violation like cheating did not appear. The time extension was tolerated because the aim of the test was to maximize performance but not to check speed of computation.

Measures of SMSES and GMSES of 9th graders were developed in English. The English version was chosen in order to get more correspondence among the measures. Nearly all the words used in the scales were also used in the subsequent achievement test. Though common and simple words that are used in the textbook were taken in stating the items of the scales, students

were allowed to ask any language difficulty during the administration. As expected, the students never faced serious language complications. Of course, a few students asked about meanings of some words. The measures of the 9th graders were administered in a large hall that can accommodate about 200 persons. Moreover, the researcher himself administered the measures in both shifts in collaboration with one math teacher.

3.5 Pilot Study

Two phases of piloting (pre-pilot and pilot) were carried-out particularly for subsequent math achievement test. Primarily 34 items were pre-piloted among 40 students randomly selected for each grade level. During pre-piloting, the items were presented for three math teachers of each grade level. The teachers were asked to rate the relevance of each item and the representation of the contents covered through the semester. They indicated their evaluation on a rating scale of least appropriate, appropriate, and most appropriate. Fortunately, all the items of both grade levels were judged as appropriate except that all the grade 9 teachers rated one item from the short answer category as least appropriate. When asked later in face-to-face discussion by the researcher the reason why they rated it as least appropriate, they mentioned that the item didn't represent any topic dealt in the semester. This item was excluded later in the main study. At this stage, Kuder-Richardson20 analyses for the internal consistency of the achievement test revealed coefficients .613 and .755 for grades 5 and 9, respectively.

Based on the information gained during pre-pilot items that were very difficult (less than 0.30 difficulty level index) were changed by simpler ones or avoided. There was no any item discarded or improved for its too easiness because the largest difficulty level index observed was 0.75. Moreover, some

items from both grade levels were rearranged from multiple choice type to short answer type and vice versa.

Eventually the rearranged and improved items were organized for the second time. At this phase, the items were reduced to 30 for each grade level. The second phase-pilot test was made on all the scales and the achievement test. The summary of the statistics of the instruments of the pilot test is presented below.

Table 3-4 **Descriptive statistics of the pilot study: Means (M), standard deviations (SD), reliability coefficients [alpha (KR20)] and standard errors of measurement (SEM).**

Variable	5 th Grade					9 th Grade				
	M	SD	alpha (KR 20)	SEM	n	M	SD	alpha (KR20)	SEM	n
SMSES	140.630	15.443	.761	7.550	40	110.975	22.986	.871	8.256	40
GMSES	25.375	4.436	.796	2.004	40	21.150	6.620	.803	2.938	40
SMAT	13.781	4.216	.733	2.178	41	15.522	5.540	.826	2.311	46

Note: SMSES= Specific math self-efficacy scale; GMSES= General math self-efficacy scale; SMAT= Subsequent math achievement and Cronbach alpha for the scales and KR₂₀ for the achievement tests.

3.6 Data Analysis

Based on the main questions of the study different statistical methods that enable to answer them were employed. Statistical techniques that include Pearson correlations and backward multiple regressions followed by F-tests were used to analyze the predictive utility of the variables. Moreover, t-tests were employed to see mean scores differences across grade levels and sexes. The analyses were made using SPSS.

CHAPTER FOUR

RESULTS AND DISCUSSION

In this part of the paper the major findings are presented and discussed. The presentation includes the chi-square test of homogeneity, Pearson correlations, linear multiple regressions and t-tests for mean scores differences across comparable groups.

4.1 Results

4.1.1 Sources of Math Self-efficacy Development

The degree of the relationship between sources of self-efficacy and grade level is shown in the following chi-square distribution.

Table 4-1 **The chi-square distribution regarding source of self-efficacy and grade level**

Sources of Self-efficacy	Agreement of the Students							
	Grade 5 (n=156)				Grade 9 (n=157)			
	Low fo	Medium fo	High fo	X^2_{obt}	Low fo	Medium fo	High fo	X^2_{obt}
Previous experience	1	112	43	120.81	4	133	20	188.97
Vicarious experience	3	95	58	82.42	13	107	37	91.17
Verbal persuasion	4	82	70	67.85	16	66	75	38.62
Physiological states	46	70	40	9.69	64	79	14	44.27

Note. Where fo (observed frequency), fe (expected frequency) = 52 for grade 5 and 52.33 for grade 9.

As Table 4.1 indicated each chi-square obtained is greater than the critical value 5.99 at $P=.05$ with degrees of freedom 2. The test statistics imply that the distribution of the students on the response categories was not the same.

4.1.2 Inter-correlations of the Variables Treated in the Study

To start with, the correlation matrices were presented for the sexes separately for the two grades.

Table 4-2 **Pearson correlations among the variables for boys and girls (Grade 5)**

Variable	PRME	SMSES	GMSES	SMAT
PRME	—	-.006	.084	.085
SMSES	.017	—	.282*	.433**
GMSES	-.148	.435**	—	.266*
SMAT	.140	.184	.111	—

Note. PRME = Previous math experience; SMSES= Specific math self- efficacy; GMSES= General math self-efficacy; SMAT= Subsequent math achievement

** p=0.01,*p= 0.05

The coefficients above the diagonal stand for boys (n=78) and that are below for girls (n=78).

Table 4.2 depicted that only the correlation coefficient between specific math self-efficacy and general math self-efficacy was positive and statistically significant ($r=.435$, $p=.01$ with $df=76$) on the 5th grade girls. Except one weak negative correlation ($r=-.148$) which was obtained between previous math experience and general math self-efficacy others were very low positive correlations. Among boys of 5th grade three statistically significant correlations (at $p \leq .05$ with $df=76$) were obtained. These coefficients were $r=.282$ of specific math self-efficacy and general math self-efficacy, $r=.266$ of general math self-efficacy and subsequent math achievement, and $r=.433$ of specific math self-efficacy and subsequent math achievement. Moreover, all the coefficients were positive except that a negative but virtually zero ($r=-.006$) was obtained between previous math experience and specific math self-efficacy.

Table 4-3 **Pearson correlations among the variables for boys and girls**
(Grade 9)

Variable	PRME	SMSES	GMSES	SMAT
PRME	—	.327**	.326**	.548**
SMSES	.353**	—	.528**	.635**
GMSES	.058	.401**	—	.403**
SMAT	.440**	.673**	.276*	—

Note. PRME = Previous math experience; SMSES= Specific math self- efficacy; GMSES= General math self-efficacy; SMAT= Subsequent math achievement
** p=0.01, *p= 0.05
The coefficients above the diagonal stand for boys (n=80) and that are below for girls (n=77).

Table 4.3 presented that the inter-correlations were positive and statistically significant at $p \leq .05$ with degrees of freedom 75 and 78 for girls and boys, respectively at grade 9. The exception was the non-significant correlation ($r = .058$) which was obtained between previous math experience and general math self-efficacy scale of girls. Besides, the correlations between specific math self-efficacy and subsequent math achievement ($r = .673$ for girls and $r = .635$ for boys) were fairly high.

Table 4-4 **Pearson correlations among the variables for the two Grades**
[(5th grade (n=156) and 9th grade (n=157))]

Variable	Sex	PRME	SMSES	GMSES	SMAT
Sex	-	.013	.014	-.009	.120
PRME	.146.	-	.005	-.025	.111
SMSES	.142	.352**	-	.360**	.308**
GMSES	.009.	.200*	.462**	-	.184*
SMAT	.167*	.514**	.658**	.341**	-

Note. PRME = Previous math experience; SMSES= Specific math self- efficacy; GMSES= General math self-efficacy; SMAT= Subsequent math achievement
**p=.01, * p=.05

Correlations above the main diagonal are for 5th graders and below it are for 9th graders.

Table 4.4 indicated that among the ten inter-correlations only three were statistically significant at $p \leq .05$ with degrees of freedom 154 for 5th graders. The significant correlations were that of specific math self-efficacy and general math self-efficacy ($r = .360$), between specific math self-efficacy and subsequent math achievement ($r = .308$), and between general math self-efficacy and subsequent math achievement ($r = .184$). Very low negative correlations $r = -.009$ between sex and general math self-efficacy and $r = -.025$ between sex and previous math experience were observed.

Among 9th graders, "sex" failed to have statistically significant correlation with the other three variables. But statistically significant correlation ($r = .167$, $p < .05$) was observed between sex and subsequent math achievement. The other six correlations were also statistically significant ($p \leq .05$). The highest correlation ($r = .658$) was obtained between specific math self-efficacy and subsequent math achievement.

4.1.3 Predictive Utility of Sex, Previous Math Experience and Math Self-efficacy

Multiple linear regressions were computed to calculate the coefficients of determinations. Continuing to the regressions backward and stepwise solutions had been used to identify the most important predictors among those considered.

Table 4-5 **Summary of backward multiple regression: Sex, GMSES, PRME, and SMSES as predictors of SMAT [grade 5, n=156]**

Model	Variables Entered	R	R ²	Change in R ²	Std. Error of the Estimate	F	Sig.
1	Sex, GMSES, PRME, SMSES	.356	.127	-	4.58	5.492	.000
2	Sex, PRME, SMSES	.346	.120	.007	4.58	6.913	.000
3	Sex, SMSES	.329	.108	.012	4.60	9.302	.000
4	SMSES	.308	.095	.013	4.62	16.183	.000

Note. PRME = Previous math experience; SMSES= Specific math self- efficacy; GMSES= General math self-efficacy; SMAT= Subsequent math achievement

The regression results of 5th graders depicted that the total coefficient of determination (R²) was .127. The 12.7 percent (F (4,151) = 5.492, p<.001) of the variance in subsequent math achievement was explained by the combined effects of sex, previous math experience, specific math self-efficacy, and general math self-efficacy. Further, the backward solution indicated that out of 12.7 percent of the variation 9.5 percent (74.80% of R²) was contributed by the powerful predictor specific math self-efficacy (β = .274, t= 3.363, p <.001). The other three, in combination, were responsible for the remaining 3.2 percent of variance (25.20% of R²) of which 1.3 percent (10.24% of R²) by sex, 1.2 percent (9.45% of R²) by previous math experience, and .7 percent (5.51% of R²) by general math self-efficacy. The beta coefficients of these predictor variables, sex, previous math experience, and general math self-efficacy were not statistically significant at p= .05. Due to this the stepwise solution excluded these variables and the only powerful predictor selected at last was specific math self-efficacy with R²= .095, F (1,154) = 16.183, p<.001 and β = .308, t= 4.023, p<.001.

To reach at genuine result another test statistic was used to test the difference between the coefficients of determination. The F-test was

computed for the difference in R^2 of the selected predictor specific math self-efficacy with the R^2 of the other three variables sex, previous math experience, and general math self-efficacy. Finally, the computed value $F=1.84$ did not exceed $F_{crit} = 2.65$ at $p= .05$ with degrees of freedom 3 and 151. The result implied that it was not necessary to include sex, previous math experience, and general math self-efficacy as predictor variables at 5th grade.

Table 4-6 **Summary of backward multiple regression: Sex, GMSES, PRME, and SMSES as predictors on SMAT [Grade 9, n=157]**

Model	Variables Entered	R	R^2	Change in R^2	Std. Error of the Estimate	F	Sig.
1	Sex, GMSES, PRME, SMSES	.726	.527	-	3.69	42.344	.000
2	Sex, PRME, SMSES	.725	.526	.001	3.69	56.608	.000
3	PRME, SMSES	.724	.524	.002	3.68	84.838	.000
4	SMSES	.658	.433	.091	4.00	118.530	.000

Note. PRME = Previous math experience; SMSES= Specific math self- efficacy; GMSES= General math self-efficacy; SMAT= Subsequent math achievement

Among 9th graders the total coefficient of determination (R^2) was .527. In other words, 52.7 percent ($F(4,152) = 42.344, p<.001$) of the variation of subsequent math achievement was accounted for by the combined effects of sex, previous math experience, specific math self-efficacy, and general math self-efficacy. Where the contribution share for the variability was 43.3 percent (82.16% of R^2) by specific math self-efficacy, 9.1 percent (17.27% of R^2) by previous math experience, .2 percent (.38% of R^2) by sex, and .1 percent (.19% of R^2) by general math self-efficacy.

The selected predictor variables were, therefore, previous math experience and specific math self-efficacy scale since their beta coefficients ($\beta = .316$, $t=5.260$, and $\beta = .524$, $t= 7.899$, $p<.001$), considered respectively were statistically significant. It is possible to note further that the latter was more powerful predictor than the former.

The F-test computed to see the significance of the difference in R^2 for the non significant predictor variables revealed that it was unnecessary to include sex and general math self-efficacy in the model of prediction. This is suggested because the computed $F=.482$ did not exceed $F_{crit}= 3.04$ at $p=.05$ for 2 and 152 degrees of freedom.

In the final analysis, the two predictor variables, previous math experience ($\beta =.322$, $t= 5.424$, $p<.001$) and specific math self-efficacy ($\beta=.545$, $t=9.174$, $p<.001$) accounted for the 52.4 percent (99.4% of R^2) of the variance of the criterion variable-subsequent math achievement.

4.1.4 Grade Level Differences in the Variables Treated in the Study

Mean differences across the two grades were compared using independent t-tests for each sex group separately and later as a group.

Table 4-7 Grade level differences on the variables treated in the study

Variable	Grade 5 Girls (n=78)		Grade 9 Girls (n=77)				Grade 5 Boys (n=78)		Grade 9 Boys (n=80)			
	M	SD	M	SD	t-test	Sig.	M	SD	M	SD	t-test	Sig.
PRME	75.936	7.330	66.110	8.394	7.765	.000	76.141	8.725	68.719	9.365	5.152	.000
SMSES	137.692	23.307	115.870	27.757	5.303	.000	138.321	23.411	123.825	27.898	3.533	.001
GMSES	25.500	3.748	23.468	5.298	2.760	.006	25.436	3.566	23.562	5.226	2.625	.010
SMAT	14.667	4.818	13.312	4.788	1.756	.081	15.821	4.823	15.075	5.642	0.891	.374

Note. PRME = Previous math experience; SMSES= Specific math self- efficacy; GMSES= General math self-efficacy; SMAT= Subsequent math achievement

df= 153 (for girls)

df= 156 (for boys)

The values of t-tests presented in Table 4.7 showed that girls of 5th graders excelled girls of 9th graders in previous math experience, specific math self-efficacy, and general math self-efficacy ($p < .01$). But the difference concerning subsequent math achievement ($t(153) = 1.756, p > .05$) failed to be statistically significant. However, the difference is in favor of 5th graders. Similarly as it is presented in the same table, the t-computed values indicated that boys of 5th grade scored higher than boys of 9th grade in previous math experience, specific math self-efficacy, and general math self-efficacy ($p < .05$). But they scored nearly comparably ($t(156) = .891, p > .05$) in subsequent math achievement.

Table 4-8 **Grade level differences on the variables (Boys and Girls combined)**

Variable	Grade 5 (n=156)		Grade 9 (n=157)			
	M	SD	M	SD	t-test	Sig.
PRME	76.038	8.032	67.439	8.969	8.933	.000
SMSES	138.010	23.286	119.920	28.025	6.207	.000
GMSES	25.470	3.646	23.520	5.245	3.821	.000
SMAT	15.240	4.840	14.210	5.301	1.801	.073

Note. PRME = Previous math experience; SMSES= Specific math self- efficacy; GMSES= General math self-efficacy; SMAT= Subsequent math achievement
df= 311

Reconsidering the two groups totally (with out controlling sex), the differences were in favor of fifth graders. As Table 4.8 depicted only the difference in subsequent math achievement did not reach statistically significant level ($t(311) = 1.801, p > .05$).

4.1. 5 Sex Differences in the Variables Treated in the Study

T-tests calculated for sex differences served to make comparisons.

Table 4-9 T-tests for sex differences on the variables treated in the study

Variable	Grade 5						Grade 9					
	Girls (n=78)		Boys (n=78)				Girls (n=77)		Boys (n=80)			
	M	SD	M	SD	t-test	Sig.	M	SD	M	SD	t-test	Sig.
PRME	75.936	7.330	76.141	8.725	-.159	.874	66.110	8.394	68.719	9.365	-.1835	.068
SMSES	137.692	23.307	138.321	23.411	-.168	.867	115.870	27.757	123.825	27.898	-1.791	.075
GMSES	25.500	3.748	25.436	3.566	.109	.913	23.468	5.298	23.563	5.226	-.113	.910
SMAT	14.667	4.818	15.821	4.823	-1.495	.137	13.312	4.788	15.075	5.647	-2.106	.037

Note. PRME = Previous math experience; SMSES= Specific math self- efficacy; GMSES= General math self-efficacy; SMAT= Subsequent

math achievement

df= 154 (grade 5)

df= 155 (grade 9)

Table 4.9 presented that girls and boys of 5th grade were comparable in the measures previous math experience, specific math self-efficacy, and general math self-efficacy. Relatively, large difference was observed in favor of boys in subsequent math achievement though it did not reach statistically significant level ($t(154) = 1.495, p > .05$).

Among 9th graders the differences computed tended to indicate that boys were superior to girls in all the measures. But except the difference in subsequent math achievement ($t(155) = 2.106, p = .05$) others failed to be statistically significant at $p = .05$.

4.2 Discussion

4.2.1 Sources of Math Self-efficacy Development

In assessing sources of math self-efficacy development, the respondents' agreement varied across the response categories. Based on their response, the order of their influence tends to decrease from previous experience to physiological states in both grades. That is, the chi-square distribution indicated that previous experience took the first rank and the physiological states the last whereas vicarious experience and personal persuasion the intermediate. This order of the respondents' agreement is consistent with the order suggested by Bandura (1977). To note again, among 5th graders only one respondent agreed to the option that previous experience has low impact on the development of math self-efficacy. Similarly, four 9th graders who are 48 fewer than the expected showed their agreement to the low influence of math previous experience. Physiological states as sources of math self-efficacy development were judged as least influential by forty-six 5th graders who are 6 fewer than the expected and by sixty-four 9th graders who are 12 more than the expected.

The data suggest that students are more dependent on their former performance. It is appropriate, therefore, to induce learners that they should be dependent on their own competency so that their efficacy on math will be enhanced.

4.2.2 Predictive Utility of Sex, Previous Experience, and Self-efficacy

In this study, two measures of math self-efficacy were considered. These were specific math self-efficacy scale which was developed at topics level and general math self-efficacy scale developed at more general subject level.

In analyzing the predictive power of sex, previous math experience, specific math self-efficacy, and general math self-efficacy to the criterion variable-subsequent math achievement the two grade levels were taken separately.

At 5th graders sex, previous experience in math, and general math self-efficacy failed to predict subsequent math achievement. Non predictive power of previous math experience to subsequent math achievement contradicted with the argument that prior mastery experience is the most potent source of influence on perceptions of efficacy (Bandura, 1977; Bong, 1997; Pietsch, *et al.*, 2003). Moreover, the result contradicted with Norwich's (1987) study from England that reported that prior math performance made significant contribution to predict subsequent task performance among elementary school learners of 9 & 10 years of age.

The non-significant predictive power of previous math experience might be because the measures collected at the teacher-scored results of 2nd and 3rd grades suffer from measurement problems. The automatic promotion given to primary school pupils throughout grade 4 may also have been wrongly implemented. That is, students may transfer to the next grade level without adequate assessment of their knowledge and skill. Such improper

implementation of continuous assessment might have spoiled the students' achievements, and the scores may fail to represent the students' true ability. Past performance by itself may not convey message to learners unless it is interpreted as a reflection of actual ability. Bandura (1986) argued that people are more influenced by how they interpret their experience than by their attainments per se. Due to this argument past experience predicts future performance less than self-efficacy. Or prior experience influences subsequent behaviour largely through its effect on self-efficacy beliefs and these can influence performance without past behaviour (Pajares & Miller, 1994).

Like previous math experience, general math self-efficacy did not predict subsequent math achievement at 5th grade. The cognitive assessment students made in responding for the items like "I can do math class works well" might lack correspondence with the items that include specific math problems in the subsequent math achievement. As Pajares & Miller (1994) cautioned, failing to make clear correspondence between efficacy items and the measure of performance leads to get weak predictive power of efficacy.

Though Chemers, *et al.*, (2001) stated that academic self-efficacy has predictive power above and beyond more objective measures such as past performance on academic tasks, the opposite happened in this study. The self-efficacy measure called general math self-efficacy made 0.7 percent of increment in the variation by far less than the increment 1.2 percent contributed by previous math experience.

However, the most important predictor was specific math self-efficacy. In other words, there was a greater degree of correspondence between the topic specific items of efficacy and the subsequent achievement measure developed on the very topics. The variance of subsequent math achievement accounted for by specific math self-efficacy was 9.5 percent which was

74.80% of the total variance. This finding is consistent with many research reports (e.g., Randhawa, *et al.*, 1993; Pietsch, *et al.*, 2003). The finding, too, confirmed the argument of Pajares and Miller (1994) stated that correspondence between the efficacy items and the performance measure enhances the predictive power of the efficacy measures. Suggesting that items of the specific math self-efficacy measure were more appropriate than that of the general math self-efficacy one.

Coming to 9th graders like to 5th graders sex and general math self-efficacy were not significant predictors of subsequent math achievement. But previous math experience, which was not important predictor at 5th grade, found to be an important predictor at 9th grade. Among grade 9 students previous math experience which was the average measure of grades 6 and 7 math final results contributed 9.1 percent of the variation of subsequent math achievement. In comparing the contribution of previous math experience between 5th and 9th graders, it can be suggested that as students go through higher grade levels their teacher-scored results are likely to predict future performances. In short, the measure taken from 6 and 7 grade levels tended to be more reliable than that was taken from grades 2 and 3. Strengthening the finding obtained at 5th grade, measure of specific math self-efficacy found to contribute more significantly than previous math experience at grade 9. The variance of subsequent math achievement contributed by specific math self-efficacy was 43.3 percent which was 82.16% of the total variance.

The finding that was observed here that specific math self-efficacy as strong predictor of math achievement is consistent with other findings (e.g., Randhawa, *et al.*, 1993; Chemers, *et al.*, 2001; Pietsch, *et al.*, 2003). Once again, specific math self-efficacy was more responsible for predicting subsequent math achievement at 9th grade than at 5th grade. The variance in subsequent math achievement accounted for by specific math self efficacy

was 43.3 percent at 9th grade but at 5th grade the variance was 9.5 percent. This finding suggests that students at lower grades are less accurate in judging or reporting their belief in their capability than those at higher grades. The inaccurate cognitive assessment that younger students make may reduce the predictive power of self-efficacy because self-efficacy beliefs deal primarily with cognitive perceptions of capability Bong & Clark (1999) as cited in Pietsch, *et al.* (2003). Hence, researchers need to establish the factors that encourage the development and maintenance of positive self-perceptions and beliefs, especially for that of academic self-efficacy from the early years of preschool, elementary school and secondary school right through to postsecondary education (Chemers, 2001).

4.2.3 Grade Level Differences in Math Self-efficacy

Grade 5 students surpassed grade 9 students in general and specific math self-efficacy ($t(311) = 3.821$, $t(311) = 6.207$, $p < .001$), respectively. This finding nullified the hypothesis that stated as students who have longer experiences in math are expected to have higher sense of math self-efficacy than less experienced ones. Contradictory to this finding Bong's (2001) study among Korean students revealed that high school students demonstrated more differentiated math self-efficacy than did middle school across both sexes. Zimmerman and Martinez-Pons (1990), too, reported that high school students exceeded elementary school ones in math self-efficacy where the students were sampled from the middle-class homes of New York City.

The contradictory observation investigated among the students of Debre Birhan town may be due to different factors. For instance, the differences in educational services in Debre Birhan, Korea and New York City may be responsible for the contradictory findings. The cultural and socio-economical disparities, too, may be the sources for the lack of agreement.

Besides, the differences on the scales of measurement used, the nature of the school that the students were selected from (e.g., Zimmerman and Martinez-Pons took some of their samples from one gifted school), and grade levels considered may have been the causes for the observed contradictory findings of these studies.

Another possible explanation is the frustration that 9th graders face due to the change of language of instruction from Amharic to English. The participants of this study have been attending their lessons in Amharic till they join 9th grade. So this change of medium of instruction may lead them to be more restricted and frustrated in their confidence in math.

Another disharmony of the findings of the study is that even though elementary school students found to be more confident than high school ones, the predictive power of the self-efficacy measure found less powerful at 5th graders. In other words, 5th graders made inaccurate personal judgment of competence as compared to 9th graders. One possible explanation for this finding is that elementary school students make relatively poor cognitive assessment than high school students.

4.2.4 Gender Differences in Math Self-efficacy

Boys and girls of 5th grade scored comparably in both general and specific math self-efficacy measures. The finding of this study is consistent with that of Zimmerman and Martinez-Pons (1990) who reported comparable math self-efficacy between boys and girls of 5th graders in New York City. Gender gap in math self-efficacy in elementary schooling is not commonly observed (Eccles, 1983) as cited in Pajares (1997).

Coming to 9th graders, boys and girls were found comparable in general math self-efficacy. But in specific math self-efficacy the mean score of boys

was higher than that of girls, but not significantly so. This observation may not be surprising because researchers as Zimmerman and Martinez-Pons (1990) reported comparable scores in math self-efficacy between females and males at the 11th grade level. However, this finding contradicted with the well established gender differences in favor of boys in math self-efficacy among high school students (e.g., Bong, 1997; Mittelberg & Lev-Ari, 1999; Randhawa, *et al.*, 1993). At high school level, boys are more confident than girls in their math capability (Eccles, 1983) as cited in Pajares (1997). Even though the gap is not statistically significant the observed relatively large difference will lead girls not to compete as their male counterparts. Hence, to enable girls to cope up with math courses as well math-related jobs in their future lives, there is a need of developing mechanisms that enhance their math confidence. The factors that discourage high school females from developing strong sense of confidence as their male counterparts are worthy of careful study (Chemers, *et al.*, 2001).

The stronger the sense of personal efficacy, however, the greater the perseverance and the higher the likelihood that the chosen activity will be performed successfully (Bandura, 2001). Bringing this into academic settings, students who are high in academic self-efficacy make greater use of effective cognitive strategies in learning, manage their time and learning environments more effectively, and are better at monitoring and regulating their own effort (Chemers, *et al.*, 2001). On the contrary, perceptions of inefficacy in mathematics would lead learners to reduced levels of motivation and lessen their engagement in math and math-related courses (Randhawa, *et al.*, 1993). Due to this it is necessary to help girls at Debre Berhan high school to become equally efficacious as boys so that their academic achievement will be enhanced, too.

In general, the findings of this study tally with the conclusion of Pintrich and De Groot, (1990) stating that recent findings suggest that boys and girls

report equal confidence during the elementary years but, by middle and high school, boys show high confidence.

4.2.5 Gender Differences in Math Achievement

Gender differences in math achievement have been reported repeatedly in favor of boys in local studies conducted in elementary and high schools (e.g., Seleshi, 1995; Yoseph, 1997; Adamu, 2004). However, contradictory findings were obtained in this study. In previous math experience collected from 2nd and 3rd grades recorded results, boys and girls were comparable. Similarly in the measure called subsequent math achievement which was developed by the investigator, significant gender gap was not observed at 5th grade. There was, of course a tendency that boys were superior to girls ($t(154) = 1.495, p > .05$).

In foreign studies gender differences in math achievement in elementary schools are contradictory. Hence, the findings of this study were in agreement with some studies (e.g., Hilton & Berglund, 1974; Sherman, 1980) and inconsistent with other studies (e.g., Marshall & Smith, 1987; Mills, *et al.*, 1993).

In previous math experience collected from grades 6 and 7 results somewhat larger gap between mean scores of boys and girls than 5th graders previous experience or subsequent math achievement was observed in favor of boys. However, the difference ($t(155) = 1.835, p > .05$) was not statistically significant. Among all the comparisons made, significant gender difference in subsequent math achievement ($t(155) = 2.106, p < .05$) appeared at 9th grade in favor of boys where this phenomenon is consistent with other studies reported at high school level (e.g., Hilton and Berglund, 1974; Sherman, 1980; Randhawa, *et al.*, 1993).

For the contradictory findings of this study it seems important to summarize some issues. One problem in gender research in math achievement is inability of identifying the grade level or year that the difference appears for the first time and the direction of the difference. The age at which gender differences first appear in math reasoning and the direction of such differences differ from one study to another (Mills, *et al.*, 1993). With this controversy, however, many literatures recommended that the gap increases with age (grade level) in favor of boys but when it starts is not still well identified. In response of this issue Beller and Gafni (1996) attempted to study among young students and reached at the conclusion that gender gap becomes wider as age increases in that at age 13 boys performed better than girls but at age 9 there was no performance gap. Supporting this pattern Fennema & Sherman (1978) as cited in Pajares & Miller (1994) discussed that some findings showed that children did not differ in their math performance during elementary school but they began to appear in middle school and increased with time and schooling in favor of boys (men). The same pattern appeared in this study where the t-values increased with grade level. Table 4.10 indicated the pattern clearly.

Table 4-10 **The increment of t-values calculated for gender gap in math achievement across the grade levels**

Grade	2&3	5	6&7	9
t-computed	.159(ns)	1.495 (ns)	1.835 (ns)	2.106 (s)

Note. The differences are in favor of boys; s= significant at $p=0.05$; ns= not significant at $p=0.05$

The gender gap obtained at high school level in subsequent math achievement might be attributed to different factors. Girls joining high school may take high responsibilities to home tasks more than they were at elementary school. Hence, they might be preoccupied in home activities more than boys. The other possible explanation is that as girls grow in

schooling they start to be more sensitive to social influences that impose them by taking math as a masculine subject. Peers, parents, and teachers tended to hold lower expectations for girls than for boys in math (Seleshi, 1995). Similarly, Adamu (2000) reported that teachers expect better participation and performance from boys than from girls among pupils of grades 5 through 8. Such biased and wrong expectations of peers, parents, and teachers that girls cannot achieve equally as boys in courses like math may prevent girls from studying with their maximum effort. In other words their academic motivation decreases. Moreover, Seleshi (1995) reported that the gender gap in math achievement among students of grades 8 through 11 was due to gender difference in attitude. That is, females were found to have lower positive attitude towards math as compared to males and this contributed to their lower achievement in the subject. Adamu (2004), too, reported that boys were superior to girls in math self-esteem, and that math self-esteem and math achievement were positively and significantly related. Still, in the present situation, further studies are needed to fully identify the underlying factors for the gap so that interventions can be designed.

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.1 Summary and Conclusion

Based on the Bandura's contention that self-efficacy plays a significant role in affecting individual's learning, the present study was designed to deal with this construct and math achievement. A number of studies supported Bandura's theory that self-efficacy is a variable that influences human behaviour. In spite of the fact that self-efficacy determines students' academic motivation and achievement, no local studies are conducted in this area especially in mathematics learning beginning from elementary school.

This study was then targeted in investigating the interplay of math-self-efficacy with other related variables among students of grades 5 and 9 of Debre Birhan town schools. To achieve this end, the following main questions were stated in the beginning of the study.

- Do students of grades 5 and 9 differ with respect to the influence of the sources of math self-efficacy development?
- Do sex, previous math experience and math self-efficacy predict subsequent math achievement among 5th and 9th graders?
- Do 9th graders differ significantly from 5th graders in math self-efficacy?
- Do girls and boys of grades 5 and 9 differ significantly in math self-efficacy and achievement?

To answer these questions 156 (78 girls and 78 boys) from grade 5 and 157 (77 girls and 80 boys) from grade 9, totally, 313 students were selected.

The measures used were documentary evidences, questionnaires, and achievement tests. The collected data were analyzed using chi-square, linear multiple regression, and t-test.

The results in the final analysis showed that:

- Students reported that among the sources of math self-efficacy development, previous experience took the first line and physiological states the last, while vicarious experience and verbal persuasion the intermediate.
- Among 5th graders only specific math self-efficacy made positive and significant contribution in predicting subsequent math achievement. Sex, previous experience and general math self-efficacy did not.
- Among 9th graders previous math experience and specific math self-efficacy predicted subsequent math achievement positively and significantly but sex and general math self-efficacy did not.
- The means of 5th graders on specific math self-efficacy and general math self-efficacy were significantly higher than those of 9th graders.
- The means of girls and boys on previous math experience, specific math self-efficacy and general math self-efficacy were comparable at 5th grade. The mean of boys on subsequent math achievement was higher than that of girls but failed to be statistically significant at $p=.05$.
- Among 9th graders non-significant mean differences in favor of boys were observed on previous math experience, specific math self-efficacy, and general math self-efficacy. However, boys excelled girls significantly in subsequent math achievement.

5.2 Recommendations

In light of the findings of this study the following recommendations were suggested in reference to Debre Birhan town schools.

- Parents should not be biased against females in assigning home tasks and in supporting the academic progress of boys and girls.
- School counselors, in collaboration with school directors, teachers and parents, should ensure that girls and boys have equal access to materials like textbooks.
- Teachers and school counselors should help students become confident of their own performance. This can enhance their sense of efficacy and future performance in math.
- High school directors and counselors should device interventions to narrow down the gender gap observed in math achievement.
- Further investigations are warranted especially to identify when the gender gap appears in math self-efficacy and achievement so that early interventions can be made.
- More salient psychological variables such as self-concept, attitude and anxiety should be included in future studies to investigate the causal relationships of the variables.

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APPENDICES

Appendix A

A list of Targeted Schools of Debre Birhan Town

1. Model Number-1 Elementary School (Grades 1- 6)
2. Model Number-2 Elementary School (Grades 1- 6)
- *3. Baso Elementary School (Grades 1- 6)
4. Andnet Elementary School (Grades 1-8)
5. Atse Zerayacob General Elementary School (Grades 1-8)
- *6. Biruh Tesfa General Elementary School (Grades 1-8)
7. Tebasie Elementary School (Grades 1-8)
- *8. Debre Birhan General Secondary School (Grades 9 and 10)

Note. * Indicates Sample Schools

Appendix B

Group Statistics

Variable	Grade	n	Mean	Std. Dev.	Min.	Max.	Possible Max.
PRME	5	156	76.038	8.032	60.5	93.0	100
	9	157	67.439	8.969	50.5	92.0	100
SMSES	5	156	138.010	23.286	75	174	174
	9	157	119.920	28.025	60	172	174
GMSES	5	156	25.470	3.646	14	30	30
	9	157	23.520	5.245	8	30	30
SMAT	5	156	15.240	4.840	5	28	30
	9	157	14.210	5.301	3	28	30

Note. PRME = Previous math experience; SMSES= Specific math self- efficacy; GMSES= General math self-efficacy; SMAT= Subsequent math achievement

Appendix C

በአዲስ አበባ ዩኒቨርሲቲ የድህረ ምረቃ ት/ቤት የላይኮሎጂ ትምህርት ክፍል

ለአምስተኛ ክፍል ተማሪዎች የቀረበ መጠይቅ

ውድ ተማሪዎች:-

ይህ መጠይቅ በሒሳብ ትምህርት ሂደት ላይ መረጃዎችን ለማሰባሰብ ሲባል የተዘጋጀ ነው። የሚሰበሰበው መረጃ ለጥናታዊ ስራ ብቻ ይውላል። በእናንተ የሒሳብ ውጤት ላይ ምንም አይነት ለውጥ አያመጣም። ነገርግን የጥናቱ ስኬታማነት በእናንተ ትክክለኛ መረጃ መስጠት ላይ ስለሚወሰን መልሳችሁን በተገቢው መንገድ እንድትሰጡ ከወዲሁ ከምስጋና ጋር ትጠየቃላችሁ።

ሴክሽን -----

የክፍል ቁጥር-----

ዎታ:- ወንድ

ሴት

ስም መጻፍ አያስፈልገውም!

ክፍል አንድ:-

መመሪያ:- በዚህ መጠይቅ የተለያዩ የሒሳብ ተግባራት ተዘርዝረዋል። ከተራ ቁጥር 1 እስከ 29 ለተዘረዘሩት ተግባራት አሁኑኑ እንድትሰሩ ብትጠየቁ በችሎታችሁ ያላችሁን የመተማመን ደረጃ ከ 0 እስከ 6 ካሉት የደረጃ ተወካይ ቁጥሮች ውስጥ እየመረጣችሁ ከእያንዳንዱ ተግባር ፊት ለፊት በመጻፍ አመልክቱ። ከተራ ቁጥር 30 እስከ 34 ለተዘረዘሩት ተግባራትም እንዲሁ አሁን ባላችሁበት የክፍል ደረጃና የትምህርት ጊዜ ምን ያክል ማከናወን እንደምትችሉ ከ 0 እስከ 6 በመምረጥ አመልክቱ።

የቁጥሮቹ ውክልና የሚከተለው ነው።

0	1	2	3	4	5	6
በፍሁም አልችልም	በትንሽ ርግጠኝነት እችላለሁ	በመለስተኛ (በመጠኛ) ርግጠኝነት እችላለሁ	በመካከለኛ ርግጠኝነት እችላለሁ	በርግጠኝነት እችላለሁ	በከፍተኛ ርግጠኝነት እችላለሁ	በሙሉ ርግጠኝነት እችላለሁ

	0	1	2	3	4	5	6
1. በኪ.ግ የተሰጠን ሙሉ ቁጥር ወደ ግራም መቀየር እችላለሁ።							
2. በ ሜ. የተሰጠን ቁጥር ወደ ኪ.ሜ መቀየር እችላለሁ።							
3. በአሀዘ የተጻፉ ሙሉ ቁጥሮችን በፊደል መጻፍ እችላለሁ።							
4. በፊደል የተጻፉ ሙሉ ቁጥሮችን በአሀዘ መጻፍ እችላለሁ።							
5. የአንድን ሙሉ ቁጥር ተከታይ መፈለግ እችላለሁ።							
6. የአንድን ሙሉ ቁጥር ቀዳሚ መፈለግ እችላለሁ።							
7. የሆሌዎችን የቁጥር ቤት ዋጋ መለየት እችላለሁ።							

ክፍል ሁለት

የግል ሁኔታ መጠይቅ

መመሪያ:- የሚከተሉትን ስለ ወላጆች የሚጠይቁ መረጃዎች ተገቢ መልስ ያያዘውን ፊደል በማክበብ አመልክቱ::

ሀ. የወላጆች የትምህርት ሁኔታ

የእናት የትምህርት ደረጃ:-

- ሀ. ምንም ያልተማረች
- ለ. መሰረተ ትምህርት
- ሐ. አንደኛ ደረጃ
- መ. ሁለተኛ ደረጃ
- ሠ. ሠርተፊኬት (10+1 ወይም 12+1)
- ረ. ዲፕሎማ እና ከዚያ በላይ

የአባት የትምህርት ደረጃ:-

- ሀ. ምንም ያልተማረ
- ለ. መሰረተ ትምህርት
- ሐ. አንደኛ ደረጃ
- መ. ሁለተኛ ደረጃ
- ሠ. ሠርተፊኬት (10+1 ወይም 12+1)
- ረ. ዲፕሎማ እና ከዚያ በላይ

ለ. የወላጆች መኖሪያ

እናት:- ሀ. ገጠር

ለ. ከተማ

አባት:- ሀ. ገጠር

ለ. ከተማ

ሐ. የወላጆች የስራ ሁኔታ

እናት:- ሀ. የቤት እመቤት

ለ. ነጋዴ

ሐ. የግል ድርጅት ሰራተኛ

መ. የመንግስት ሰራተኛ

አባት:- ሀ. ገበሬ

ለ. ነጋዴ

ሐ. የግል ድርጅት ሰራተኛ

መ. የመንግስት ሰራተኛ

ክፍል ሦስት

መመሪያ፡- ተማሪዎች በሒሳብ ትምህርት ችሎታቸው ያላቸው በራስ የመተማመን ደረጃ ይለያያል። እንዳንዶቹ ክፍተኛ በራስ የመተማመን ደረጃ ሲኖራቸው እንዳንዶቹ ደግሞ በተቃራኒው ዝቅተኛ ይኖራቸዋል። ይህ ልዩነትም ከዚህ በታች ከ 1-6 ከተዘረዘሩት ምንጮች ይመሰረታል ተብሎ ይታመናል። በመሆኑም እናንተ በአሁኑ ጊዜ ባላችሁ የሒሳብ ትምህርት በራስ መተማመን የእያንዳንዱን አስተዋፅዖ በራሳችሁ እይታ በማጤን የምትስማሙበትን ከተሰጡት የደረጃ አማራጮች ውስጥ በማክበብ አመልክቱ።

	ዝቅተኛ (1)	መጠነኛ (2)	ከፍተኛ (3)
1. በሒሳብ የፈተና ውጤቱ እና አጠቃላይ አሰራሪ ከእናቱ የሚሰጠኝ ድጋፍና አስተያየት።	1	2	3
2. በሒሳብ የፈተና ውጤቱ እና አጠቃላይ አሰራሪ ከአባቱ የሚሰጠኝ ድጋፍና አስተያየት።	1	2	3
3. በየክፍል ደረጃው የክፍል ጓደኞቹ በሒሳብ ትምህርት ያላቸውን አቀባበልና አሰራር ከራሴ ጋር በማወዳደር።	1	2	3
4. ከሒሳብ ትምህርት አቀባበልና ከማስመዘገብው ውጤት አንጻር መምህራን የሚሠጡኝ ማበረታቻና አስተያየት።	1	2	3
5. የሒሳብ ትምህርት በምማርበት ጊዜና የፈተና ወይም የመልመጃ ጥያቄዎች ሲቀርቡልኝ ከሚሰማኝ ውስጣዊ እንደ ፍርሃት እና ጭንቀት አይነት ስሜቶች።	1	2	3
6. በየጊዜው እና በየክፍል ደረጃው የማስመዘገብው የሒሳብ ውጤት።	1	2	3

Appendix D

Addis Ababa University

School of Graduate Studies

Department of Psychology

Descriptive Questionnaire for Grade 5 Students

Dear students,

The purpose of this questionnaire is to collect information about your mathematics learning. The data to be collected will serve only for research purpose. It will not make any change in your mathematics result. The quality of the research depends on your genuine answers. So be frank, please.

Thank you in advance!

Section _____ Roll. No. _____

Sex: Male Female

No need of writing name!

Part I

Direction: The attached form lists different mathematical activities. For the statements 1 through 29 rate how sure you are that you can do them as of now and for the statements 30 through 34 rate how sure you are that you can do them currently under the column confidence. Rate your degree of confidence by recording a number from 0 to 6 using the scale given below.

0	1	2	3	4	5	6
Not sure at all	Less sure	Some what sure	Moderately sure	Sure	Very sure	Completely sure

	Confidence
1. I can change a whole number given in kg to g.	
2. I can change a whole number from m to km.	
3. I can write decimals in words.	
4. I can write whole numbers that are written in words in decimals.	
5. I can find immediate successor of a whole number.	
6. I can find what precedes a whole number	
7. I can identify place values of digits.	

0	1	2	3	4	5	6
Not sure at all	Less sure	Some what sure	Moderately sure	Sure	Very sure	Completely sure

	Confidence
8. I can change whole numbers form expanded notation to decimal notation.	
9. I can change whole numbers from decimal notation to expanded notation.	
10. I can compute sums of whole numbers.	
11. I can compute differences of whole numbers.	
12. I can write whole numbers in powers.	
13. I can multiply fractions by powers of 10.	
14. I can compute products of whole numbers.	
15. I can compute divisions of whole numbers.	
16. I can compare whole numbers given in the from of powers.	
17. I can compute whole numbers involving different operations.	
18. I can list factors of a whole number.	
19. I can find remainders by dividing whole numbers.	
20. I can identify whole numbers that are divisible by 3.	
21. I can find HCF of two whole numbers.	
22. I can find $\frac{1}{4}$ of a whole number.	
23. I can inter change units of measurement of time.	
24. I can change units of measurement.	
25. I can find LCM of two whole numbers.	
26. Given mathematics results of ten students, I can find their mean result.	
27. I can find solutions of mathematical linear equations	
28. I can find solutions of inequalities.	
29. I can solve mathematical word problems.	
30. I can do mathematics class works well.	
31. I can do mathematics home works well.	
32. I can do matriematics tests well.	
33. I can get high marks in mathematics in my class.	
34. I can learn mathematics well.	

Pat II

Personal Information

Direction: The following statements are presented so that you provide some information about your parents. Hence, give your answers by circling the letter of your choice.

A. Educational Background of Parents

Mother's educational level

- A. Illiterate
- B. Basic education
- C. Primary education
- D. Secondary Education
- E. Certificate (10+1 or 12+1)
- F. Diploma and Above

Father's educational level

- A. Illiterate
- B. Basic education
- C. Primary education
- D. Secondary Education
- E. Certificate (10+1 or 12+1)
- F. Diploma and Above

B. Residence of Parents

B. Mother's Residence

- A. Rural
- B. Urban

B. Father's Residence

- A. Rural
- B. Urban

C. Occupation of Parents

Mother's Occupation

- A. House wife
- B. Merchant
- C. Private institution worker
- D. Government employed

Father's Occupation

- A. Farmer
- B. Merchant
- C. Private institution worker
- D. Government employed

Part III

Direction: The possible sources for the development self-efficacy are presented below. You are requested to indicate your agreement on the influence of each of the sources on the development of your math self-efficacy. Hence, indicate your agreement level by circling either of the numbers of the options 1(low), 2(medium), and 3(high) by reading the statements carefully.

The confidence that I have by now on my capability in math is developed from:

	Low (1)	Medium (2)	High (3)
1. the suggestions and comments that I get from my mother	1	2	3
2. the suggestions and comments that I get from my father	1	2	3
3. observing my classmates while learning math and solving problems	1	2	3
4. the feedbacks my teachers provide me based on my performance in math	1	2	3
5. the physiological states (emotions) like heart beat changes and sweating that happen when I start to work on math class works or tests	1	2	3
6. my own performances obtained at different times on math assignments and tests.	1	2	3

Appendix E

ለአምስተኛ ክፍል ተማሪዎች የቀረበ የሒሳብ ፈተና

ስም _____ ክፍል _____ ቁጥር _____

አጠቃላይ መመሪያ:- ይህ ፈተና 30 ጥያቄዎችን ይዟል። ሁሉንም ጥያቄዎች በአንድ ሰዓት ውስጥ እንድትሰሩ ትጠየቃላችሁ።

መመሪያ አንድ:- ከዚህ በታች 25 ጥያቄዎች በምርጫ መልክ ቀርበዋል። ለእያንዳንዱ ጥያቄ አራት መልስ ይሆናሉ የተባሉ አማራጮች አሉ። በመሆኑም ለእያንዳንዱ ጥያቄ ትክክለኛ መልስ የያዘውን ፊደል በማክበብ መልሱ።

1. 3, 000, 173 በፊደል ሲጻፍ ከሚከተሉት በየትኛው ይወከላል?

ሀ. ሦስት ሚሊዮን አንድ መቶ ሰባ ሦስት

ለ. ሦስት መቶ ሺ አንድ መቶ ሰባ ሦስት

ሐ. ሠላሳ ሺ አንድ መቶ ሰባ ሦስት

መ. ሦስት ሺ አንድ መቶ ሰባ ሦስት

2. የአራት ሚሊዮን አራት መቶ ሺ አምስት መቶ ሠላሳ ስድስትን ትክክለኛ የአሀዝ አፃፍ ምረጡ።

ሀ. 4,040,536

ለ. 40,400,536

ሐ. 4,400,536

መ. 44,000,536

3. ከሚከተሉት አማራጮች የ 29,099 ተከታይ የትኛው ነው?

ሀ. 29,098

ለ. 29,100

ሐ. 29,010

መ. 30,100

4. በ 10, 352, 768 ውስጥ 3 የስንት ቤትን ያመለክታል?

ሀ. 1,000,000

ለ. 100, 000

ሐ. 10, 000

መ. 1,000

5. ከሚከተሉት አማራጮች ውስጥ የ 562,347 የአስር ርቢ ትንታኔ የትኛው ነው?

ሀ. $5 \times 10^7 + 6 \times 10^6 + 2 \times 10^5 + 3 \times 10^4 + 4 \times 10^2 + 7 \times 10^1$

ለ. $5 \times 10^6 + 6 \times 10^5 + 2 \times 10^4 + 3 \times 10^3 + 4 \times 10^2 + 7 \times 10^1$

ሐ. $5 \times 10^5 + 6 \times 10^4 + 2 \times 10^3 + 3 \times 10^2 + 4 \times 10^1 + 7 \times 10^0$

መ. $5 \times 10^4 + 6 \times 10^3 + 2 \times 10^2 + 3 \times 10^1 + 4 \times 10^0 + 7$

6. ከሚከተሉት አማራጮች ውስጥ የ $5 \times 10^6 + 3 \times 10^5 + 3 \times 10^3 + 2 \times 10^1 + 5 \times 10^0$ ተወካይ አሀዝ የትኛው ነው?

ሀ. 5,303,025 ለ. 5,300,325 ሐ. 5,330,025 መ. 53,325

7. $156,731 - 18,978 - 209 =$ -----

ሀ. 145,644 ለ. 137,644
ሐ. 147,644 መ. 137,544

8. አስር ተማሪዎች በሂሳብ ትምህርት ያስመዘገቡት ውጤት 60, 65, 52, 73, 80, 81, 44, 63, 52, 34 ቢሆን አማካይ ውጤታቸው ስንት ይሆናል?

ሀ. 55.5 ለ. 58.6 ሐ. 60.4 መ. 62.6

9. $4^3 =$ -----

ሀ. 7 ለ. 12 ሐ. 64 መ. 81

10. $15.65 \times 100 =$ -----

ሀ. 1565 ለ. 15650 ሐ. 156500 መ. 1565000

11. $7,341 \times 20 =$ -----

ሀ. 14682 ለ. 14782 ሐ. 146810 መ. 146820

12. ከሚከተሉት ትልቁ የትኛው ነው?

ሀ. 2^5 ለ. 3^4 ሐ. 4^2 መ. 5^2

13. $20 - 10 \times 12 =$ -----

ሀ. -120 ለ. -100 ሐ. 100 መ. 120

14. ከሚከተሉት የ 45 አካፋይ ያልሆነው የትኛው ነው?

ሀ. 5 ለ. 15 ሐ. 45 መ. 90

15. አንድ ኪሎ ግራም ብርቱካን 2.50 ብር ቢያወጣ በ ብር 2500.00 ምን ያህል ኪሎ ግራም ብርቱካን መግዛት ይቻላል?

ሀ. 1,500 ለ. 1,000 ሐ. 500 መ. 250

16. 263 ለ 4 ሲካፈል ቀሪው ስንት ይሆናል?

ሀ. 3 ለ. 2 ሐ. 1 መ. 0

17. ከሚከተሉት መሰረታዊ ቁጥሮች ውስጥ ለ 3 ተካፋይ የሆነው የትኛው ነው?

ሀ. 433 ለ. 251 ሐ. 476 መ. 462

18. $4860 \div 12 =$ -----

ሀ. 405 ለ. 406 ሐ. 425 መ. 450

19. የ 42 እና የ 45 ትልቁ ያጋራ አካፋይ ስንት ነው?

ሀ. 3 ለ. 5 ሐ. 6 መ. 9

20. የ 8 ቁጥር 1/4 ከንት ነው?

ሀ. 2 ለ. 1 ሐ. 1/2 መ. 1/4

21. 2:30 ወደ ሲኮንድ ሲቀየር ከንት ይሆናል?

ሀ. 900 ለ. 7,200 ሐ. 73,800 መ. 9,000

22. የ 35 እና የ 42 ትንሹ የጋራ ብዙት ከንት ነው?

ሀ. 140 ለ. 168 ሐ. 210 መ. 420

23. ከሚከተሉት ጥንድ ሙሉ ቁጥሮች ውስጥ ደምራቸው 156 ልዩነታቸው ደግሞ 34 የሚመጣ የትኞቹ ናቸው?

ሀ. 61 እና 95 ለ. 56 እና 100 ሐ. 62 እና 94 መ. 50 እና 106

24. $2 \times m - 5 < 5$ የሚለውን ዓረፍተ ነገር እውን የሚያደርገው የትኛው ነው?

ሀ. $m > 0$ ለ. $m > 5$ ሐ. $m < 5$ መ. $m < 10$

25. በ 22 ተባዝቶ 30 ተደምርበት ውጤቱ 470 የሚመጣ ቁጥር ከንት ነው?

ሀ. 25 ለ. 24 ሐ. 22 መ. 20

መመሪያ ሁለት:- ከዚህ በታች የቀረቡትን 5 ጥያቄዎች መልሱ::

1. 10 ኪ.ግ = ----- ግራም ነው::
2. 2000 ሜ = ----- ኪ.ሜ ነው::
3. የ439,670 ቀዳሚ ከንት ነው?-----
4. $5095 + 7065 + 40 =$ _____
5. $8 \times w - 2 = 30$ የወ ዋጋ ከንት ነው?

መልስ:-

የባዶ ቦታ መልሶች:-

- | | | | |
|-------|-------|-------|------------|
| 1. ሀ | 11. መ | 21. መ | 1. 10,000 |
| 2. ሐ | 12. ለ | 22. ሐ | 2. 2 |
| 3. ለ | 13. ለ | 23. ሀ | 3. 439,669 |
| 4. ለ | 14. መ | 24. ሐ | 4. 12,200 |
| 5. ሐ | 15. ለ | 25. መ | 5. 4 |
| 6. ሀ | 16. ሀ | | |
| 7. መ | 17. መ | | |
| 8. ሐ | 18. ሀ | | |
| 9. ሐ | 19. ሐ | | |
| 10. ሀ | 20. ሀ | | |

Appendix F

Mathematics Test for Grade 5 Students

Name _____ Section _____ Roll. No. _____

General Direction: This test paper contains 30 questions. Attempt all the questions. You are allowed to work on the test for 1 hour.

Direction I: The following are 25 mathematical questions. Each question is followed by four suggested alternatives (choices). Thus indicate the correct answer by circling the letter of your choice.

- When 3,000, 173 is written in words, it becomes:
 - Three million one hundred and seventy three
 - Three hundred thousand one hundred and seventy three.
 - Thirty thousand one hundred and seventy three
 - Three thousand one hundred and seventy three
- Which one of the following is the correct decimal representation of four million four hundred thousand five hundred and thirty six?
 - 4,040,536
 - 40,400,536
 - 4,400,536
 - 44,000,536
- Which one of the following whole numbers is the successor of 29,098?
 - 29,098
 - 29,100
 - 29,010
 - 30,100
- What is the place value of 3 in 10,352,768?
 - 1,000,000
 - 100,000
 - 10,000
 - 1,000
- Which of the following is the expanded notation of 562,247?
 - $5 \times 10^7 + 6 \times 10^6 + 2 \times 10^5 + 3 \times 10^4 + 4 \times 10^2 + 7 \times 10^1$
 - $5 \times 10^6 + 6 \times 10^5 + 2 \times 10^4 + 3 \times 10^3 + 4 \times 10^2 + 7 \times 10^1$
 - $5 \times 10^5 + 6 \times 10^4 + 2 \times 10^3 + 3 \times 10^2 + 4 \times 10^1 + 7 \times 10^0$
 - $5 \times 10^4 + 6 \times 10^3 + 2 \times 10^2 + 3 \times 10^1 + 4 \times 10^0 + 7$

6. Which one of the following is the decimal notation of $5 \times 10^6 + 3 \times 10^5 + 3 \times 10^3 + 2 \times 10^1 + 5 \times 10^0$?
- A. 5,303,025 B. 5,300,325 C. 5,330,025 D. 53,325
7. $156,731 - 18,978 - 209 =$ -----
- A. 145,644 B. 137,644
C. 147,644 D. 137,544
8. Ten students have scored 60, 65, 52, 73, 80, 81, 44, 63, 52 and 34 in a mathematics test. What is their average score?
- A. 55.5 B. 58.6 C. 60.4 D. 62.6
9. $4^3 =$ -----
- A. 7 B. 12 C. 64 D. 81
10. $15.65 \times 100 =$ -----
- A. 1565 B. 15650 C. 156500 D. 1565000
11. $7,341 \times 20 =$ -----
- A. 14682 B. 14782 C. 146810 D. 146820
12. Which one of the following numbers is the largest?
- A. 2^5 B. 3^4 C. 4^2 D. 5^2
13. $20 - 10 \times 12 =$ -----
- A. -120 B. -100 C. 100 D. 120
14. Which one of the following is not a factor of 45?
- A. 5 B. 15 C. 45 D. 90
15. If a kilogram of orange costs Birr 2.50, then how many kilograms of orange can be bought by Birr 2500.00?
- A. 1,500 B. 1,000 C. 500 D. 250
16. What is the remainder when 263 is divided by 4?
- A. 3 B. 2 C. 1 D. 0
17. Which one of the following whole numbers is divisible by 3?
- A. 433 B. 251 C. 476 D. 462
18. $4860 \div 12 =$ -----
- A. 405 B. 406 C. 425 D. 450

19. What is the HCF of 42 and 45?
 A. 3 B. 5 C. 6 D. 9
20. What is $\frac{1}{4}$ of 8?
 A. 2 B. 1 C. $\frac{1}{2}$ D. $\frac{1}{4}$
21. How is 2:30 written in seconds?
 A. 900 B. 7,200 C. 73,800 D. 9,000
22. Which of the following is the LCM of 35 and 42?
 A. 140 B. 168 C. 210 D. 420
23. The sum of two numbers is 156. Their difference is 34. What are the numbers?
 A. 61 and 95 B. 56 and 100 C. 62 and 94 D. 50 and 106
24. What is the solution of inequality $2x - 5 < 5$?
 A. $x > 0$ B. $x > 5$ C. $x < 5$ D. $x < 10$
25. 22 times a number plus 30 results in 470. What is the numbers?
 A. 25 B. 24 C. 22 D. 20

Direction II: The following are 5 mathematical problems. Solve each of them accordingly and write your answers on the spaces provided.

1. 10 kg = _____ g.
2. 2000 m = _____ km.
3. 439,670 is the immediate successor of _____
4. $5095 + 7065 + 40 =$ _____
5. Given that $8x - 2 = 30$, find the value of x .

Answer

Short Answer

- | | | | | | | |
|-----|---|-------|-------|-------|------|------------|
| 11. | A | 6.A | 11. D | 16.A | 21.D | 1. 10,000 |
| 12. | C | 7. D | 12. B | 17.D | 22.C | 2. 2 |
| 13. | B | 8. C | 13. B | 18. A | 23.A | 3. 439,669 |
| 14. | B | 9. C | 14. D | 19.C | 24.C | 4. 12,200 |
| 15. | C | 10. A | 15. B | 20.A | 25.D | 5. 4 |

Appendix G

Addis Ababa University

School of Graduate Studies

Department of Psychology

Descriptive Questionnaire for Grade 9 Students

Dear students,

The purpose of this questionnaire is to collect information about your mathematics learning. The data to be collected will serve only for research purpose. It will not make any change in your mathematics result. The quality of the research depends on your genuine answers. So be frank, please.

Thank you in advance!

Section _____ Roll. No. _____

Sex: Male Female

No need of writing name!

Part I

Direction: The attached form lists different mathematical activities. For the statements 1 through 29 rate how sure you are that you can do them as of now and for the statements 30 through 34 rate how sure you are that you can do them currently under the column confidence. Rate your degree of confidence by recording a number from 0 to 6 using the scale given below.

0	1	2	3	4	5	6
Not sure at all	Less sure	Some what sure	Moderately sure	Sure	Very sure	Completely sure

	Confidence
1. I can find union of two finite sets.	
2. I can list elements of a finite set.	
3. I can list proper subsets of a finite set.	
4. I can find successor of (what comes next to) a given numeral written in a base different from base ten.	
5. I can write numbers in expanded notation.	
6. I can compare numerals written in bases other than base ten.	
7. I can speak of what property of addition is applied in equality of addition of whole numbers.	

0	1	2	3	4	5	6
Not sure at all	Less sure	Some what sure	Moderately sure	Sure	Very sure	Completely sure

	Confidence
8. Given two simple statements, I can form their compound statement joined by "if ..., then...".	
9. If I am given a universal set and any two sets taken from it, I can find complements.	
10. I can decide whether a given collection of objects is a set or not .	
11. I can describe sets in complete listing method.	
12. I can find $n(A \cup B)$ if $n(A)$, $n(B)$, and $n(A \cap B)$ are given.	
13. I can list all subsets of a given finite set.	
14. I can change numerals of base ten to any other bases and vice versa.	
15. I can change numbers from expanded notation into decimal notation.	
16. I can answer questions about any two nonempty sets.	
17. I can determine truth values of compound statements joined by disjunction.	
18. I can find number of subsets of a finite set.	
19. I can determine truth values of conditional compound statements.	
20. I can choose equivalent sets	
21. I can choose equal sets.	
22. I can choose converse of a conditional statement.	
23. I can describe sets in set builder method.	
24. I can add numerals in bases other than base ten.	
25. I can multiply numerals in bases other than base ten.	
26. I can subtract numerals in bases other than base ten.	
27. I can find symmetric difference (Δ) of any nonempty sets A and B.	
28. I can divide numerals in bases other than base ten.	
29. I can solve mathematical word problems.	
30. I can do mathematics class works well.	
31. I can do mathematics home works well.	
32. I can do mathematics tests well.	
33. I can get high marks in mathematics in my class.	
34. I can learn mathematics well.	

Appendix H

Mathematics Test for Grade 9 Students

Name _____ Section _____ Roll. No. _____

General Direction: This test paper contains 30 questions. Attempt all the questions. You are allowed to work on the test for $1\frac{1}{2}$ hours.

Direction I: The following are 25 mathematical questions. Each question is followed by four suggested alternatives (choices). Thus indicate the correct answer by circling the letter of your choice.

- Which one of the following is **not** true about $S = \{1, \{2\}, a\}$?
A. $\{2\} \in S$ B. $1 \in S$ C. $a \in S$ D. $2 \in S$
- Which one of the following is **not** a proper subset of $N = \{p, q, r, s\}$?
A. $\{ \}$ B. $\{p, r\}$ C. $\{q, r, s\}$ D. $\{p, q, r, s\}$
- Which one of the following numerals is the successor of (comes next to) $(288)_{\text{nine}}$?
A. $(289)_{\text{nine}}$ B. $(290)_{\text{nine}}$ C. $(300)_{\text{nine}}$ D. $(310)_{\text{nine}}$
- Which one of the following is the expanded notation of 54087?
A. $5 \times 10^5 + 4 \times 10^4 + 8 \times 10^2 + 7$ B. $5 \times 10^3 + 4 \times 10^2 + 8 \times 10 + 7$
C. $5 \times 10^5 + 4 \times 10^4 + 8 \times 10 + 7$ D. $5 \times 10^4 + 4 \times 10^3 + 8 \times 10 + 7$
- Which one of the following numerals is the largest?
A. $(32)_{\text{seven}}$ B. $(44)_{\text{five}}$ C. $(42)_{\text{six}}$ D. $(121)_{\text{four}}$
- The equation ' $a+b = b+a$ ' for any whole numbers a and b indicates _____ property.
A. associative B. closure
C. commutative D. distributive
- Let p be " $2 > 1$ " and q be " $8 \neq 10$ ", then the equivalent statement of $q \Leftrightarrow \neg p$ is:
A. If $8 \neq 10$, then $2 \leq 1$. B. If $2 > 1$, then $8 \neq 10$.
C. If $8 = 10$, then $2 > 1$. D. If $2 \leq 1$, then $8 = 10$.
- If $U = \{1, 2, 3, \dots, 10\}$, $A = \{1, 3, 4, 9\}$, and $B = \{4, 6, 8, 10\}$, then which one of the following is true?
A. $B' = \{1, 2, 3, 5, 7, 9\}$ B. $A' = \{2, 5, 6, 8, 10\}$
C. $(A \cup B)' = \{2, 5, 6\}$ D. $(A \cap B)' = \{1, 2, 3, 5, 6\}$

9. Which one of the following is a set?
 A. $\{x: x \text{ is a beautiful girl}\}$ B. $\{x: x \text{ is a lovely doctor}\}$
 C. $\{x: x \text{ is a mathematics teacher}\}$ D. $\{x: x \text{ is a good student}\}$
10. The converse of the statement "If a polygon is a square, then it is a rectangle" is
 A. If a polygon is a rectangle, then it is a square.
 B. If a polygon is a square, then it is **not** a rectangle.
 C. If a square is a polygon, then it is a rectangle.
 D. If a polygon is a rectangle, then it is **not** a square.
11. If $n(A) = 15$, $n(B) = 7$, and $n(A \cap B) = 7$, then $n(A \cup B) =$ _____.
 A. 29 B. 22 C. 15 D. 8
12. How can $S = \{t: t \in \mathbb{Z} \text{ and } -2 \leq t < 3\}$ be described in complete listing method?
 A. $S = \{-2, -1, 1, 2\}$ B. $S = \{-2, 1, 3\}$
 C. $S = \{-1, 0, 1, 2\}$ D. $S = \{-2, -1, 0, 1, 2\}$
13. Which one of the following statements is true?
 A. $-1 \subset \{-1, \{0\}\}$ B. $\{0\} \subset \{-1, \{0\}\}$
 C. $\{-1, \{0\}\} \subset \{-1, \{0\}\}$ D. $\{-1, 0\} \subset \{-1, \{0\}\}$
14. The decimal notation of " $3 \times 10^2 + 10 + 4 \times \frac{1}{10} + 9 \times \frac{1}{10^2}$ " equals:
 A. 3004.9 B. 301.94 C. 300.94 D. 310.49
15. Which one of the following is necessarily true for any two nonempty sets A and B?
 A. $A \cap B \neq \emptyset$ B. $A \cup B \neq \emptyset$ C. $A \cup B = \emptyset$ D. $A \cap B = \emptyset$
16. Let p be " $3+2=5$ " and q be " $4+11=15$ ". Which one of the following has a **false** truth value?
 A. $p \vee q$ B. $\neg p \vee q$ C. $p \vee \neg q$ D. $\neg p \vee \neg q$
17. Which one of the following compound statements has a **false** truth value?
 A. If 6 is even, then 5 is even B. If 6 is even, then 5 is odd.
 C. If 6 is odd, then 5 is even D. If 6 is odd, then 5 is odd.
18. Which one of the following sets is equivalent to the set $\{a, \{b, c\}, d\}$?
 A. $\{2, 4, 6\}$ B. $\{1, 2, 3, 4\}$
 C. $\{x: x \in \mathbb{N} \wedge 3 < x < 6\}$ D. $\{x: x \in \mathbb{Z} \wedge 2 \leq x \leq 5\}$
19. Which one of the following sets is equal to $K = \{a^3: a \in \{-1, 0, 1\}\}$?
 A. $K = \{-3, 0, 3\}$ B. $K = \{-1, 0, 1\}$
 C. $K = \{0, 3\}$ D. $K = \{-1/3, 0, 1/3\}$

20. The set builder description of $C = \{2, 4, 6, 8, \dots\}$ is:
 A. $\{x: x \text{ is a multiple of } 2\}$ B. $\{x: x \text{ is an even integer}\}$
 C. $\{x: x \text{ is an even whole number}\}$ D. $\{x: x \text{ is an even natural number}\}$
21. Which one of the following is correct for any two sets A and B?
 A. If $A \subset B$, then $A \subset B$. B. If $A \subset B$, then $A \subset B$.
 C. If $A \subset B$, then $B \subset A$. D. If $A \subset B$, then $B \subset A$.
22. $(632)_{\text{seven}} - (504)_{\text{seven}} = (\text{_____})_{\text{seven}}$
 A. 125 B. 128 C. 131 D. 135
23. Given $A = \{a, b, d, e\}$ and $B = \{c, d, e, f, g\}$, then $A \Delta B$ becomes
 A. $\{a, b, c, e, f, g\}$ B. $\{a, b, c, f, g\}$
 C. $\{a, b, f, g\}$ D. $\{d, e\}$
24. $(1020)_{\text{three}} \div (102)_{\text{three}} = \text{_____}$.
 A. $(100)_{\text{three}}$ B. $(12)_{\text{three}}$ C. $(10)_{\text{three}}$ D. $(11)_{\text{three}}$
25. From 500 students of a school 80 are members of anti-AIDs club, 100 are members of environmental science club, and 30 are in both clubs. How many students are not members of either clubs?
 A. 150 B. 290 C. 320 D. 350

Direction II: The following are 5 mathematical problems. Solve each of them accordingly and write your answers on the spaces provided.

- Given $A = \{1, 2, 3, 4\}$ and $B = \{1, 3, 5, 7, 9\}$, then $A \cup B = \text{_____}$.
- Find the base ten numeral of $(505)_{\text{six}}$.
- If set A has 4 elements, then the number of its subsets is equal to _____.
- $(7058)_{\text{nine}} + (2421)_{\text{nine}} = (\text{_____})_{\text{nine}}$
- $(22)_{\text{five}} \times (13)_{\text{five}} = (\text{_____})_{\text{five}}$

Answer

- | | | | |
|------|-------|-------|-------|
| 1. D | 8. A | 15. B | 22. A |
| 2. D | 9. C | 16. B | 23. B |
| 3. C | 10. A | 17. A | 24. C |
| 4. D | 11. C | 18. A | 25. D |
| 5. C | 12. D | 19. B | |
| 6. C | 13. C | 20. D | |
| 7. A | 14. D | 21. B | |

Short Answer

- $\{1, 2, 3, 4, 5, 7, 9\}$
- 185
- 16
- 10,480
- 341

DECLARATION

I declare that this thesis is my original work. The sources used for the thesis are adequately acknowledged.

Asp July 10, 2006