ADDIS ABABA UNIVERSITY
GRADUATE STUDIES
EPARTMENT OF SCIENCE AND MATHEMATICS EDUCATION

THE EFFECT OF DEMONSTRATING GRAPHING CALCULATOR ON GRADE 12 STUDENTS' ATTITUDE AND ACHIEVEMENT ON MATHEMATICS IN CRUISE SCHOOL (ADDIS ABABA CITY ADMINISTRATION)

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A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES ADDIS ABABA UNIVERSITY DEPARTMENT OF SCIENCE AND MATHEMATICS EDUCATION IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTERS OF EDUCATION IN MATHEMATICS EDUCATION

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Acronyms

GC: - Graphing Calculator

Ha: - High achievers

IT: - Information Technology

La: - Law achievers

Ma: - Medium achievers

PRIA: - Pre-intervention achievement

POIA: - Post-intervention achievement

M.S:- Mean Score

S.D:- Standard Deviation

SPSS:- Statistical Package for Social Science

Abstract

The Effect of Demonstrating Graphing Calculator on Grade 12Students' Attitude and Achievement on Mathematics in Cruise School (Addis Ababa City Administration)

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The main purpose of this research paper was to explore the effect of Graphing Calculator on students' achievement and attitude toward mathematics. The participants of the study ware grade 12students of Cruise School who learnt in two sections. To prepare students for the life in today's highly technical society their mathematical knowledge must include and go beyond knowledge in the simple skills into solving more complex problems. The purpose of the study was to determine to what degree the use of graphing calculator affect students' achievement in mathematics. Another area of concern in many mathematics classes is the attitude of the students towards mathematics, poor attitude toward learning mathematics can lead to poor mathematics achievement. One of the cases of the poor attitude toward mathematics is the instructional method which is implemented in the classroom. To conduct this research the study employed the quasi – experimental nonequivalent group design. The participants of the study i.e Grade 12 students were selected through purposive sampling. The researcher used the students' previous achievement result before the intervention and the post-test after the intervention to analyze the effect of Graphing calculator on mathematics. The result shows that, there is no significant difference between the achievements of experimental and control group. But as we see from the attitude inventory scale, students develop positive attitude towards mathematics and enjoy learning mathematics when they learn using Graphing Calculator.

CHAPTER ONE

1. INTRODUCTION

1.1 Background of the Study

To prepare students for the life in today's highly technical society their mathematical knowledge must include and go beyond knowledge in the simple skills into solving more complex problems. It is needed to prepare students who know how to identify problems and find its solution and know how to evaluate progress and learning in mathematics. (Idris, 2004).

Many students are struggling to learn mathematics. Some students state that they hate math and feel that they will never use it in the future. Campoy (1992, as cited in Myers, 2009) has remarked that technology provides a better way of teaching mathematics. The use of technology in mathematics education allows students the opportunity to focus less on the computational aspects and to focus more on the applications of mathematics (NCTM, 2000 as cited in Myers 2009).

Students who are engaged in their work are energized by four goals, success, curiosity, originality, and satisfying relationships. But the question now is, "How do we cultivate these drives in the students' lives? And what kind of work do students find totally engaging? Students want and need work that stimulates their curiosity and awakens their desire for deep understanding. As for topics that relate to students' lives, the connection here cannot be superficial; it must involve an issue or idea that is manageable. How can we connect them?

Like other mathematics teachers, . the researcher concerned about his students' mathematics ability and achievement. Most of the time students are search for the answer of a problem without regard to the process that brings them there. The study would like to investigate these process can be enhanced through the use of graphing calculator. Some educators believe that using calculators inhibits the ability of students to perform basic, rote tasks, other maintain that using calculators to free up students from the pencil- paper computations allow for more higher level thinking and real-world applications

(Campagnone 2004). The purpose of the study was to determine to what degree the use of graphing calculator affect students' achievement in mathematics.

Another area of concern in many mathematics classes is the attitude of the students towards mathematics, specifically many students find that sketching graphs is too tedious for them and even confusing. This poor attitude towards learning mathematics often leads to the poor appreciation of sketching graph of functions which will consequently result in poor mathematics achievement. This poor attitude could be attributed to a number of reasons, (1) students were not able to visualize what they were learning (2) students found that plotting and drawing graphs was tedious and time consuming (3) students realize that plotting graphs was a routine procedure and thus become boring, or realize that problem solving situations, activities and the answer that were generated were too specific. These factors will tend to make learning mathematics and problem solving is uninteresting, (Arnold, 1999) .

Graphing calculator is a technology that was developed as an aid in teaching and learning mathematics. As technology is now a major player in visualization and in the exploration of challenging concepts in Mathematics, this study aims to spearhead in using new technologies as tool in the teaching and learning of Mathematics and help creating a successful learning climate in the Ethiopian context.

1.2 Statement of the problem

As the researcher see from his experience as a student and a teacher, the teaching and learning of mathematics in our country's situation is teacher centered and students are not given enough opportunities to develop their own thinking skills. So this situation results in students becoming passive receivers of information which is the cause of loose of conceptual understanding. Most of the time mathematics content is taught with the intention of finishing the textbook and preparing the students for examinations. So we have to lay concern on how well the students understand mathematical concepts. Research has also shown that students in many of today's mathematics classroom have

little opportunity to explore mathematical patterns and processes which can help them understand mathematical concepts (Rose & Kurzz, 1993 cited in Idris, 2006)

Ethiopian students are not exceptional with respect to the problem. There are diverse factors which are responsible for the students' poor mathematics achievement. Stuart (2000) as emphasized that, the two principal factors that contribute to the students' poor mathematics achievement are teacher centered class and poor use of teaching aids. With regard to the former, the teaching and learning of mathematics does not give students enough opportunities to develop their own thinking skills and understanding of mathematical concepts. As Tesfaye Jale(2009)stated, teachers need to accomplish the tasks of fostering mathematical literacy of students, enhancing the ability of students thinking mathematically, giving attention on the ability to do and use mathematics intelligently rather than on covering a wide area of mathematical content or on using sophisticated mathematical content. Further, teacher centered mathematics classes are performed or conducted without teaching aids, most of the time. Even if they exist, most of them are not fully helpful to clarify mathematical concepts students need to understand. The other factor that has contributed in poor mathematics achievement is students' poor attitude towards learning mathematics (Idris, 2006).

In order to enhance students' achievement in mathematics, using graphing calculator has been considered. However, educators (researchers) on the area display conflicting views. While some educators (e.g Futch & Stephens, 1997 as cited in Dunham 1998) believe that using calculators inhibits the ability of students to perform basic, rote tasks, others (e.g. Campagnone, 2004) maintain that using calculators allow students for higher level thinking and real-world applications. However, no local research has investigated whether using graphing calculator enhances students' mathematics achievement in the context of Ethiopian high school/elementary students. Hence, this study has been initiated to achieve the following general objective.

Traditional teaching approach emphasizes more on how much the students can remember and less on how well the students can think and reason. Thus learning becomes forced and hardly brings satisfaction to the students (Idris 2006). The instructor in a traditional classroom encourages memorization and recitation with no time for student reflection

(Curtis 2006). Learning mathematics for many low achiever students is uninteresting. Poor attitude toward learning mathematics can lead to poor mathematics achievement. One of the cases of the poor attitude toward mathematics is the instructional method which is implemented in the classroom. So, we have to create an active and dynamic classroom for a better attitude. By building good attitude towards learning mathematics, it is expected that mathematics achievement can also improve.

1.3 Objectives of the study

The objective of the study was to explore the use of graphing calculator, assess how it helps to develop positive attitude for learning mathematics and investigate its effect on students' achievement. These are specifically;

1 To see if there is any significant difference in mathematics achievement between students who learned mathematics with graphing calculator and students who learned mathematics without graphing calculator.
2 To see if there is any significant difference on attitude and achievement of students toward mathematics before and after learning mathematics with graphing calculator?
3 To see if there is effect of gender on attitude towards using Graphing Calculator in mathematics
4 To see the effect of the component of attitude on attitude toward using Graphing Calculator and achievement on mathematics.

1.4 Research Questions

The study has the following research questions;

1. Is there any significant difference on attitude and achievement of students toward mathematics before and after learning mathematics with graphing calculator?
2. Is there any effect of gender on attitude toward using Graphing Calculator in mathematics?

3. Is there any significant difference in mathematics achievement between students who learned mathematics with graphing calculator and students who learned mathematics without graphing calculator?
4. What is the effect of component of attitude on attitude towards using Graphing Calculator and achievement in mathematics.

1.5 Significance of the study

To help students to develop positive attitude and self-confidence to mathematics and towards themselves as learners of mathematics they should experience enjoyment through positive attitude in their ability to succeed, a sense of purpose through relevant experience and meaningful activities, pride in achievement and pleasure in the use of suitable materials and graphing calculator(Idris 2006).

The motivation to learn and perform better in mathematics is affected by the instructional method and the learning process in the classroom, and also affected by teaching materials and technology used in the class. So to bring good attitude towards mathematics and mathematics class we have to use the brain warming technologies like graphing calculator.

Graphing calculator is a new technology for my student which is used as an aid in teaching and learning mathematics. As technology is now a major player in visualization and in the exploration of challenging concepts in mathematics, this study aims to identify the use of graphing calculator as a teaching tool in mathematics classroom and how much it is helpful to create a successful learning climate. The study would like to show that the effect of implementing graphing calculator in mathematics instruction to the possible effect it may have on students' achievement and attitude towards mathematics and towards the use of technology. And also extract, to what extent using the graphing calculator allowed the students to work more realistic and challenging problems.

The results obtained in this study are helpful to teachers of mathematics, who are faced every day with the difficulty of clarifying basic mathematical concepts for their students

where and how often graphing calculator use in the class instruction time. The information from the study may also help school administrators to decide whether or not to purchase graphing calculators for their school as a teaching instrument. The release of this study may help other researchers as a base of further research. The major findings of the study are believed to contribute towards filing the knowledge gap of the topic under investigation. Technological curricula have enriched students' understanding of mathematical concepts, increased their problem solving abilities, and improved their attitudes toward mathematics. Therefore the result of the study may help curriculum developers to incorporate mathematics with technology.

1.6 Limitation of the Study

Some of the students who participated on the study did not have knowledge of using a graphing calculator, so they did not have a meaningful strategy for using the calculator but pushed buttons rather than attending to the meaning of the problem presented to them. The other limitation was the effect that calculator has on group work, since it is a private device which often lead to the breakdown of group work interactions (Doer and Zanger, 2000 cited in Christina, 2007).

The limited number of graphing calculator used in the class when compared with the number of students might have hindered individual students to perform their own problems.

1.7 Definition of terms

Achievement: - Mathematics achievement is defined as a measure of the ability of students to understand, analyze and answer specially designed test items based on the standard syllabus. The level of achievement exhibited by the students will categorize them as high or low mathematics achievers.

Attitude: - Students can describe their attitude toward a course by expressing like or dislike with regards to the subject. Attitude, for this study, is defined as the anxiety, value students place on the usefulness of mathematics in their life now and in the future, or negative and positive disposition and enjoyment (Tapia & Marsh, 2004).

Graphing calculator: a calculator that has the capability of producing a graphical representation of an input function.(Brady 2006)

Technology: "A body of knowledge and the systematic application of resources to produce outcomes in response to human needs and wants" (Savage & Sterry, 1990, p. 7).

CAPTER TWO
2. REVIEW OF RELATED LITERATURE

2.1 Defining attitude toward mathematics

The lack of theoretical framework that characterizes research on attitude toward mathematics is partially shown by the fact that a large portion of studies about attitude do not provide a clear definition of the construct itself: attitude tends rather to be defined implicitly and a posteriori through the instruments used to measure it (Leder, 1985; Daskalogianni & Simpson, 2000).

When a definition is explicitly given, or can be inferred, it mainly refers to one of the three following types:

1. A 'simple' definition of attitude, that describes it as the positive or negative degree of affect associated with a certain subject. According to this point of view the attitude toward mathematics is just a positive or negative emotional disposition toward mathematics (McLeod, 1992; Haladyna, Shaughnessy J. & Shaughnessy M., 1983).
2. A multidimensional definition , recognizes three components in the attitude: emotional response, beliefs regarding the subject, behavior related to the subject. From this point of view, an individual's attitude toward mathematics is defined in a more complex way by the emotions that he/she associates with mathematics (which, however, have a positive or negative value), by the individual's beliefs towards mathematics, and by how he/she behaves (Hart, 1989).
3. A bi-dimensional definition, in which behaviors do not appear explicitly (Daskalogianni & Simpson, 2000): attitude toward mathematics is therefore seen as the pattern of beliefs and emotions associated with mathematics.

Kulm (1980) suggests that '*It is probably not possible to offer a definition of attitude toward mathematics that would be suitable for all situations, and even if one were agreed on, it would probably be too general to be useful*' (p. 358). In this way, the definition of attitude assumes the role of a '*working definition*'.

2.1.1 The meaning of positive and negative attitude

In actual fact the term attitude is used in both practice and research together with the adjectives "positive"/ "negative". This dichotomy between positive/ negative attitude pervades mathematics education research, both implicitly and explicitly. For example, classic studies regarding the relationship between attitude and achievement in fact investigate the correlation between *positive* attitude and success. In the same way studies aiming to change attitude actually end up in setting the objective of transforming a 'negative' attitude into a 'positive' one. The definition of 'positive' or 'negative' attitude toward mathematics clearly depends on the definition of attitude itself. According to the 'simple' definition, it is clear what a 'positive' or a 'negative' attitude is: a 'positive' attitude is a positive emotional disposition toward the subject; a 'negative' attitude is a negative emotional disposition toward the subject. If we choose the bi dimensional (or multidimensional) definition, it is not clear what a 'positive' attitude should mean, but referring only to the emotional dimension is reductive, since we have to take into account the two (three) dimensions, i.e. emotions, beliefs, (behaviors) and their interaction. What actually happens is that in most studies the choice of a definition for attitude, and consequently a characterization of 'positive'/'negative' attitude, not only is not explicitly made: often it is not made at all, and the assessment / measurement instruments used by the researcher implicitly end up by continuously wavering between various definitions within a single study.

The characterization of an individual's attitude as positive / negative is in most cases simply the result of a process of measurement, performed through instruments such as the Thurstone or Likert attitude-scales or the semantic differential technique. This process ends up in a score - attached to an individual's attitude obtained by summing points relating to the single items. The choice of scores to be assigned to the items naturally leads to a positive/negative evaluation of each one. Since in most questionnaires used to assess attitude the items range from those related to emotions ("I like mathematics") to those related to beliefs ("Mathematics is useful"), to those related to behavior ("I always do my homework in math"), an answer can be characterized as 'positive' by referring to

different meanings of the word 'positive' itself. More precisely, this meaning varies depending on whether 'positive' refers to emotions, beliefs, or behavior:

1. When it refers to an emotion, 'positive' normally means 'perceived as pleasurable'. So, anxiety when confronting a problem is seen as 'negative', while pleasure in doing mathematics is evaluated as 'positive'.
2. When it refers to beliefs, 'positive' is generally used with the meaning 'shared by the experts'.
3. When it refers to behavior, 'positive' generally means 'successful'. In the school context, a successful behavior is generally identified with high achievement: this naturally poses the problem of how to assess achievement (Middleton & Spanias, 1999).

In actual fact the three meanings overlap. For example, in the case of beliefs, sometimes 'positive' means that it is supposed to elicit a 'positive' emotion. A typical case is represented by the belief 'Mathematics is useful', which is also used in questionnaires aimed at measuring just the emotional dimension of attitude. But often 'positive' referred to a belief means that it is supposed to be related to a 'positive' behavior, i.e. to a successful behavior. Sometimes the latter meaning is also used for emotions, implicitly admitting that a 'positive' emotion toward mathematics, being pleasurable, is necessarily associated with a 'positive' behavior in mathematics. On the contrary several studies (Evans, 2000) suggest the possibility that for certain subjects an optimal level of anxiety exists: above this level, but also below it, performance is reduced. The problem is that, generally differences between the various meanings are rarely made explicit: in this way, a priori assumption is often made as to what should in effect be the result of an investigation, for example, that a belief which is 'positive' because it is shared by experts, is associate with a 'positive' behavior in that it is successful. This continuous sliding between the researcher's assumptions and the desired result of the investigation enhances the risk of *circularity* in research on attitude, a risk that Lester (2002) more generally pointed out for research on affect. In addition Interest in and enjoyment of mathematics (or intrinsic motivation), encourage students to study mathematics and enjoy

learning for its own sake. The enjoyment of mathematics category was designed to measure the degree to which students enjoy working mathematics and mathematics classes. (*Internet source*).

2.2 Student Attitudes

The everyday notion of attitude refers to someone's basic like or dislike of a topic or idea. Attitude is a behavior that is measured by various evaluative processes. The Attitudes Toward Mathematics Inventory (Tapia & Marsh, 2004) investigates other areas of attitude toward mathematics. Specifically, it assesses confidence, anxiety, value, enjoyment, and motivation. Confidence measures students' confidence and how they perceive their performance in mathematics. The value of mathematics refers to the students' beliefs on the usefulness, relevance, and worth of mathematics in their personal and future professional lives. Anxiety measures feelings of anxiety and the outcomes of those feelings. Enjoyment of mathematics measures how much students enjoy working with mathematics and attending mathematics classes. Motivation measures interest a student has in mathematics and the desire to take more mathematical courses (Tapia & Marsh, 2004 as cited in Curtis 2006).

To investigate the effect of Graphing Calculator on students' attitude towards mathematics the researcher used the three variables in this particular study i.e Anxiety, Negative thought and Enjoyment.

Anxiety

Math anxiety is often stated as a factor that causes students to have a negative attitude toward mathematics. Mathematics anxiety is defined as an "irrational dread of mathematics that interferes with manipulating numbers and solving mathematical problems within a variety of everyday life and academic situations" (Furner & Berman, 2003, p. 170 as cited in Curtis 2006). The researcher used anxiety as a variable to identify the use of Graphing Calculator in classroom either decrease mathematics anxiety or not.

Negative thought

Students who will express like or dislike of mathematics have experiences that have controlled their emotions, expectations, and values with regard to the subject (Hannula,2002 as cited in Curtis 2006). Sometimes students have a negative disposition toward the subject mathematics. One of the factors that contribute for this is the teaching

learning environment which discourages the students from finding the relevance and making sense of the mathematics (Turner 2002 as cited in Curtis 2006). Does this negative disposition was improved by using Graphing calculator in the classroom or not?

Enjoyment

As research result of Curtis (2006) revealed that students in traditional classroom are become disinterested during lecture time. Their note taking skills are poor and they need an incentive to complete homework. To decrease the dissatisfaction of students they have to enjoy mathematics class. The researcher selects the variable enjoyment to answer the question 'does the use of Graphing Calculator create an enjoyable environment in the classroom?'

2.3 Mathematics and technology

Electronic technologies are essential tools for teaching, learning, and doing mathematics. Students can learn more mathematics more deeply with the appropriate use of technology (NCTM, 2000 as cited in Stoilescu,2009). The use of technology can furnish visual images of mathematical ideas, they facilitate organizing and analyzing data, and they compute efficiently and accurately (NCTM, 2000). The NCTM's Principals and Standards for School Mathematics Technology Principal states: "Technology is essential in teaching and learning mathematics, it influences the mathematics that is taught and enhances students' learning (NCTM 2000 as cited in Stoilescu,2009).

In teaching mathematics, educational technology has a proven track record of enhancing teachers' ability to cover multiple subjects with increasing precision. In particular, this is demonstrated in new pedagogical approaches in classrooms' work and inquiry (Hoyles, Noss, & Kent, 2004 as cited in Stoilescu,2009) which include more accessible classroom environment. No longer is the classroom geared toward specialized students or those geared toward a career in mathematics. Technology has made it possible to conduct classrooms simulations and projects in mathematics in ways more relevant to the daily experiences of students of different background and different locations (Stoilescu ,2009)

Technology is not only used in the classroom but also by the school administration. Planning diverse learning environments is a complex process that requires extensive information relating to a large variety of characteristics of both the student and the learning environment (personal goals, curriculum, student population, resources, social objectives). A study conducted looked at the integration of an information system into school management's decision making process in planning the teaching and learning of students is essential. The integration showed a significant improvement in student achievement, particularly in difficult subjects like mathematics (Chen & Kalay, 2002). In mathematics education, technology is often viewed as a provider of learning devices and tools – calculators and computers – which may be used in the classroom (Simonson & Thompson, 1997,cited in Donald 1998)

Although computer technology (CT) has great potential to impact the teaching and learning of mathematics, the presence of CT hardware does not automatically produce desirable schooling outcomes in mathematics education (Clark 1983; Li 2004). Successful and effective use of technology for the teaching and learning of mathematics depends upon sound teaching and learning strategies that come from a thorough understanding of the effects of technology on mathematics education (Albright and Graf 1992; Coley, Cradleer et al. 2000 as cited in Qin Li & Xin Ma, 1996)

2.4 Graphing calculator

The graphing calculator is easy to use and powerful hand-held tool that can be easily learnt by teachers, students, and those interested. All commands are placed in neatly arranged pull-down menus, and in the event that one cannot find the commands, the calculator's catalog gives an alphabetically arranged list of all the commands. The keys have also been strategically arranged in functional groups for easy access to the user, for example the arithmetic keys are together and so are the trigonometry keys, can handle real and complex numbers, matrices and even strings. Its features for trigonometry, calculus, and simple algebra in the form of an equation solver will also meets the needs of most secondary school curriculum.

In addition, graphing calculator can carry out list based one and two variable statistical analysis. The descriptive statistics and linear regression models are applicable to secondary school curriculum, whilst the calculator's advanced hypothesis testing, confidence intervals and distributions.

The graphing calculator also has an added accessory that can further enhance its usability and practicality for classroom usage. For example, it has a calculator to calculator link cable that can transfer data from one calculator to another. This feature can be very useful for teachers wanting their classes to investigate the same set of data for purposes of teaching mathematical concepts. With a common set of data, teaching can be more focused and more effectively executed. (Idris, 2006)



Fig. 1 Graphing calculator

2.5 Graphing calculator and mathematics

Graphing calculator help in visualizing mathematical concepts, to improve critical thinking ability, numerical and algebraic representations (Idris, 2004). The Graphing calculator is the cross between a computer and a scientific calculator. It has the ability to draw and analyze graphs, carry out complex computations, numerically solve equations, perform matrix arithmetic and statistical analysis. When solving problem by using graphing calculator students may be involved in creative process such as;

- Searching for alternative methods of solving problem
- Creating and recognizing patterns
- Experimenting with different ways of communicating mathematical ideas
- Creating personal hypothesis

2.6 The effect of graphing calculator

2.6.1 Graphing Calculator on Achievement in Mathematics

Several studies have shown that the use of graphing calculators have helped in improving students' spatial visualization skills, critical thinking ability, understanding of connections among graphical, tabular, numerical, and algebraic representations, and achievement in mathematics. From this findings the results of the study by (Idris and Chang, 2011) show that graphing calculator based performance assessment was effective in improving students' mathematics achievement in two topics they used to teach by it. One of the factors that contributed to the improvement of students' mathematics achievement in the two topics might be the students' use of graphic calculator in the performance assessment tasks had increased their use of graphic, numeric and symbolic solution strategies which, in turn, enhanced their understanding of the mathematical topics studied. At the same time, graphic calculator based performance assessment increased the time spent by the teachers in the experimental groups on the teaching and learning activities which involved more problem solving and investigation as compared to the teachers in the comparison groups. In general, the results suggest that performance assessment that incorporated the use of graphic calculator has influenced the teaching and

learning of mathematics which supports students' visualization, allowing them to explore problems which they may not otherwise be able to solve and thus enable them to better understand the two mathematical topics. In conclusion, graphic calculator based performance assessment enables students to solve problems graphically, numerically and symbolically which, in turn, enable them to better understand the mathematics they are learning.

Burril(2002) states the benefit of graphing calculator as follows "*Given supporting conditions, the evidence indicates that handheld graphing technology can be an important factor in helping students develop a better understanding of mathematical concepts, score higher on performance measures, and raise the level of their problem solving skills*".

Following the model of Hembree, King (1997) as cited in Barton 2007, performed a meta-analysis to determine the effect of computer enhanced instruction on college level mathematics. Thirty studies (with 68 effect sizes) were collected from dissertations and journal articles published from 1986 to 1995, which met the criteria for a meta-analysis. Mathematics topics included functions, algebra, linear programming, finite mathematics, statistics, and business, applied, and science calculus. Computer enhanced instruction in the studies included teacher demonstration using a single computer and a classroom display unit, student use of a graphing or programmable calculator, or students (singly or in pairs) using microcomputers in a laboratory setting. Results of the analysis include: (a) a statistically significant positive influence was found on overall achievement when the computer or graphing calculator were used (b) no significant effect was found between technology and comparison groups on procedural achievement, however, a significant favorable effect resulted on procedural achievement when the experimental group students were allowed to use technology during testing (d) when experimental group students were denied use of technology on tests, procedural achievement (though not statistically significant) was adversely affected, (e) instructional use of computers and graphing calculators as both tool and for demonstration was the most beneficial to all achievement, (f) access to graphing calculator only in the classroom or lab had a slightly adverse effect on conceptual achievement(Barton, 2007).

2.6.2 Graphing Calculator on Attitude towards Mathematics

In separate studies conducted by Rosa (1990), Riley (1993), Almeqdadi (1997), and Rodil (2000), it was evident that the use of graphing calculator as an instructional technology has improved the students' attitude toward mathematics. The study of O'Callaghan (1995) revealed that the students who used the calculator showed significant improvements in their overall self-concept and attitude toward mathematics and their enjoyment of the subject.

Similarly, related studies such as those of Devantier (1992) and Wong (1998), share the same findings that students who used graphing calculators in their mathematics classes had better achievement and more favorable attitude toward the subject than those who did not use calculators (Acelajado 2002).

Students using calculators were also found to have a better attitude toward mathematics (NRC, 2001; Grouws & Cebulla, 2000; Hiebert, 1999 as cited in Curtis 2006). For example, Hembree and Dessart (1986) completed a comprehensive meta-analysis of 79 reports that dealt with the use of calculators in the classroom. In all of the studies, one group of students was permitted to use calculators while the second group received the same instruction, but without the use of calculators. The meta-analysis showed that students with the calculators showed an improvement in problem solving. The studies also helped the researchers to discover that if calculators are used appropriately, they could be beneficial on tests. Most importantly, studies consistently showed students who used calculators had a better attitude toward mathematics. Using graphing calculators as a tool can facilitate learning. Students are accustomed to technology and should expect to see it in the classroom. Students will find they have a better understanding of the material and a new value for mathematics. More recent research supports the fact that student use of calculators improves their attitude toward mathematics (Glasgow & Reys, 1998; Kennedy, 2002; Edwards, 2003; Dick, Dion, & Wright, 2004 as cited in Curtis 2006). Calculators enable students to visualize concepts often left to appear abstract. Students can make connections to personal experiences through simulation tasks(Curtis, 2006).

2.6.2.1 Powerful Tools Can Improve Student Attitudes

Technology in general and graphing calculators in particular have great potential in improving students' affective responses to math learning tasks (Kaput, 1989). A recent meta-analysis of 18 classroom experiments with student attitudinal outcomes revealed that students using calculators during instruction reported significantly better attitudes toward math than those who did not (Ellington, 2003). Researchers look at the size of an effect in determining whether a positive intervention is worth spreading. The size of the effect of calculators on attitudes falls in the same range as other instructional practices that researchers recommend strongly. However, better attitudes do not automatically translate into more learning. Expert teachers take advantage of positive attitudes to raise expectations for their students. Of course, there are many ways in which teachers may attempt to raise expectations, not all of which work. (Texas Instrument Research Note, 2007)

2.6.3 Graphing Calculator on Mathematics Anxiety

The non-cognitive variable which considered is mathematics anxiety. Trichett (1997) emphasized that too much anxiety can become harmful when its effects interfere with new learning and performance in school. The use of graphing calculators in teaching has contributed a lot in the reduction of students' anxiety in mathematics as indicated in the studies conducted by Martin (1980), and Bitter & Hatfield (1993) as cited in Acelajado (2002).

The study conducted by Acelajado (2003) revealed that the use of graphing calculator in College Algebra improved the respondents' achievement and attitude and reduced the anxiety in mathematics of first year students from the College of Science. The motivation to learn and perform better in mathematics is affected by the learning procedure, the instructional materials and technology used, along with a number of non-cognitive factors. Astin (1993) asserted that well designed lessons with interesting activities become meaningful only when they affect the student in the process. Moreover, Stuart

(2000) emphasized that innovations in the methods of teaching and the use of teaching aids may improve students' feeling of success and may help them develop confidence in mathematics(Acelajado, 2002)

2.6.4 Graphing Calculator on Understanding Functions and Graphing

Several studies examined students' ability to relate functions and graphs and found that the experimental groups were better able to understand the relationship between a function and its graphical representation (Alexander, 1993; Boer-Van Oosterum, 1990; Browning, 1990 as cited in Barton 1998). Students with access to graphing technology were often better able to consider different aspects of graphs and discuss global features of the graphs including domain, increasing and decreasing behavior, and asymptotic and end behaviors (Mustafa, 1997; Norris, 1994; Rich, 1991 as cited in Barton 2007)
One study found there is a significant difference between the graphing technology students' and the other students' ability to link functions and their graphs (Giamati, 1991 as cited in Barton 2007). There were also indications in Giamati's study that students using graphing technology had better understanding of specific transformations including shrinks, stretches, and vertical and horizontal translations (Barton 2007).

2.6.5 Graphing Calculator on Visualization of Mathematical Concepts

Another area of focus for studies was the effect of the graphing technology on visual thinking and spatial skills. Drottar (1998) stated that the greatest benefit related to graphing calculator use was to enhance students' visualization of algebra concepts. Chandler (1992) noted there was a positive increase in students' understanding and achievement when they were able to visualize the concepts and problems to be solved. Stick (1997) concluded that teachers should encourage visual displays before introducing analytical method in dealing with algebra and calculus concepts (inequalities, asymptotes, derivatives, concavity, integrations, transcendental functions, and series). Others found the experimental group showed significant gains in spatial visualization skills (Vasques, 1991; Shoaf-Grubbs, 1992, as cited in Barton, 2007)

Over all Visual aids have the following use on students learning;

1. They gain attention – We cannot teach without the attention of our students, no matter how carefully prepared our lesson may be. A new presentation on a screen is difficult to ignore – a new sentence in a speech is not.
2. They add variety – Visual aids add variety and interest.
3. They add conceptualization – This is the major advantage of visual aids. Many concepts or ideas are understood visually rather than verbally. If knowledge is understood and remembered visually, we should transmit it visually.
4. They aid memory. Research shows that most people find visual information is easier to remember than verbal information. For example mind maps display verbal information visually, and so aid learning. (Petty, 2004 on the book Teaching Today p.357-358).

2.6.6 Graphing Calculator on Students Responsibility for Their Own Learning

In giving students a graphing calculator, teachers can also give students more responsibility for their own learning. Students can examine multiple representations interactively and examine meanings of representations and their relationships. They can work on interactive explorations, real world data collection, and investigations. Furthermore, they can assess their work and discover errors on their own(Texas Instrument Research Note 2007).

2.7 The Use of Graphing Calculator to Teach Mathematics

From the results obtained by (Idris, 2006), a number of implications can be put forward in the interest of improving mathematics teaching in the classroom. Firstly, the generally significant differences of mathematics achievement of the experimental groups as compared to the comparison groups indicate that the graphing calculator can possibly contribute towards improved learning in mathematics. This observation can therefore encourage classroom teachers and even curriculum developers on the potential of the graphing calculator as an effective tool in learning mathematics.

Technology enhances mathematics learning. In mathematics education, technology is often viewed as a provider of learning devices and tools calculators and computers which may be used in the classroom (Simonson & Thompson, 1997,cited in Donald 1998). With calculators and computers students can examine more examples or representational forms than are feasible by hand, so they can understand what's being taught. The effective use of technology depends on the teacher. Teachers should use technology to enhance their students' learning opportunities by selecting or creating mathematical tasks that take advantage of what technology can do efficiently and well graphing, visualizing, and computing (NCTM, 2000).(Bazile 2004)

Burrill (2002), who synthesized scientific research on the use of graphing calculators, concluding that, Students who use handheld graphing technology have a better understanding of functions, of variables, of solving algebra problems in applied contexts, and of interpreting graphs than those who did not use the technology. No significant differences in procedural skills were found between students who use handheld graphing technology and those who do not. This indicates that extensive use of the technology does not necessarily interfere with students' acquisition of skills. Students used the graphing calculator as a visualization tool to get a clear picture of the function graph ,as a checking tool to see whether the graph they produced on the paper is correct or not ,and as a comparing tool to compare different function graphs and see the changes at the same time. However regarding using the graphing calculator in high level tasks there is little evidence to say that using the graphing calculator promoted students understanding of the high level task(Ocak 2008).

2.8 Trends in Calculator Research

1. *Problem solving.*

Some researcher(e.g Dick 1992 as cited in Dunham 1998) support that calculator can lead to improve problem solving ability, because they free more time for instruction, provide more tools and methods for problem solving and also as they freed students from the burden of computation and analyzing the solution. Research supports these observations. Hembree and Dessart's meta-analysis (1986) shows that using a calculator in problem solving creates a computational advantage and more often results in selection of a proper approach to a solution. Moreover, calculator use produces a greater positive effect size for high- and low-ability students than average-ability students. Dunham and Dick (1994) and others report that students using graphing technology (a) were more successful on problem solving tests (b) had more flexible approaches to problem solving (c) were more willing to engage in problem solving and stayed with a problem longer (d) concentrated on the mathematics of the problems and not the algebraic manipulation and (e) solved non routine problems inaccessible by algebraic techniques (Rich, 1991).

2. *Concept development.*

Irwin (1997) as cited in Dunham 1998, reports that calculators serve as catalysts for acquiring fraction concepts, in that most learning in her study resulted from students' reconsidering their ideas after finding conflicts between their expectations and the calculator results, while Cronin's (1992) study shows no significant difference in concept learning with fraction calculators. Graphing calculator use can significantly improve students' understanding of functions and graphs (Hollar, 1997; Kinney, 1997). According to Dunham and Dick (1994), students who use graphing calculators: (a) place at higher levels in a hierarchy of graphical understanding (b) are better able to relate graphs to their equations (c) can better read and interpret graphical information (d) obtain more information from graphs (e) are better at "symbolizing" .(f) understand global features of functions better (g) increase their "example base" for functions by examining a greater

variety of representations and (h) better understand connections among graphical, numerical, and algebraic representations.

3. *Computation Skills.*

Some researchers (Fleener, 1995; Futch & Stephens, 1997; Johnson, 1991 as cited in Dunham 1998) argue that calculator use will adversely affect computational skills. But there is a contrary result on other research, students who learn paper-and-pencil skills in conjunction with technology-based instruction (from simple four-function calculators to the most sophisticated CAS software) and are tested *without* calculators perform as well or better than students who do not use technology in instruction (Heid, 1997; Hollar, 1997 as cited in Hembree & Dessart 1992). Hembree & Dessart (1986, 1992) express concern for negative results with sustained calculator use at one grade level (4) and urge special attention to skill development at that level. Research indicates that teachers' beliefs about mathematics affect their beliefs about calculator use (Simmt, 1995); those who support "mastery first" often view mathematics merely as computation rather than a process for patterning, reasoning, and problem-solving (Fleener, 1994,1995). Teachers with a rule-based view of mathematics are more likely to believe that calculators will hinder rather than enhance learning (Futch & Stephens, 1997 as cited in Dunham, 1998).

4. *Calculator-induced errors.*

Although research supports the claim that calculator use improves student performance in computation, concept development, and problem-solving, a growing number of studies show that there may be a class of errors and misconceptions that are induced by calculators. Tuska (1993) as cited in Dunham 1998, identifies eight types of errors made by students using graphing calculators, such as considering every number as rational, assuming "solve" means "find zeros," and thinking of the domain as a subset of the range. Students' difficulties with scale (Goldenberg, 1988) are compounded by the flexible scaling required when using different window settings on graphing calculators (Dunham & Osborne, 1991).

5. *Classroom dynamics.*

One of the most profound impacts that graphing calculators may have is in changing the climate of the classroom, creating learning environments like those envisioned by the NCTM *Standards* (1989) . Farrell (1990, 1996) reports students become more active in classrooms with graphing technology in use, and do more group work, investigations, explorations, and problem solving; she says graphing calculators act almost as a third agent in the classroom as students consult with both the technology and the teacher. Some researcher (e.g Simonsen (1992), Dick and Shaughnessy (1988), and Slavit (1996)),all agree on that less lecturing by teachers and more investigations by students in graphing calculator classrooms, although some educators express concern that such explorations place an overemphasis on induction vs. deduction (Quigley, 1992). Hylton-Lindsay's (1998) claims that graphing calculator use enhances metacognition and encourages students to self-regulate thought processes, and Slavit (1996) reports higher levels of discourse and an increase in analytic questions when calculators are in use.

6. *Special populations.*

The "leveling" effect of calculator use is evident for a variety of groups traditionally disadvantaged because of different cognitive styles, learning disabilities, or special circumstances. Studies show that calculator use benefits non-visualizers (Galindo-Morales, 1995), low-ability and at-risk students (Hembree & Dessart, 1986, 1992;); non-traditional college students (Austin, 1997), students with learning disabilities (Glover, 1992), and those with low mathematical confidence (Dunham, 1995). One cluster of studies indicates gender differences in the effects of using calculators; there is evidence that with calculators female students perform as well as or better than males (Dunham, 1995). That is, in some instances, women and girls made greater gains with calculators than males did, and females who performed at lower levels than males without calculators reversed the pattern when calculators were in use (Austin, 1997). Christmann and Badgett (1997) as cited in Dunham 1998, report that, in a study of statistics achievement, males outperform females using computers, but the pattern reverses in favor of females when calculators are used. Explanatory factors may include reduction of

anxiety and increased confidence for female students (Bitter & Hatfield, 1993; Dunham, 1995). Jones and Boers suggest, however, that calculators do not give women an edge; rather, men are "deskilling" in algebra in the presence of calculators. Some studies show improvement in spatial visualization skills when instruction is calculator-based (Nimmons, 1998 as cited in Dunham,1998), and spatial ability is sometimes a significant predictor for mathematics achievement in women (Dunham,1998).

CHAPTER THREE
RESEARCH DESIGN AND METHODOLOGY

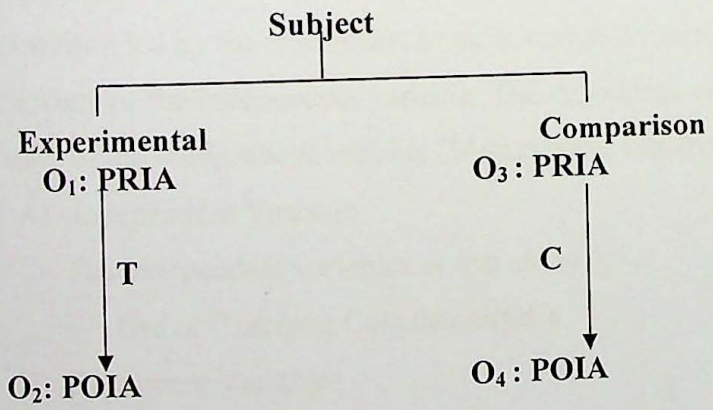
3.1 Research Design

The study aims to investigate the effects of graphing calculator on mathematics achievement and attitude of students in Cruise School, Addis Ababa and to answer the research questions posed in this research. The research study employed the quasi-experimental non-equivalent PRIA and POIA design. This design is often used in classroom when experimental and comparison groups are such naturally assembled groups as intact classes, which may be similar. Because this design may be the only feasible one, the comparison is justifiable, but, as in all quasi-experimental studies, the results should be interpreted cautiously.

3.1.1 Quantitative Research Design

A quantitative research approach is explaining phenomena by collecting numerical data that are analyzed using mathematically based methods. (Creswere 1994, cited in O'Donnell,2008). This study generated quantitative data through the use of a questionnaire and administering a PRIA and POIA test to participant students.

The PRIA-POIA Nonequivalent-Groups Design



It is the most appropriate design for measuring the impact or effectiveness of a program. The change is measured by comparing the difference in the phenomenon or variable(s) before and after the intervention. (Kumer,2005). Before the start of the experiment, the students were given an orientation on how to use a graphing calculator. The experiment lasted for 4 weeks, from February 15 to March 15, with the researcher handling the two intact classes which were scheduled on the same day, five times a week, and forty five minutes per period.

3.2 Source of Data

Primary Data Source: - Quantitative data was collected from the mathematics achievement of students and questionnaire .The attitude scale or the questionnaire has two parts the first part used to measure the attitude of students toward mathematics which is adapted from the Fennema-Sherman attitude scale and the second part was developed from Tapia & Marsh (2004)by the researcher to enable to know the attitude of students toward the use of Graphing Calculator.

3.3 Variables

The independent variable is called independent because it is independent of the outcome being measured. More specifically, the independent variable is what causes or influences the outcome. The dependent variable is called dependent because it is influenced by the independent variable. The independent variable is the factor that is manipulated or comparison led by the researcher. In most studies, researchers are interested in examining the effects of the independent variable. The dependent variable is a measure of the effect (if any) of the independent variable (Marczyk and Geofferey R.,1964).

A) Independent Variable

The independent variables of this study is

- Use of Graphing Calculators(GC)

B) Dependent Variables

Dependent variables of this study are;

- The students' mathematics achievement
- Attitude of students towards using GC

3.4 Sample or participants of the study

The participants of the study were grade 12 students of Cruise School who learnt in two sections. Each section consists of 65 students per class. One section has been assigned for the experimental group by simple random sampling and another section to be the comparison group. The experimental group learnt mathematics by using graphing calculator for four weeks, while the comparison group learnt mathematics by using traditional whole class instruction. Both sections were taught by the same teacher with equal time schedule, five periods per week and forty five minutes per period.

3.5 Sampling Method

The participants of the study i.e Grade 12 students were selected through purposive sampling. Purposive sampling is used to allow individual judgments to be used when selecting the participants. The researcher only selects those sections which in his opinion are likely to have the potential to do through the study. In addition the students in each group were classified into three groups by achievement level. To classify those students in to the three groups the researcher used the students' previous mathematics achievement. If the students scored $\geq 75\%$, then they were called higher achiever. If the students scored $50\% \leq X < 75\%$, then they were called medium achiever whereas those students who scored $<50\%$ were called lower achiever group. This grouping was made to assess the effect of the intervention (Assefa Enno,2004)

3.6 Instructional Method

During the beginning of the treatment period the researcher initially introduced the use of the Graphing calculator for the treatment group. In this time the students were required to explore and be familiar with the use of GC and its functions. After they were introduced

to GC, the researcher demonstrated the use of the GC based on the content that students learn during the time of treatment. The content was *derivative and application of derivative, integral calculus and application of integral calculus*. On the next stage the students tried to use GC to solve questions and saw the relationship between different concepts.

3.7 Research Instruments

Two research instruments were employed to collect data; a questionnaire and test (pre-intervention and post-intervention tests).

3.7.1 Questionnaire

Questionnaires have the power to obtain data from a large sample relatively inexpensive and are the most efficient way of collecting research data without placing pressure on its participants (Thietart 1999 cited in O'Donnell, 2008). This study used 5-level Likert scale questionnaire to measure students' attitude toward the subject of mathematics and the effect of graphing calculator on mathematics. The first set of questionnaire on attitude of students toward the subject mathematics contained 18 questions. The second set of questionnaire which measures students' attitude towards the effect of Graphing calculator on mathematics was classified into three levels; anxiety, negative thought and enjoyment.

3.7.1.1 Design of Questionnaire

The study employed two set of questionnaire. The first set of the questionnaire measures students' attitude towards the subject of mathematics in a form of Likert scale using 18 items (the first nine are negative and the rest nine are positive). The second set of the questionnaire measures the effect of GC on mathematics classified in terms of three variables; anxiety, negative thought and enjoyment.

1. Anxiety towards the use of graphing calculator. The questionnaire contains a series of 4 statements which measure anxiety.
2. Negative thoughts towards graphing calculator use in mathematics. The questionnaire contains a series of 7 statements which measure negative thought.
3. Enjoyment of graphing calculator use in mathematics. The questionnaire contains a series of 7 statements which measure enjoyment.

All items are closed-ended statements that ask each student to rate as either

- Strongly Agree
- Agree
- Undecided
- Disagree
- Strongly Disagree

Closed-ended statements were chosen since participants can rate them with minimal effort and it helps to control the diversity of the response.

3.7.2 Testing

The other instrument used to collect data was testing. The pre-test/post-test assessment is widely used and is accepted as a reliable measure of outcome assessment across many disciplines (Adam,1995). A pre-intervention achievement which was analyzed from the students' mark-list and post-intervention achievement test were utilized to assess the effect of graphing calculator in the mathematics achievement of students.

3.7.2.1 Design of post-test

To investigate students' ability on mathematics, their previous achievement was taken from their mark list. This helps the researcher to determine the students in each group whether or not similar in their mathematics ability. The post-test was designed based on the topic that the students on the treatment group learned through the help of graphing calculator but the students on the comparison group without the help of it. The topics are derivative and application of derivative, integral calculus and application of integral

calculus. The post-test contains thirty items (derivative 8 items, application of derivative 7 items, integration 8 items, application of integration 4 items, and limit and continuity 3 items to investigate the graph of a function).

3.8 Validity and Reliability of Instruments

A. Validity of Instrument

Validity is defined as the extent to which the instrument measures what it purports to measure (Miller,1997). The pre-intervention achievement of the students was analyzed from the previous result. The post tests used to address research questions under investigation. The face validity of each item in the post test was approved by other mathematics teachers, Department head and school exam committees. Best and Kahn (2002), described that the items of the instrument should represent a significant aspect of the purpose of the investigation. Content validity addresses to what extent the appropriate content is represented in questions. In this regard all the content that covered during the instruction time using Graphing Calculator included in the post test item. Construct validity is the degree to which an instrument measures the trait or theoretical construct that it is intended to measure. In this particular study all the questions are selected from the previous year's national exam papers. So all the questions ware capable to what the research intended to measure.

B. Reliability of Instruments

Reliability is defined as the extent to which a questionnaire, test, observation or any measurement procedure produces the same results on repeated trials. In short, it is the stability or consistency of scores over time or across raters (Miller,1997).

For this study the reliability of the instrument was checked by using SPSS software. The reliability of pre-attitude and post-attitude was checked using Cronbach's alpha coefficient. The pre-attitude scale has 18 questions, Cronbach's alpha 0.71. For the post-attitude scale, since the scale was divided based on the three attitude levels the

Cronbach's alpha coefficient was computed independently. Anxiety (4-items reliability coefficient is 0.74. Negative thought (7-items reliability coefficient is 0.734. Enjoyment (7-items reliability coefficient 0.746)

With regard to the pre-attitude responses 71% are similar and 29% are different. For the post-attitude scale, the anxiety responses are 74% similar, Negative thought 73.4% are similar and Enjoyment 74.6% are similar. Also the reliability of the post-test was checked using coefficient of Alpha Cronbach. Thus, the coefficient of Alpha Cronbach of the post-test was 0.721

3.9 Data Analysis

The data obtained from students through questionnaire and achievement record ware analyzed using statistical method. To interpret data the mean scores, standard deviation and mean difference were computed for both groups. Independent t-test, paired t-test and Regression analysis were also employed. The significance of differences between the mean scores and the mean differences of both the experimental and comparison groups were tested at $\alpha = 0.05$

An effect size is typically calculated by taking the difference in means between two groups and dividing that number by their combined (pooled) standard deviation. Intuitively, this tells us how many standard deviations' difference there is between the means of the intervention (treatment) and comparison conditions; for example, an effect size of .25 indicates that the treatment group out performed the comparison group by a quarter of a standard deviation. Cohen (1988) proposed rules of thumb for interpreting effect sizes . i.e 0 --- 0.2 small effect, 0.21---- 0.50 medium effect, 0.5---0.8 large effect. Each data was analyzed using the Statistical Package for Social Science SPSS.

3.10 Ethical considerations

All participants were informed about the content and purpose of the study prior to all data collection techniques being initiated. Permission was given from the principal of the school and permission was required from the participants to use the data collected to aid in the fulfillment of the research goals. Participants were also informed that they had the right to participate in the study freely. All the responses of the students were explained to be taken as confidential.

CHAPTER FOUR

4. PRESENTATION ANALYSIS AND INTERPRETATION OF DATA

4.1 Introduction

This chapter presents the major findings of the study. The data is organized in to tabular form and analyzed to answer the research questions;

- Is there any significant difference on attitude and achievement of students toward mathematics before and after learning mathematics with graphing calculator?
- Is there any effect of gender on attitude toward using Graphing Calculator in mathematics?
- Is there any significant difference in mathematics achievement between students who learned mathematics with graphing calculator and students who learned mathematics without graphing calculator?
- What is the effect of component of attitude on attitude towards using Graphing Calculator and achievement in mathematics?

4.2 Descriptive Statistics on Attitude

The first variable which was tested by the research study was the effect of graphing calculator (GC) on attitude of students toward mathematics. On this section a 5-Level Likert questionnaire was administered to the participant students to answer the research question "Is there any significant difference on attitude of students toward mathematics before and after learning mathematics with graphing calculator?" , the questionnaire contained a series of statements about students attitude toward mathematics to measure pre-attitude and students were asked to indicate their level of agreement with each statement(Strongly Disagree , Disagree, Undecided, Agree and Strongly Agree).Since the researcher was concerned to determine the attitude level, the Fennema- Sherman Mathematics Attitude scale which was prepared by Fennema-Sherman classified as positive and negative level of attitude was used. The post attitude questions consists Anxiety, Negative thought and Enjoyment which is designed by Tapia & Marsh (2004) an instrument to measure mathematics attitude and modified to measure the effect of

Graphing calculator in mathematics. The result of the questionnaire were reflected in Table 4.1 to 4.5

Table 4.1 Frequency table of Students attitude toward mathematics

	Inventory	1 SDA		2 DA		3 UD		4 A		5 SA			
		f	%	f	%	f	%	f	%	f	%	mean	s.d
1	I am no good in math	8	12.6	15	23.8	3	4.8	24	38.1	13	20.6	2.5	1.3
2	I don't think I could do advanced mathematics	23	36.5	28	44.4	5	7.9	6	9.5	1	1.6	4.1	0.9
3	I am not the type to do advanced mathematics	5	7.9	7	11.1	3	4.7	32	50.8	18	28.6	2.1	1.11
4	I am not the type to do well in math	2	3.2	6	9.5	4	6.3	25	39.7	26	41.3	1.8	1.00
5	Math has been my worst subject	35	55.6	8	12.7	11	17.5	4	6.3	4	6.3	4	1.31
6	Most subject I can handle OK but math is too hard for me	2	3.1	4	6.3	12	19	26	41.3	19	30.2	2.1	1.02
7	Mathematics will not be important to me in my life's work	32	50.8	9	14.3	14	22.2	5	7.9	3	4.7	4.1	1.14
8	Taking mathematics is a west of time	6	9.5	1	1.6	7	11.1	20	31.7	29	46	1.98	1.23
9	I expect to have little use for mathematics when I get out of school	13	20.6	32	50.8	8	12.7	11	17.5	0	0	3.76	0.96

An analysis of the result revealed that most students (58.7%) strongly agree or agree on the statement that they are no good in math. 81% students strongly disagree or disagree on the statements that they could not do advanced mathematics and they think themselves as the type to do advanced mathematics. For most students (68.3%) math is not their worst subject. Students also demonstrate agreement or disagreement on the following statements,

- I am not the type to do well in math (81%)(agree)
- Most subject I can handle OK but math is too hard for me (71.5%)(agree)

- I expect to have little use for mathematics when I get out of school (71.4%) (disagree)

From the analysis of the above result for most of the students mathematics is not their worst subject and they agree that it helps for their life's work but they do not feel that they can perform mathematics well. This implies we have to employ other method of instruction for a better approach.

Table 4.2 Frequency table of students' attitude toward mathematics

		1 SDA		2 DA		3 UD		4 A		5 SA		mean	S.d
10	I am sure I could do advanced work in mathematics	24	38.8	24	38.8	9	14.3	1	1.5	5	7.9	2.0	1.1
11	I am sure that I can learn mathematics	24	38.8	23	36.5	8	12.7	3	9.1	5	7.9	2.1	1.2
12	I think I could handle more difficult mathematics	17	26.9	24	38.8	6	9.5	8	12.7	8	12.7	2.44	1.3
13	I can get good grades in mathematics	25	39.7	30	47.6	6	9.5	0	0	2	3.2	1.8	0.9
14	I will need mathematics for my future work	11	17.5	14	22.2	14	22.2	8	12.7	10	15.9	2.89	1.3
15	I study mathematics because I know how useful it is	2	3.2	6	9.5	15	23.8	20	31.7	18	28.6	3.8	1.1
16	Knowing mathematics will help me earn a living	18	28.6	21	33.3	20	31.7	3	4.8	2	3.2	2.19	1.0
17	Mathematics is a worthwhile and necessary subject	0	0	4	6.3	5	7.9	27	42.9	24	38.8	4.2	0.8
18	I will use mathematics in many ways as an adult	30	47.6	25	39.7	7	11.1	0	0	0	0	1.6	0.7

77.6% students show their disagreement on the statement that they could do advanced work in mathematics. And 75.3% students show that they have no confidence on further learning of mathematics. Also students demonstrate agreement or disagreement on the following statements.

- I think I could handle more difficult mathematics (65.7%)(disagreement)

- I can get good grades in mathematics (87.3%)(disagreement)

- I will need mathematics for my future work (39.7%)(disagreement)

- I study mathematics because I know how useful it is (60.3%)(agreement)
- Knowing mathematics will help me earn a living (61.9%)(disagreement)
- Mathematics is a worthwhile and necessary subject (81.7%)(agreement)
- I will use mathematics in many ways as an adult (87.4%)(disagreement)

Students agree that mathematics is a useful subject and they study mathematics because of its usefulness but they disagree that they could perform mathematics well. So this implies the subject is too hard for most of the students. We have to develop their confidence on the subject by providing different instructional method and instructional materials.

The post attitude questionnaire administered to answer the question **"How are students attitude toward mathematics affected by the use of the Graphing Calculator?"**

The questionnaire contained a series of statements about students' attitude toward the usage of Graphing Calculators in mathematics and students were asked to indicate their level of agreement with each statement (Strongly Agree, Agree, Undecided Disagree and Strongly Disagree). The statements were divided in to three sections.

- Anxiety towards Graphing Calculator use in Mathematics
- Negative thoughts towards Graphing Calculator use in Mathematics
- Enjoyment of Graphing Calculator use in Mathematics.

1. Anxiety towards Graphing Calculator use in Mathematics

Table 4.3 Frequency table of students' anxiety toward the effect of graphing calculator on mathematics

	Inventory items	1 SDA		2 DA		3 UD		4 A		5 SA			
		f	%	f	%	f	%	f	%	f	%	mean	s.d
1	I do not feel comfortable when I learn math using a graphing calculator	33	52.4	10	15.9	8	12.7	6	9.5	6	9.5	3.98	1.33
2	The thought of using a graphing calculator in math activities frighten me	39	61.9	10	15.9	4	6.3	5	7.9	5	7.9	4.17	1.277
3	I am worried about using a graphing calculator because I don't know what to do if something goes wrong	14	22.2	18	28.6	12	19.1	13	20.6	6	9.5	3.30	1.303
4	The use of graphing calculator confuse me	16	25.4	14	22.2	10	15.9	14	22.2	9	14.3	2.7	1.41

In table 4.3 students demonstrate considerable collective disagreement with the following items

- I do not feel comfortable when I learn math using a graphing calculator (68.3%)
- The thought of using a graphing calculator in math activities frighten me (77.8%)
- I am worried about using a graphing calculator because I don't know what to do if something goes wrong (50.8%).

But most students are agree about the statements 'the use of graphing calculator confuse me' (52.4%), this happen in case of the students were new about using Graphing calculator. As we see from their response most of the students are not anxious about the use of the Graphing Calculator. So they displayed minimal anxiety level toward the usage of graphing calculator in mathematics. This implies teachers can employ the technology in the class room. The research conducted by Idris(2006) the result showed that students in the experimental group showed significantly greater reduction on mathematics anxiety

than students in the control group. And also the result of the study conducted by Acelajado(2002) shows that Positive effects of using graphing calculators include students' improved achievement, reduced anxiety in mathematics and increased self-confidence.

2. Negative thoughts towards the graphing calculator use in mathematics

Table 4.4 Frequency table of students' negative thought toward the effect of GC on Mathematics

	Inventory	1 SDA		2 DA		3 UD		4 A		5 SA			
		f	%	f	%	f	%	f	%	f	%	mean	s.d
1	Graphing calculators are good tools for calculation but not for my learning of math	17	27	10	15.9	11	17.5	9	14.3	16	25.4	3.02	1.58
2	I think learning to use a graphing calculator wastes too much time in the learning of math	39	61.9	12	19.1	6	9.5	3	4.8	3	4.8	4.29	1.09
3	I feel that graphing calculators should not be used in math test	17	27	9	14.3	2	3.17	5	7.9	30	47.6	3.4	1.76
4	I feel that graphing calculators should not be used for math homework	21	33.3	9	14.3	8	12.7	13	20.6	12	19.1	3.25	1.55
5	Graphing calculators should only be used to check my answer once I have worked the problems with pencil and paper	9	14.3	11	17.3	5	7.9	11	17.5	28	44.4	2.48	1.59
6	Using a graphing calculator in math will cause me to forget how to do basic computational skills	10	15.9	11	17.5	14	22.2	8	12.7	20	31.7	2.73	1.47
7	I understand mathematics better if I solve problems with paper and pencil	9	14.3	7	11.1	5	7.9	16	25.4	26	41.3	3.73	1.41

Table 4.4 contain a series of statements in the questionnaire looked at students negative thoughts towards the usage of the graphing calculator in mathematics. Students are disagree or strongly disagree on the statement that "graphing calculators are good tools for calculation but not for their learning of math" (42.9%). And also they agree on the

statement that graphing calculator should only be used to check their answer once they have worked the problems with pencil and paper (61.9%). Students agree that they understand mathematics better if they solve problems with paper and pencil (66.7%). On the other hand students disagree on the following statements.

- Learning to use a graphing calculator wastes too much time in the learning of math (81%)
- Graphing calculator should not be used in math homework (47.6%)

But 54.4% students agree that graphing calculator should not be used on math test. From the result as we see students have collectively a positive attitude towards the use of the graphing calculator. But it used only to check their answer after they worked the problems using paper and pencil, so we did not take it has a major role on mathematics learning but it has role as an aid.

A review of research on Student Achievement and Attitude In Computer and Calculator Enhanced Mathematics Courses by Barton (1998) stated that, Sixty-nine percent of the studies that examined attitude toward the technology found that, the experimental group had a positive attitude about using the technology (or a more positive attitude than students who did not use the graphing technology) and felt it had helped them learn mathematics.

3. Enjoyment of graphing calculator use in mathematics

Table 4.5 Frequency table of students' attitude toward the effect of GC on Mathematics

	Inventory	1 SDA		2 DA		3 UD		4 A		5 SA			
		f	%	f	%	f	%	f	%	f	%	mean	s.d
1	Graphing calculator make mathematics fun	8	12.7	8	12.7	18	28.6	10	15.9	19	30.2	3.29	1.39
2	Math is easier if graphing calculators are used to solve problems	9	14.3	10	15.9	7	11.1	15	23.8	22	34.9	3.37	1.56
3	I prefer to do all the graphing and other calculation with the use of graphing calculator	18	28.6	11	17.5	13	20.6	14	22.2	7	11.1	2.63	1.39
4	I want to get better at using a graphing calculator to help me with mathematics	9	14.3	8	12.7	8	12.7	20	31.7	18	28.6	3.49	1.41
5	I enjoy using a graphing calculator in mathematics activities	7	11.1	6	9.5	6	9.5	25	39.7	19	30.2	3.75	1.29
6	I enjoy investigating mathematics problems using a graphing calculator	10	15.9	4	6.3	8	12.7	18	28.6	23	36.5	3.17	1.44
7	Graphing calculator helps to see relationship between concepts	9	14.3	8	12.7	7	11.1	18	28.6	21	33.3	3.51	1.45

As the table shows the students were very interested about the use of the graphing calculator in mathematics. 46.1% student mean of 3.4 either strongly agree or agree on the statement that graphing calculator make mathematics fun. 58.7% of the students have positive outlook on the fact that math is easier if graphing calculators are used to solve problems. But they don't prefer to do all the graphing and other calculation with the use of graphing calculator with disagreement of 47.1%. 60.3% of the students agree that they want to get better at using a graphing calculator to help them with mathematics and 69.9% of them agree on the statement that "I enjoy using a graphing calculator in mathematics activities". Interestingly 61.9% of the students agree that graphing calculator helps to see relationship between concepts.

The percentages of these responses indicate students' positive attitude level reactions to the use of the graphing calculator in mathematics and students can enjoy mathematics when they learn using Graphing Calculator. Meta-analysis of different research on the effect of Graphing calculator on students' attitude as described in Susan 1998, thirteen studies surveyed students concerning the benefit of the technology in learning the concepts of the course. Sixty-nine percent of the studies that examined attitude toward the technology found that the experimental group had a positive attitude about using the technology (or a more positive attitude than students who did not use the graphing technology) and felt it had helped them learn mathematics. Twenty-three percent of the studies found no change in the experimental group's attitude toward the technology at the conclusion of the treatment (or no difference between treatment and comparison group).

The research conducted by Souter (2002) on the effect of Graphing calculator on attitude of students is supported this result, In reference to the research question concerning how technology enhanced algebra instruction compares with traditional algebra instruction in student attitude towards technology, 85% of the technology enhanced students answered that they enjoyed using technology in algebra, and 85% answered that technology makes algebra easier to learn. In the traditional classes, 80% answered that they would enjoy using technology in their algebra class, and 68% answered that technology would make algebra easier to learn. When asked if using technology in algebra is important, 72% of technology enhanced students agreed, and 40% of traditional students agreed. When asked if learning algebra was important, 65% of the technology enhanced students agreed, and 75% of the traditional students agreed.

The research conducted by Idris(2006) concluded the following which support the findings of this study. "Students generally have very positive attitudes towards graphic calculator and their use. Graphics calculators give students a powerful means of solving problems. Students enjoy using graphics calculators. Many graphic calculators provide students with an environment in which mistakes can be quickly and easily amended, trial solutions are encouraged, and mistakes often lead to unexpected results that encourage further exploration."

The data on pre and post intervention attitude and achievement of the students was analyzed using the Statistical Package for Social Science (SPSS) version 15.0. In order to investigate the research questions on attitude and achievement, the researcher state the questions independently. In order to support or reject the research questions the analysis employed different descriptive and inferential statistics, such as mean score, standard deviation, Independent and paired t-test etc.

4.3 **Analysis of the Result on Attitude**

To answer the research question "Is there any significant difference on attitude of students toward mathematics before and after learning mathematics with graphing calculator?" paired sample t-test was taken.

Table 4.6 Paired sample test of pre and post-attitude of students of experimental group.

		Mean	N	Std. Deviation	Std. Error Mean	t	df	Sig.(2-tailed)
Pair 1	pre	2.74	63	4.218	.531	-8.765	62	.000
	post	3.37	63	10.254	1.292			

As the result shows the mean score of pre attitude (2.74) is less than the mean score of post-attitude (3.37) of the students in experimental group. And as the t-values indicate there is a significant difference between the pre and post attitude of students. Therefore Graphing Calculator has a positive impact on attitude of students toward learning mathematics.

To answer the research question "Is there any effect of gender on attitude toward using Graphing Calculator in mathematics? Paired sample test was taken.

Table 4.7 Paired sample test of pre and post-attitude of male and female students of experimental group

		Mean	N	Std. Deviation	Std. Error Mean	t	df	Sig.(2-tailed)
Male	pre	2.777	25	4.093	.819	-6.420	24	.000
	post	3.464	25	8.939	1.788			
Female	pre	2.759	38	4.351	.706	-5.314	37	.000
	post	3.317	38	11.023	1.788			

As table 4.7 shows the mean pre-attitude of male students is 2.777 and for female students is 2.759 it shows the mean of the two groups are almost the same. Therefore there is no significant difference between the pre-attitude of male and female students toward mathematics. Since the mean scores of pre-attitude of male and female students are less than three collectively they have negative thought on the subject mathematics. But on the post-attitude the result (mean score of male 3.464 and female 3.317) shows there is an improvement on attitude of students toward learning mathematics with the use of Graphing Calculator.

The result of the study conducted by Farooq and Shah(2008) shows that, there is no significant difference in male and female students about the usefulness of mathematics, mathematics as male domain and mathematics teachers perception at secondary school level. The t-value in the study for total attitude mean scores indicates that there is no significant difference between the total mean scores of male and female students towards mathematics, therefore, the null hypothesis that "there is no significant effect of gender on students' attitude towards mathematics at secondary school level" is accepted at 0.05 level of significance.

To determine the effect of gender on students' attitude towards the effect of the use of Graphing Calculator in mathematics i.e anxiety, negative thought and enjoyment, independent t-test was taken.

Table 4.8 Independent t-test of gender and attitude of experimental group toward the use of Graphing calculator in Mathematics.

	SEX	N	Mean	Std. Deviation	Std. Error Mean	t	df	Sig.(2-taild)
Sum anxiety	female	40	3.56	3.008	.476	.251	61	.803
	male	23	3.51	2.266	.472			
Sum negative	female	40	3.29	5.602	.886	.291	61	.772
	male	23	3.24	4.488	.936			
Sum enjoy	female	40	3.41	6.458	1.021	.293	61	.770
	male	23	3.34	6.013	1.254			

Table 4.8 shows that, The value of t(61) = 0 .251 with p =0 .803 > 0.05 females were not significantly different from males on the attitude anxiety towards using Graphing Calculator in mathematics. The value of t(61) =0 .291 with p =0 .772 > 0.05 implies there is no statistically significant difference between female and male students attitude on negative thought toward the use of Graphing Calculator. The independent t-value t(61) = 0.293 with p = 0.770 , female and male students are not statistically different on their enjoyment attitude towards the use of Graphing Calculator.

The above table shows that both males and females are express almost the same attitude on the use of Graphing Calculator in mathematics. But the result in this study contradicts the research result of Doenges and Karen(1996) stated that ,a majority of the students

interviewed regarded the graphing calculator in a positive light. Most of the negative comments came from students low in spatial ability. Females made negative comments more than males in a ratio of 2 to 1. Females with low spatial skill exhibited more negative attitudes than males of low spatial skill. Sixteen out of 25 students noticed significant gender differences in attitudes and use of graphing calculators in their classrooms.

To answer the research question "What is the effect of component of attitude on attitude towards using Graphing Calculator?" regression analysis was taken.

Table 4.9 Regression analysis for the effect of component of attitude on attitude towards using Graphing Calculator.

R = 1.000					R^2 = 1.000	
ANOVA Table						
	Sum of squares	df	Mean Square		F	Sig.
Regression	6519.429	3	2173.143		490.035	.000
Residual	.000	59	.000			
Total	6519.429	62				
Attitude Levels in the equation						
Attitude level	r(constant)	B	Std. Error	Beta	t	Sig.
Anxiety	-1.8E-014	1.000	.390	.267	5.561	.000
Negative thought		1.000	.063	.506	19.502	.000
Enjoyment		1.000	.052	.610	19.704	.000

As shown in the above table $F(3,62) = 490.035$ indicates that the multiple correlation R were significant that is the students attitude levels anxiety, negative thought and enjoyment have a significant contribution on total attitude of students toward the effect of Graphing Calculator on mathematics. As the t-value indicates that the contribution of each of the attitude levels anxiety, negative thought and enjoyment were significantly affected the attitude of students toward the effect of Graphing Calculator on mathematics. From regression table above ,since $R^2 = 1.000$ for GC attitude then the three attitude levels anxiety, negative thought and enjoyment have 100% effect or contribution on GC

attitude. Anxiety, negative thought and enjoyment have a contribution of 15.4%, 38.3% and 46.3% respectively.

4.4 Analysis of the result on Achievement

4.4.1 General Descriptions of the Data

The means and standard deviations of the students' achievement of both groups are provided as follows. For all statistical analysis, $\alpha =$ 0.05 level of significant is used throughout the paper. The overall mean of PRIA for experimental and comparison groups were 53.41 and 56.20 respectively where as the standard deviation of experimental and comparison groups were 13.332 and 11.759. Similarly the overall mean of POIA for experimental and comparison groups were 56.87 and 59.38 respectively where as the standard deviation of experimental and comparison groups were 11.055 and 12.335 respectively.

To identify whether students in experimental and comparison groups were equal in their mathematics achievement the researcher tried to see the difference between the mean scores of pre-intervention achievement of both groups.

In order to answer the question ,is there any significant difference between the mean scores of the PRIA for the experimental and comparison group? An independent sample t- test was used.

Table 4.10 The mean scores of the PRIA of the experimental group and the comparison group

Group		N	Mean	Std. deviation	Std. Error	t	df	Sig.(2-tailed)
PRIA	Experimental	65	53.41	13.332	1.654	-1.266	128	.208
	Comparison	65	56.20	11.759	1.459			

Table 4.10 shows the independent t-test of the mean scores of the pre-intervention achievement of the experimental and comparison group. As we observed from table 4.10 of the independent t-test, the mean score of the experimental group (53.41) is less than the mean score of the comparison group (56.20).

In order to compare mean scores of pre-intervention achievement of the experimental (PRIA) and comparison group in terms of achievement, independent t-test was used. As revealed by the test, there is no statistically significant difference between the mean scores of the two groups (53.41, 56.20; $t(128) = -1.266$, $p = 0.208$). So there is no significant difference between the PRIA of experimental and comparison group. This shows that both groups were almost similar in their mathematics achievement at the beginning of the treatment given to the students.

In order to answer the research question "Is there any significant difference in students' mathematics achievement before and after learned mathematics with graphing calculator?" Compare the mean scores of pre-intervention and post-intervention achievement of the experimental group and paired sample test was used.

Table 4.11 Paired sample test of the mean scores of the PRIA and POIA of the experimental group.

		Mean	N	Std. Deviation	Std. Error Mean	t	df	Sig.(2-tailed)
Pair 1	PRIA	53.41	65	13.332	1.654	-2.559	64	.013
	POIA	56.87	65	11.055	1.371			

The table shows the paired samples t-test of the mean scores of the PRIA and POIA for the experimental group. The paired t-value between the PRIA and POIA of the experimental group showed a value of $t(64) = -2.559$ with $p=0$ .013 . Thus the result showed that there is a significant difference between the mean scores of PRIA (53.1) and POIA (56.87) of experimental group. Therefore we can accept that there is a significant difference between the mean scores of PRIA and POIA of experimental group at $p<0.05$.

The effect size of GC on the students' achievement is d= 0.28 which implies it has a medium effect. This result is the same as the finding by Idris (2006), that showed the students in the experimental group gained more scores from the pre-test to the post-test.

In order to answer the above research question with respect to sex paired sample test was used.

Table 4.12 Paired sample test of mean scores of PRIA and POIA for male and female students of the experimental group.

		Mean	N	Std. Deviation	Std. Error Mean	t	df	Sig.(2-tailed)
Female	PRIA	54.38	42	13.433	2.073	-.964	41	.340
	POIA	56.10	42	9.956	1.536			
Male	PRIA	52.22	23	13.149	2.742	-2.236	22	.036
	POIA	58.35	23	12.957	2.702			

The above result helps to determine the effect of GC on students of a certain sex. For female students the mean score of the PRIA and POIA were 54.38 and 56.10 respectively and for male students PRIA and POIA were 52.22 and 58.35 respectively.

In the above table 4.12, paired sample test of mean scores of the PRIA and POIA for female and male students of the experimental group at $p<0.05$ showed that a value of $t(41)= -0.964$ with p =0 .340 for female students .This entails that there is no significant difference between PRIA and POIA of female students of the experimental group. And the value of $t(22) = -2.236$ with $p = 0$ .036 for male students implies that there is a significant difference between PRIA and POIA for male students of experimental group. The effect size of GC on male students' achievement is d=0.45 which implies it has a medium effect. This implies GC has no significant effect on female students but it has medium effect on male. May be this happen in case of the differences of the number of female and male students in the class. Since male students are small in number they had

the opportunity to get the calculator frequently. So it had the effect on their achievement. Additionally, there is a striking gender difference in the *nature* of computer use: girls use computer technology only if it has clear relevance and a recognizable advantage. Boys, on the other hand, are more interested in exploring and discovering new facilities (Hennessy, 1999).With regard to this study, male students appeared to be more interested to use the Graphing Calculator. But in other research result the reverse was true for example, in some instances, women and girls made greater gains with calculators than males did, and females who performed at lower levels than males without calculators reversed the pattern when calculators were in use (Austin, 1997; Bitter & Hatfield, 1993; Bosche, 1998; Nimmons, 1998; Ruthven, 1990; Jones & Boers, 1993; Wilkins, 1995 as cited in Dunham,1998)

To determine the effect of GC on students of different achiever levels the researcher grouped students in to three achiever levels. Based on achievement, students are classified as grade greater than or equal to 75 high achievers (Ha) grade between 50 and 75 medium achievers and class grade less than 50 lower achievers. In order to answer the above research question and compare the mean scores of PRIA and POIA for higher, medium and lower achievers of the experimental group, paired sample test was used.

Table 4.13 Paired sample test of the mean scores of the PRIA and the POIA for higher, medium and lower achievers of the experimental group.

		Mean	N	Std. Deviation	Std.Error Mean	t	df	Sig.(2-tailed)
Ha	PRIA	82.80	5	5.450	2.437	-2.409	4	.074
	POIA	87.00	5	4.950	2.214			
Ma	PRIA	59.74	27	10.064	1.937	1.024	26	.315
	POIA	57.37	48	5.513	1.061			
La	PRIA	42.92	33	3.502	1.011	-1.545	11	.151
	POIA	45.33	12	3.701	1.068			

The above table shows the mean scores of the PRIA and POIA for higher, medium and lower achievers of the experimental group. The mean score of higher achievers was 82.80(S.D= 5.450) and 87.00 (S.D = 4.950), medium achiever 59.74 (S.D = 10.064) and 57.37 (S.D = 5.513) and lower achiever 42.92 (S.D = 3.502) and 45.33(S.D = 3.701) respectively in both PRIA and POIA. The result of POIA is greater than PRIA on both higher and lower achievers but POIA less than PRIA for medium achievers.

Table 4.13 showed the paired sample test of the PRIA and POIA of different achievers of the experimental at $p<0.05$. For higher achievers (Ha) the value of $t(4) = -2.409$ with $p = 0.074$ shows that there is no a significant difference between PRIA and POIA of higher achievers. For medium achievers $t(26) = 1.024$ with $p = 0.315$ .For lower achievers $t(11) = -1.545$ with $p = 0.151$ .Thus the result shows that there is no significant difference between PRIA and POIA of medium and lower achievers.

As we see from the above three tables (4.11 – 4.13) the mean score of students in the experimental group increases from PRIA (53.41) to POIA (56.87).As the t-test implies the change is significant and this significant change was seen on male students, the mean score of PRIA (52.22) changed to POIA (58.35). Graphing calculator as the medium effect on male students with effect size of d = 0.45. When we see the effect of using Graphing Calculator on different achiever levels, the change is not statistically significant on all achiever levels, but the mean score of higher and lower achievers was improved from PRIA to POIA. For medium achievers the mean score was not improved, but 21 students were ranked themselves from lower achievers to medium achievers. This implies Graphing Calculator has a potential to create initiative to learn for lower achievers.

Hembree and Dessart (1986, 1992) reported that the inclusion of calculators in the study of mathematics had a positive influence on students' attitudes toward mathematics. A second calculator meta-analysis (Ellington, 2003) supported many of the Hembree and Dessart results and also provided limited details on the graphing calculator's effect on achievement in precollege mathematics classrooms. In the same manner as Hembree and Dessart, the 54 studies conducted between 1983 and 2002 were separated according to mode of testing. When calculators were part of instruction but not used in testing, the skills needed to solve problems on mathematics achievement tests improved. On the

other hand, paper-and-pencil skills and the skills necessary to understand mathematical concepts were maintained but did not get better as a result of using calculators.

In a review commissioned by Texas Instruments (Burrill et al., 2002), a group of researchers synthesized the results of 43 quantitative and qualitative research studies on the use of handheld graphing technology in high school mathematics. The findings for mathematics achievement include "The improvements in achievement were more pronounced for low ability students when compared to average or high ability students."(as cited in Ellington (2006))

To answer the research question "Is there any significant difference in mathematics achievement between students who learned mathematics with graphing calculator and students who learned mathematics without graphing calculator?" the research employed independent t-test on POIA for experimental and comparison group.

Table 4.14 The independent sample test of mean scores of the POIA for the experimental group and the comparison group.

	GRUOP	N	Mean	Std. Deviation	Std. Error Mean	df	t	Sig.(2-tailed)
POIA	Experimental	65	56.87	11.055	1.371	128	-1.224	.223
	Comparison	65	59.38	12.335	1.530			

As shown in table 4.14 of independent sample test of mean scores of the POIA for the experimental group and the comparison group, the mean score of experimental (56.87) is less than mean score of comparison (59.38) but to generalize the significant difference we have to see the value of independent t test at $p< 0.05$. The result showed that $t(128)=-1.224$ with $p =0.223$. This result indicates there is no statistically significant difference between the mean scores of POIA for experimental and comparison group.

Table 4.15 Paired sample test of PRIA and POIA of comparison group

		Mean	N	Std. Deviation	Std. Error Mean	t	df	Sig.(2-tailed)
Pair 1	PRIA	56.20	65	11.759	1.459	-2.479	64	.016
	POIA	59.38	65	12.335	1.530			

As the result of the table shows t(64) = -2.479 with sig.= .016 there is no significant difference between PRIA and POIA of the comparison group. To compare the mean gain of the two groups paired sample test was taken.

Table 4. 16 Paired sample test of mean differences of experimental and comparison group.

		Mean	N	Std. Deviation	Std. Error Mean	t	df	Sig.(2-tailed)
Pair 1	MGC	2.02	65	10.336	1.282	-.667	64	.507
	MGE	3.28	65	10.823	1.342			

As the table shows t(64) = -.667 with sig. =0.507 ,there is no statistically significant difference between mean gain of experimental and comparison group. Therefore demonstrating Graphing calculator during instruction time in treatment group as a medium effect on achievement of male students, But it had no meaningful effect on achievement when compared with comparison group. This might be happen because of the duration of the treatment period.

This result agree with the finding of (Idris and Cheng 2011), the study which was conducted on eleven schools, there was no significant difference in mathematics achievement between the experimental and control groups for all the schools at $p < .05$. But it contradicts that, for each of the eleven schools, the mean mathematics achievement score of the experimental group was higher than that of the control group, indicating that the experimental groups performed significantly better than the control groups in the mathematics achievement test for the two topics of Straight Line and Statistics. The results suggest that graphic calculator based performance assessment was effective in improving students' mathematics achievement in the topics of Straight Line and

Statistics. In addition, Graham and Thomas' (2000) study which examined the effect of using graphic calculator activities in the teaching and learning of algebra on students' mathematics achievement showed that the experimental groups significantly outperformed the control groups on the post-test, even though there was no significant difference in mathematics achievement between the two groups on the pre-test.

To clarify the above result the research compares the two groups in terms of sex and achiever levels using independent t-test.

Table 4.17 Independent sample test of mean scores of the POIA of male and female students of experimental and comparison group.

		GROUP	N	Mean	Std. Deviation	Std. Error Mean	t	df	Sig.(2-tailed)
POIA	Male	Experimental	23	58.347	12.95660	2.70164	-.218	60	.828
		Comparison	39	59.076	12.59988	2.01760			
	Female	Experimental	42	56.54	10.190	1.632	-.844	66	.402
		Comparison	26	58.79	11.776	2.187			

The mean score of male students of experimental is 58.347 and comparison group is 59.076. The result of the table shows t(60)=-0.218 with value of p=0.828 >0.05 . So, there is no significant difference between male students of experimental and comparison group at p<0.05. The mean score of female students of experimental is 56.54 and comparison group 58.79. The result of the table shows t(66)= -0.844 with p =0.402 > 0.05 . So, there is no significant difference between the mean score of female students of experimental and comparison group at p< 0.05

As we see from the above table there is no statistically significant difference between the achievement of male and female students of both experimental and comparison group. Therefor we can conclude that, there is no significant difference in mathematics achievement between students of the two corresponding sex who learned mathematics with graphing calculator and students who learned mathematics without graphing calculator. As Li and Ma (1996) stated that sex is not the only factor, there are other factors that may contribute to mathematics teaching and learning with technology are the learner characteristics. Students' achievement, behavior, attitude towards mathematics and technology may depend on their gender, grade level, ability level, and socio-economical status (SES).

To identify the effect of graphing calculator on different achievers level between two groups, the researcher classifies students on both groups into three achiever levels. Higher achievers (Ha), (class grade greater than or equal to 75), medium achievers (Ma) (between 50 and 75) and lower achievers (La) less than 50.

In order to answer the above research question and compare the mean scores of the POIA of higher, medium and lower achievers of the experimental and comparison group, independent sample test was taken.

Table 4.18 Independent sample test of mean score of POIA of higher, medium and lower achievers of experimental and comparison group.

	GROUP	N	Mean	Std. Deviation	Std. Error Mean	t	df	Sig.(2-tailed)
Ha	Experimental	5	87.00	4.950	2.214	1.167	10	.270
	Comparison	7	82.57	7.323	2.768			
Ma	Experimental	48	57.3	5.545	1.800	-2.845	90	.060
	Comparison	44	60.48	7.389	1.140			
La	Experimental	12	45.33	3.701	1.068	.843	24	.406
	Comparison	14	44.29	2.614	.699			

Table 4.18 shows independent sample test of mean score of POIA of higher, medium and lower achiever of experimental and comparison group. The mean score of higher achiever of experimental were 87.00 and comparison were 82.57, the mean score of medium achiever of experimental 56.65 and comparison 60.48, for lower achiever experimental (45.33) is greater than comparison (44.29). To identify the effect of the treatment independent t value were taken. Thus for higher achiever of both groups $t(10)=1.167$ with $p=0.270$. This implies there is no significant difference between higher achievers of experimental and comparison group on their POIA at $p< 0.05$. For medium achievers $t(88)=-2.802$ with $p =0.060$. This implies there is no a significant difference between medium achievers of experimental and comparison group at $p<0.05$. Since the mean score of the comparison group is greater than the experimental group there is another factor that affect the achievement of the comparison group medium achievers. The traditional method of teaching has its own role to improve students' achievements and also since there was learning, change obviously occurred. For lower achievers $t(24)=0.843$ with $p =0.408$. There is no significant difference between lower achievers of experimental and comparison group at $P < 0.05$.

The study conducted by Lyublinskaya and Tournaki (2011) on Student achievement measured via a midyear department test; Fall and Spring semester grades; and New York State Regents exam scores and passing rates ,as the result shows there were no significant differences between the control and experimental groups or between different levels in the Regents exam scores. There results indicate that the TI-Nspire technology had a different impact on the performance of students of different achievement levels. The higher achieving students who used TI-Nspire performed significantly better on school/teacher made assessments (which is the same as the result of this study). Lower achieving students on the other hand, are still struggling with basic skills and concepts that could be targeted equally by graphing calculator and TI-Nspire technology. But on this study higher and lower achievers of the experimental group perform better although not significant.

To answer the research question "What is the effect of component of attitude toward the use of Graphing Calculator on achievement in mathematics?" regression analysis was employed.

Table 4.19 Regression of achievement as a function of attitude on the effect of the use of Graphing Calculator in mathematics.

R = .226				R^2 = .051	
ANOVA Table					
	Sum of squares	df	Mean square	F	Sig.
Regression	330.035	3	110.012	1.059	.374
Residual	6130.364	59	103.904		
Total	6460.399	62			

Variables in the equation						
Attitude Levels	r	B	Std. Error	Beta	t	Sig.
Anxiety	58.760	-.578	.526	-.155	-1.099	.276
Negative thought		-.053	.281	-.027	-.188	.852
Enjoyment		.298	.212	.182	1.401	.166

In the regression table above, F(3,59) = 1.059 with sig. 0.374 indicates that the multiple correlation R were not significant that is the contribution of all attitude levels anxiety, negative thought and enjoyment collectively do not significantly affect the mathematics achievement of students. Similarly t values indicate that the contribution of each of the attitude levels, anxiety, negative thought and enjoyment do not have significant effect on the achievement of students.

From the regression table since R^2 = .051 for mathematics achievement the three attitude levels anxiety, negative thought and enjoyment had 5.1% effect or contribution for mathematics achievement . This indicates the contribution of the three attitude levels had little effect only 5.1% almost 94.9% were other factors which have contribution on students' mathematics achievement. To see the contribution of each anxiety 2.2%, negative thought 0.1% and enjoyment 2.8%.

CHAPTER FIVE

5. SUMMARY OF THE FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The purpose of the study was to investigate the effect of using Graphing Calculator on students' achievement and attitude levels toward mathematics. This chapter presents the summery of findings, conclusion and recommendations.

5.2 Summary of Findings

The finding of the study are summarized as follows

- There is no significant difference between male and female students on pre-attitude towards mathematics. The mean of both students is 2.75 it tends to the negative attitude towards mathematics. Sex of the students does not affect the pre-attitude towards mathematics. Also sex has no significant effect on the three attitude levels (anxiety, negative thought and enjoyment) towards the effect of using Graphing calculator in mathematics.
- The three attitude levels, anxiety, negative thought and enjoyment have 100% contribution on the attitude towards the effect of Graphing Calculator on mathematics. And anxiety has 15.4%, negative thought 38.3% and enjoyment has 46.3% contribution on the attitude of the effect of using Graphing Calculator on mathematics.
- The contribution of each of the attitude levels, anxiety, negative thought and enjoyment were not significantly affect the mathematics achievement of students. All the three attitude levels have only 5.1% effect or contribution on mathematics achievement.
- There is no significant difference on the total students but GC has a significant difference on the achievement of male students of experimental group. There is a striking gender difference in the *nature* of computer use: girls use computer technology only if it has clear relevance and a recognizable advantage. Boys, on the other hand, are more interested in exploring and discovering new facilities.

(Hennessy,1999).With regard to this study, male students appeared to be more interested to use the Graphing Calculator. But this needs further investigation.

- There is no significant difference between the mean scores of pre-intervention achievement of experimental and comparison group. This helped the researcher to know the background of the students on mathematics achievement. In this case both students in experimental and comparison group had almost equal mathematics achievement.
- There is a significant difference between the PRIA and POIA of the experimental group which implies GC has a medium effect on students mathematics achievement with respect to sex, GC has no significant effect on female students mathematics achievement of experimental group but for male students GC has a medium effect at $p < 0.05$.
- There is no statistically significant difference between the mean scores of PRIA and POIA of different achievers of experimental group, but the mean scores of higher and lower achievers was improved from PRIA to POIA. For medium achievers the mean score was not improved, but 21 students are ranking themselves from lower achievers to medium achievers.
- There is no significant difference between the mean scores of POIA for experimental and comparison group and also there is no significant difference between the mean score of POIA of male and female students of experimental and comparison group. For different achievers of the two groups there is no significant difference between the mean scores of POIA for higher, medium and lower achievers of both experimental and comparison group.

5.3 Conclusion

Technology has a great role for today's advancement of human day to day life. Education is the basic need of every human society. Therefore technology has a major role for improving education quality. When students learn mathematics they can improve their thinking and problem solving ability, so the aid of technology for learning mathematics can enhance such abilities. To support classroom teaching and learning effectively, teachers must build a community in which students will feel free to express their ideas and create a climate for success. Teachers can succeed in creating communication rich environments in mathematics classrooms by using graphing calculator as a tool in his/her teaching.

One of the fruits of technology as an aid of mathematics learning is Graphing Calculator. Graphing Calculator was a new technology or instrument for my students .They have no experience of using the calculator. But they are eager to learn about it and to use it. Rarely to say it helps to improve their mathematics achievement as we see from the result, but the students are more interested by learning with the use of the calculator. And also as we see from the summery of the findings it helps some group of students like male students of the experimental group to improve their result.

For many students mathematics class is somehow uninterested, it is too hard to catch up their interest. But as we see from the inventory when they learn with the help of graphing calculator they enjoy math class. So it can be conclude that it improves students' attitude towards mathematics learning.

Students' participation to explore problems using Graphing Calculator during this particular study was insignificant, since they had no exposure to the technology. This might have its own impact on the result of this research. Despite of this limitation, when students tend to be more engaged and involved in their own learning they develop positive attitude towards mathematics.

The three attitude levels anxiety, negative thought and enjoyment of Graphing Calculator use have no significant contribution on students' mathematics achievement. This implies the achievement of the students was not dependent on the use of the calculator during the study. This could be because of other factors which are not considered in this study. Also the achievement of the comparison group increases more on POIA than PRIA. Therefore it can be concluded that the mathematics achievement is not based only on the role of Graphing Calculator.

5.4 Recommendations

Based on the results of the findings, the researcher forwards some suggestions and recommendation.

- The small sample size restricts the generalizability of this study. Hence the findings cannot be generalized to the whole population of mathematics. Therefore, this study should be repeated with more participants using many schools.
- The research was conducted to investigate the effect of Graphing Calculator on mathematics achievement and attitude of students toward mathematics but not for teachers, therefore further research is needed to identify teachers' attitude towards the usage of Graphing Calculator in mathematics class.
- This study focused on the effect of Graphing Calculator use on mathematics attitude and achievement. Other technologies should also be explored to establish if they can help to improve students' attitude and achievement of mathematics.
- This study did not prescribe an effective instructional strategy for incorporating the Graphing Calculator into students' mathematical learning. Research could be undertaken to analyze appropriate Graphing Calculator use.

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APPENDEX I

Addis Ababa University School of Graduate Studies College of Education and Behavioral Studies Department of Science and Mathematics Education

M. Ed in Mathematics Education

Questionnaire to be filled by Students

INTRODUCTION: - The purpose of this questionnaire is to determine students' attitude towards the subject mathematics. In this regard, the response that you give is of great value to the success of this study. In order to protect your privacy please do not write your name on any of the page throughout this questionnaire but write yours sex on the space given below. I thank you for spending time to fill in this questionnaire.

DIRECTION: - This inventory consists of statements about your attitude toward the subject mathematics. There are no correct or incorrect responses. Read each item carefully. Please think how you feel about each item. Place an X in the box that closely corresponds to how the statements best describe your feelings. Use the following response scale to respond to each item.

Sex _____

PLEASE USE THESE RESPONSE CODES: 1. Strongly disagree

2. Disagree
3. Not decide
4. Agree
5. Strongly Agree

Section 1. Attitude of students toward the subject mathematics

	Inventory	1	2	3	4	5
1	I am no good in math					
2	I don't think I could do advanced mathematics					
3	I am not the type to do advanced mathematics					
4	I am not the type to do well in math					
5	Math has been my worst subject					
6	Most subject I can handle OK but math is too hard for me					
7	Mathematics will not be important to me in my life's work					
8	Taking mathematics is a west of time					
9	I expect to have little use for mathematics when I get out of school					
10	I am sure I could do advanced work in mathematics					
11	I am sure that I can learn mathematics					
12	I think I could handle more difficult mathematics					
13	I can get good grades in mathematics					
14	I will need mathematics for my future work					
15	I study mathematics because I know how useful it is					
16	Knowing mathematics will help me earn a living					
17	Mathematics is a worthwhile and necessary subject					
18	I will use mathematics in many ways as an adult					

APPENDEX II

Addis Ababa University School of Graduate Studies College of Education and Behavioral Studies Department of Science and Mathematics Education

M. Ed in Mathematics Education

Questionnaire to be filled by Students

INTRODUCTION:- The purpose of this questionnaire is to determine the effect of graphing calculator on students' attitude levels in mathematics. In this regard, the response that you give is of great value to the success of this study. In order to protect your privacy please do not write your name on any of the page throughout this questionnaire but write yours sex on the space given below. I thank you for spending time to fill in this questionnaire.

Sex_____

DIRECTION:- This inventory consists of statements about your attitude toward the effect of graphing calculator on mathematics. There are no correct or incorrect responses. Read each item carefully. Please think how you feel about each item. Place an X in the box that closely corresponds to how the statements best describe your feelings. Use the following response scale to respond to each item.

PLEASE USE THESE RESPONSE CODES: 1. Strongly disagree

2. Disagree

3. Not decide

4. Agree

5. Strongly Agree

Section 2. Attitude of students' toward the effect of Graphing Calculator on mathematics.

1. Anxiety towards graphing calculator use in mathematics

	Inventory items	1	2	3	4	5
1	I do not feel comfortable when I learn math using a graphing calculator					
2	The thought of using a graphing calculator in math activities frighten me					
3	I am worried about using a graphing calculator because I don't know what to do if something goes wrong					
4	The use of graphing calculator confuse me					

2. Negative thoughts towards the graphing calculator use in mathematics

	Inventory	1	2	3	4	5
1	Graphing calculators are good tools for calculation but not for my learning of math					
2	I think learning to use a graphing calculator wastes too much time in the learning of math					
3	I feel that graphing calculators should not be used in math test					
4	I feel that graphing calculators should not be used for math homework					
5	Graphing calculators should only be used to check my answer once I have worked the problems with pencil and paper					
6	Using a graphing calculator in math will cause me to forget how to do basic computational skills					
7	I understand mathematics better if I solve problems with paper and pencil					

3. Enjoyment of graphing calculator use in mathematics

	Inventory	1	2	3	4	5
1	Graphing calculator make mathematics fun					
2	Math is easier if graphing calculators are used to solve problems					
3	I prefer to do all the graphing and other calculation with the use of graphing calculator					
4	I want to get better at using a graphing calculator to help me with mathematics					
5	I enjoy using a graphing calculator in mathematics activities					
6	I enjoy investigating mathematics problems using a graphing calculator					
7	Graphing calculator helps to see relationship between concepts					

APPENDEX III

The following questions are used to analyze students' post-intervention achievement

CHOOSE THE CORRECT ANSWER FOR THE FOLLWING QUESTIONS FROM THE GIVEN ALTERNATIVES AND WRITE YOUR LETTER OF CHOICE IN CAPITAL LETTER

1. If $f(x) = x^5$ *then* $\lim_{h\to 0} \frac{f(2+h)-f(2)}{h}$ equals

   A. 12 B. 80 C. 120 D. 16

2. Let $f(x) = g(\sqrt{3x+3})$ and g'(3)= 5, then f'(2) is equal to

   A. $\frac{1}{3}$ B. $\frac{3}{5}$ C. $\frac{3}{4}$ D. $\frac{5}{2}$

3. If y = ln(x^2+1) = , then $\frac{d^2y}{dx^2}$ is equal to

   A. $\frac{1-2X^2}{X^2+1}$ B. $\frac{-2(X^2-1)}{X^2+1}$ C. $\frac{-2(X^2-1)}{(X^2+1)^2}$ D. $\frac{2-4X^2}{(X^2+1)^2}$

4. Let $f(x) = x^4 - \frac{16}{3}x^3 + 6x^2$ for all x ε(-∞, ∞) , what is the range of f?

   A. $(-\infty, \infty)$ B. $[0, \infty)$ C. $[-9, \infty)$ D. $(-9, \frac{5}{3})$

5. Which of the following is the slope of the line tangent to the graph of $\log_2(x^2 - 4)$ at x= -6

   A. -4ln2 B. $\frac{-3}{8ln2}$ C. $\frac{-5}{4ln2}$ D. -6ln2

6. The equation of the line tangent to the graph of f(x) = 2x- sin$(1 - x)$ at $(1, f(1)$

   A. Y-3x +5 = 0 B. y – 3x + 1 = 0 C. y-x-1= 0 D. y –x +3 = 0

7. Which of the following is an anti-derivative of the function $f(x) = \frac{x+1}{x+2}$?

   A. x- ln$|X + 2|$ + 2 B. 1+ ln|x+1| C. ln$|\frac{x+1}{x+2}|$ + 1 D.ln|x+2|-2

8. If f'(x) = $\frac{4}{x} - 6x + 9$ and f(1) = 10, then the formula for f(x) is

   A. 4lnx – $3x^2$ + 9x + 4 B. 4lnx + $3x^2$ + 9x – 4 C. $\frac{4}{lnx}$ −3x+6x D. 4lnx – $3x^2$- 9x- 4

9. When evaluated $\int \frac{1}{\sqrt{x}} \sin\sqrt{x}\ dx$ is equal to

   A.$\sqrt{X}\ \cos\sqrt{X} + C$ B. $2\cos\sqrt{X} + C$ C. $-2\cos\sqrt{X} + C$ D. $\sin\sqrt{X} + \cos\sqrt{X} + C$

10. $\int COS^3\ X\ dx$ is equal to

    A. $\frac{1}{4}\sin X COS^4\ X + C$ B. 3$\cos^3$sinx +c C. sinx - $\frac{1}{3}\sin^3$x + c D. −sinx-$\frac{1}{3}\sin^3$x+c

11. $\int(\frac{x}{x+1})^2 dx$ is equal

A. X +ln|x+1| B. $\frac{1}{3}ln|x+1|+4$ C. x - $\frac{2}{(x+1)^2}-\frac{x}{x+1}+4$

D. x- $\frac{1}{x+1}-2ln|x+1|+4$

12. An ant-derivative of the function f(x) = $\frac{e^x}{e^x+1}$ is

A. $1+e^x$ B. ln(1+e^{-x}) C. ln(1 +e^x) D. e^x+e^{-x}

13. Which of the following is equal to $\int\frac{x^2-1}{x^3+x}dx$?

A. ln(x^2+1) + ln|x| + c B. $\frac{1}{2}\ln(x^2+1)-ln|x|$

B. $\ln(x^2+1)-ln|x|+c$ D. $2\ln(x^2+1)+ln|x|+c$

14. $\int_{\frac{\pi}{4}}^{\pi}\sin x dx$ is equal to

A.$\frac{\sqrt{2}+2}{2}$ B. $\frac{\sqrt{2}-2}{2}$ C. $\frac{2-\sqrt{2}}{2}$ D. $\frac{\sqrt{2}}{2}$

15. Which of the following is the value of $\int_0^{\sqrt{\pi}} x\sin(x^2+3)dx$

A. Cos3 B. –cos3 C. sin3 D. –sin3

16. On which of the following intervals is the graph of $f(x)=\frac{x}{x^2+9}$ decreasing?

A. $(-\infty,\infty)$ $B.[-3,3]$ $C.\ (-\infty,-3]U[3,\infty)$ $D.[3,\infty)$

17. Given the equation x + xy^2- y = xy. Then $\frac{dy}{dx}$ is equal to

A. $\frac{Y^2+y-1}{2xy+x-1}$ B. $\frac{y-y^2-1}{2xy-x-1}$ $C.\frac{2xy-x}{y-y^2}$ $D.\frac{y^2-y+1}{2xy-x+1}$

18. The radius of a sphere is increasing at a rate of 6cm/min. What is the rate of change of volume when the radius is 5cm?

A. 108πcm^3/min B. 600πcm^3/min C. 348πcm^3/min D. 750πcm^3/min

19. Given the equation x^3 +y^3 = 3xy. Then $\frac{dy}{dx}$ is equal to

A. $\frac{X^2-y}{x-y^2}$ $B.\frac{x+y^2}{x^2-y}$ $C.\frac{y-x^2}{y^2-x}$ $D.\frac{x-y^2}{x^2-y}$

20. $\int_0^1(e^{-x}+e^x)dx$ is equal to

A. e- $e-\frac{1}{e}$ $B.e-\frac{1}{e}-1$ $C.\frac{1}{e}-e$ $D.e+\frac{1}{e}$

21. $\int_0^2(e^{-x}+e^x)dx$ is equal to

A. $\frac{2}{3}ln2-\frac{2}{3}$ $B.6ln3-\frac{10}{3}$ $C.6ln3-\frac{8}{3}$ $D.18ln3-24$

22. What is the area of the region enclosed by the graphs f(x) = x^2-2 and g(x) = x?

A. $\frac{7}{3}sq.unit$ $B.\frac{19}{6}sq.unit$ $C.\frac{27}{6}sq.unit$ $D.8sq.unit$

23. What is the area of the region bounded by the graph of y = tanx and x-axis between x=0 and x =$\frac{\pi}{4}$?

A. ln2 B. ln$\sqrt{2}$ C.1 D. ln4

24. What is the volume of the solid generated by revolving the region bounded by the graph of $f(x) = 4^x$ and the x-axis from x=0 to x=1 about the axis

A. $\frac{15}{ln16}$ B. $\frac{15\pi}{ln16}$ C. $\frac{ln16}{15\pi}$ D. $\frac{15}{16}$

25. Which of the following is the volume of the solid obtained when the graph of y = cosx on $[0,\pi]$?

A. $\frac{1}{2}\pi^2$ B. $\frac{1}{2}\pi$ C. $\frac{1}{2}\pi + 1$ D. $\frac{1}{2}\pi - 1$

26. Which of the following is the volume of the solid generated by revolving about the x-axis the region between the graphs of $f(x) = x^2$ and $g(x) = \sqrt{x}$?

A. $\frac{\pi}{5}$ B. $\frac{5\pi}{24}$ C. $\frac{\pi}{6}$ D. $\frac{3\pi}{10}$

27. $\lim_{n\to 8} \frac{n-8}{\sqrt[3]{n}-2}$ is equal to

A. 1 B. π C. 2π D. 0

28. Which of the following is equal to $\lim_{x\to\pi} \frac{xsin2x}{x-\pi}$?

A. 1 B. π C. 2π D. 0

29. What is the largest interval(s) on which the function $f(x) = \sqrt{\frac{x-1}{x}}$ is continuous?

A. $(-\infty, 0)U[1,\infty)$ B. $(-\infty, 0)U[1,\infty)$ C. $(-\infty, 0)U(1,\infty)$ D. $(0,\infty)$

30. Let $f(x) = \frac{a}{x^2+3}, if x \leq 1$

$\frac{x-1}{\sqrt{x}-1}, if\ x > 1$ What is the value of a if f is continuous at x=1?

A. 0 B. 2 C. 4 D. 8

Declaration

I declare that **the effect of Demonstrating Graphing Calculator on Grade 12 Students' Attitude & Achievement on Mathematics in Cruise School,** is my own work and that all the sources that I have used or quoted for references are acknowledged.

Tesfamichael Fufa

Signature _____

Date October, 2013