EFFECT OF GUIDED SCORING STRATEGY ON STUDENTS' ACHIEVEMENT AND INTEREST IN QUADRATIC EQUATIONS AT SENIOR SECONDARY SCHOOL LEVEL

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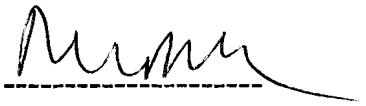

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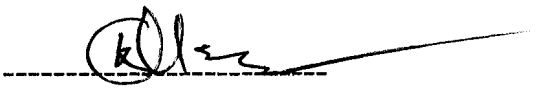

supervisor

DEDICATION

This work is dedicated to God Almighty and all who contributed in one way or the other to my success.

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ABSTRACT

The purpose of this study was to investigate the effect of guided scoring strategy on students' achievement and interest in quadratics equations. The effect of gender on the efficacy of the method was also considered. Four research question and six null hypotheses guided the study. a non equivalent control group type of quasi –experimental design was used for the study. The simple random sampling technique was used to select two schools, one from Ika South educational zone and one from Ika North East educational zone of Delta state. One intact class from each of the schools, making two classes, were used for the study. All the groups completed the same unit (Quadratic Equation) over a period of three weeks. Both the experimental and control groups were taught by the researcher to avoid teacher differences. Two instruments were used for this study, the Quadratic Equation achievement test (QEAT) and the mathematics interest scale MIS. These instruments were developed, validated, and used for data collection. Means, standard deviations and analysis of covariance (ANCOVA) were use to analyse the data, answer the research questions and test for the hypotheses. The study revealed that: the use of guided scoring strategy in teaching quadratic equation increases students' achievement in mathematics. The use of guided scoring strategy in teaching mathematics increases students' interest level in mathematics. The achievement and interest levels of students taught with guided scoring strategy are not affected by their gender.

CHAPTER ONE

INTRODUCTION

Background of Study

Mathematics is the study of patterns of structures, change, space; it is the study of figures and numbers. Mathematics is the touchstone of wit and whetstone of intelligence. It is the master and servant of most disciplines and source of enlightenment of human understanding of the universe (Osafehinti 1999). The importance of mathematics transcends all definitions and description. In all the entire history of education, mathematics has held it's leading position among all other school subjects because it has been considered as an indispensable tool in the formation of the educated man. At most basic level, the knowledge of mathematics in the conduct of everyday living and the natural and social sciences, advanced mathematics concepts and techniques are indispensable tools. According to Osafehinti (1999) no other subject forms a binding force among various branches of science namely physical, biological and social, as well as mathematics and without it knowledge of the sciences often remains superficial.

In Nigeria for example the study of mathematics is made compulsory for students in primary and secondary school levels. This is because apart from the fact that success in the subject enhances the quality of students'

certificates the trend has shown that in order to secure admission to most courses at higher levels of education, a credit pass in mathematics is an advantage. Therefore, the importance of mathematics cannot be overemphasized.

For many years Nigerian secondary school students achievement in the ordinary level mathematics examination have been considerably poor. A study conducted by Nigerian Educational Research and Development council (NERDC) in 1997 on the achievement of students in public examinations over some years has confirmed students' poor achievement in physical sciences (Mathematics, physics and chemistry) which form the foundation of future study in much of technology needed in Nigeria.

The research reports below have offered several reasons for students poor achievement in mathematics; the reasons include students background problem (Buhari 1994), students lack of interest and or negative attitude towards mathematics (Ale 1989) some that are teachers related according to Adebola (1999) includes poor teacher preparation, shortage of quality mathematics teachers, poor method of teaching, non use of instructional of materials in the teaching of mathematics concept (Agwagah 2001). Adebola (1999) also states that the reason could also be subject matter related. According to Oragwarn (2000) poor achievement can also be as a result of

marking scheme known to teachers only (students do not know how marks are awarded or lost).

For this reason, the search for ways and means of improving the teaching and learning of mathematics is a continuous exercise. The continuous search and implementation of results have resulted in the number of changing fashion in mathematics teaching in recent years. For example, there is the Target task approach, Delayed formalization approach, Heuristic method, laboratory method (Obodo, 2004). There is the use of mathematical games, model, and simulations (Agwagah, 2001) there is also the use of concept mapping in teaching mathematics (Agwagah, 2000).

Another problem facing the teaching and learning of mathematics is the shortage of human resources in mathematics. A lot of efforts have been made to address this problem. These include the use of unqualified teachers, overpopulation of the classroom and overloading of the available mathematics teachers (Usman, 2003). The shortage of human resources which leads to the over loading of the available ones as revealed by (Usman, 2003), makes it difficult to give homework for students extra practice . In a bid to cover the number of topics that they have to cover within specified time, it is almost impossible for them to plan and include the method of

examination scripts to reveal the importance of some steps in the process of solving mathematical problems.

Mathematics by nature is process oriented and through these processes, the child acquires experiences which not only illuminates mathematics but also increases the child's mathematical creativity and effectiveness. Due to this fact, the scoring of any mathematics test places emphasis on the process which differs from individual to individual. Bodies like West African examination council (WAEC) National Teachers Institute (NTI), National Board of Educational Measurement (NBEM) National Business and Technical Examination Board (NABTEB) and the National Examination council (NECO), adopt systems and marking guides which reveal the importance of the process of arriving at an answer by allocating more marks to the steps taken to arrive at an answer than the answers itself. Marks which are adopted include;

M - Method mark

B - Basic knowledge mark

A - Accuracy mark

This emphasis on process has made it mandatory for mathematics teachers to fully adopt an instructional strategy that may guide students

through the necessary process while solving mathematical problems and to emphasis that students develop their abilities in this direction. A guide is something that helps you to plan your actions or to form an opinion about something (B.B.C Dictionary 2nd Edition). Scoring is the allocation of marks at each point or step of the solving process of a mathematical problem. Strategy is the art of planning the best way to achieve something. A process is a series of action or events which have a particular result (BBC Dictionary 2nd Edition)

Guided scoring is exposing students to method of awarding marks during the marking of their examination papers especially the external examination; here the students are shown the steps marks are awarded, that is, the importance of each step is made known to them and they are adviced to act and move in that direction. The students' attentions are also drawn to some cases where the omission of certain steps will lead to the lost of the marks for that step and the next step. According to Cindy (2002), guided scoring is based on the standards of what students should understand or be able to do. It also gives clearer expectations about what will be assessed as well as standards that need to be met.

This study is interested in using guided scoring as an instructional strategy that is a way of achieving a better achievement in mathematics. In

this instructional strategy, students are exposed to the process that attains M, B, and A marks during the marking of their examination especially external examinations (JSCE and SSCE). The essense is for students to know where and how marks are awarded and lost during the marking exercise. When teachers attend coordinations for marking, whether they are partaking in the marking exercise or not they will be able to guide their students in this direction. The problem is that even though teachers realize the importance of process in solving mathematical problems, they do not show the students the important steps that need to be shown in their working and these defeats the main aim of the problem solving process. Some teachers do not bother to draw up marking schemes and if they do, it is only known to them. All that students realize is that they do not score as much as they actually expected for reasons best known to the teacher (Oragwam 2000).

Students' attention should be drawn to some aspects of the general instructions of the marking schemes of general mathematics. According to the general instructions of may/June 2005 WASSC Examination final marking scheme for General mathematics 2, section 3: Deduct 2 marks for a misreading of the data. Deduct I for an answer not given to the degree of accuracy asked for. Deduct I for premature approximation which does not considerably simplify the subsequent work.

Section 4: Give o for results obtained for work that is indecipherable or wholly suppressed (WS.O.). Deduct I mark for omission of an essential working (Oew-1) section 6: For geometric proofs except when otherwise stated, deduct I for an essential reason omitted or for a wrong reason given but not more than once in a question

Section 7: Deduct I mark for the omission of units or for wrong units.

The knowledge of the above will definitely make students to be extremely careful while writing mathematics examination and thus achieve better results.

Quadratic equation is chosen for this study because of the peculiar nature of the processes involved in each method of solving it. One step leads to another, for example one must be able to calculate the table of value before entering points on the graph, one must enter points correctly before being able to draw the curve. From personal experience as an assistant examiner and discussion with co-assistant examiners, it has been discovered that students lose more marks in solving quadratic equation problems by omitting important steps. Each method of solving the quadratic equation has its common omitted steps. For example in the formula method some students move straight to substituting without first stating the values of a, b and c. In the graphical method, some students calculate and leave their table

of value in the question paper and end up plotting graphs without table of value thereby losing the marks for the table of value and plotting of the graph.

Studies investigating teachers thinking have collected evidence that conflicts with commonly held beliefs. On such study (Fennoma, Peterson, Carpenter and Lubinski, 1990) sound that teachers thought the attributes of girls and boys who succeeded in mathematics were basically similar, yet their knowledge about which boys were successful was more accurate than their knowledge about which girls were successful. These teachers also attributed the boy's successes to ability more than to other sources and the girls' successes to effort more than to other sources.

A second study (Weisbeck 1993) found that while teachers reported they thought more about boys than about girls during instruction, they used similar characteristics when describing girls and boys. Although research that uses a cognitive science perspective is still in its infancy at least as far as gender and mathematics are concerned, it could provide knowledge about the underlying mechanisms that have resulted in gender differences in mathematics, adding to existing knowledge of overt behaviour.

The study of Doddy (1988) and Osafehinti (1988) which indicated that male learners consistently obtained significantly higher mathematics

achievement score than their female counterparts is at variance with Agwagah (1993) who reported in her study that female students made higher gains in the mean achievement scores than the male students in the algebra content as a result of instruction in mathematics reading. Based on this type of variance in different studies, this study will investigate the achievement of male students and female students in Quadratic equation using guided scoring strategy.

The interest of students in mathematics are dampened by several factors, which include, Negative attitude of students, influence of other peoples attitudes in mathematics, nature of mathematics etc. (Obodo 2004). The interest of students in mathematics can be generated and sustained through several methods. There methods, as suggested by Obodo (2004) include; motivation, Relevant set induction-technique, statement of instructional objectives, effective use of instructional materials, the use of mathematical games, the mathematics laboratory and relating mathematics to other disciplines. This study will investigate how the guided scoring strategy can be used in, generating and sustaining students' interest in mathematics.

With all these problems facing the students, the solution may lie in exposing students to the marking process during teaching. From research

into other studies, it has been observed that not much has been done on the use of guided scoring as an instructional strategy in mathematics and quadratic equation in particular. Hence the problems to be investigated in this study are: To what extent does guided scoring as an instructional strategy affect students? Also to what extent does the use of guided scoring affect the achievement of male and female students in quadratic equation? Will guided scoring enhance their interest?

Statement of the Problem

The appropriate use of instructional strategies is integral to the learning and teaching of mathematics. The reduction of the high percentage of failure in mathematics lies in the students religiously following the right process in mathematical problem solving (Oragwam, 2000). The less important steps omitted, the less the marks lost. Hence, for mathematics to fulfill its function as an essential tool for most disciplines, the mathematics teacher need to explore all avenues to ensure that the students achievements are improved.

The present mathematics classroom situation is such that some teachers do not point out the importance of some steps to students and the students end up losing marks due to ignorance. Some students even lose mark from self-esteem, they feel they know too much, and there is no need

for certain steps. The problem of this study is to investigate how guiding students during teaching with the marking scheme will affect their achievement in mathematics in general and quadratic equation in particular. It will also investigate how guided scoring will affect the achievement of males and females in quadratic equation and whether guided scoring will increase students interest in mathematics. It will go further to investigate how guided scoring will increase male and female interest in mathematics and whether guided scoring will affect the students' achievement and increase their interest.

Purpose of the Study

The purpose of this study is to investigate the effect of guided scoring as an instructional strategy on senior secondary school II students in quadratic equation aspect of mathematics. Specifically the study will determine: The effect of guided scoring on

(1) Students' achievement in quadratic equations

(2) Male and female students' achievement in quadratic equation

(3) Students interest towards learning mathematics.

(4) Male and female students' interest in mathematics

(5) Students' achievement and interest in mathematics

Significant of the Study

The following people might benefit immersely from this study. The students, the teacher, parents' school administrators, government, and researchers.

The outcome of this study is expected to be of immese benefit to the students in the sense that they will acknowledge the fact that no step is irrelevant in mathematic problem solving process. This will inform them to put all steps down in their answer sheets and gain all possible marks.

If this strategy turns out to be effective teachers, may even start applying it right from junior secondary school I to each topic and prepare students for both JSCE and SSCE. This is important because it is an instructional strategy that is seldom used.

The school administrator will also benefit from the effectiveness of this strategy in the sense that if he knows about the effectiveness of guided scoring as an instructional strategy he will encourage his teachers to go for marking coordinations to enable them acquire the knowledge of the marking system.

The government, if aware of the effectiveness of guided scoring as an instructional strategy, can make it as a rule for examining bodies to supply their marking guides to all school and teachers of all subjects.

This work will also serve as a resource material to researchers who may be interested in the area. Additionally it will provide the framework for other researchers to build on.

Scope of the Study

The study will be restricted to Ika North and Ika South educational zones in Delta state. The study will be limited to two co-educational schools in the two zones. Senior secondary school II students will be used for the study. The choice of SS II students is because quadratic equations are in the SS II curriculum.

The following subtopics in quadratic equation will be covered during the experimentation

- factorization method
- completing the square method
- formula method
- graphical method

Research Questions

The following research questions were used to guide the study

(1) How do the mean achievement scores of the student taught with guided scoring strategy differ from those taught with the conventional method?

(2) How does the mean achievement scores of male and female students taught using guided scoring differ?

(3) How does the interest towards learning of students taught with guided scoring strategy differ from those taught with the conventional method?

(4) How does the interest of male and female students taught using guided scoring differ?

Research Hypotheses

For this study the following null hypotheses were formulated and were tested at 0.05 significant level.

(1) There is no significant difference in the mean achievement scores of students taught with guided scoring strategy and students taught with the conventional method.

(2) Gender is not a significant factor on the mean achievement scores of students taught quadratic equations with guided scoring strategy

(3) There is no significant difference in the interest of students taught with guided scoring strategy and students taught with the conventional method

(4) Gender is not a significant factor on the interest of students taught quadratic equation with guided scoring strategy

(5) There is no significant interaction effect between the treatment and gender on students achievement relative to method used

(6) There is no significant interaction effect between the treatment and gender on students interest relative to method used

CHAPTER TWO

LITERATURE REVIEW

For the purpose of convenience, the literature review of this study, is arranged under the following sub-headings.

Theoretical / conceptual Framework

1. Problems of teaching and learning mathematics
2. Strategies for teaching Mathematics
3. Concept of guided scoring
4. Strategies and Achievement in Mathematics
5. Mathematics and Gender.

Empirical Related Studies

1. Studies on strategies for teaching mathematics
2. Studies on Gender and achievement in mathematics
3. Studies on interest

Summary of Literature Review

THEORETICAL/CONCEPTUAL FRAMEWORK

Problems of Teaching and Learning Mathematics

Mathematics apart from being an intellectually stimulating discipline is the corner stone in every field of education. It is one of the core subjects for both the junior and senior secondary school stages. This implies that every student must offer Mathematics. This is indicative of the importance attached to mathematics in nation building and technological development (Adebola, 1999). According to Amoo (2002), the position mathematics occupies in the National Policy of Education and it's role towards Technological and industrial development put mathematics in a special place in primary, secondary and tertiary levels of Education.

This importance not withstanding, mathematics continues to present special problems to students at all levels. Recent survey reveals that students performance in the subject continues to decline and almost getting to a dangerous Peak (Emedo, 1994, Sanusi, 1994, Buhari, 1994). The mass failure and consistent poor performance in mathematics which students have shown over a decade now cast serious doubt on the country's high attainment in science and technology. A study conducted by Nigerian Educational Research and Development council (NERDC, 1997) on the performance of students in public examinations over some years has

confirmed students' poor performances in physical sciences (mathematics, physics and chemistry) which form the foundation of future study in much of the Technology needed in Nigeria.

The problem of mathematics teaching and learning, according to Salau (1989) were those related to students, the teachers, the nature of the subject itself, the textbooks and instructional materials, the classroom environment, the syllabus, available time and language, the school and the society in Nigeria at large. Student background problems according to Buhari (1994) comes in four different ways, namely

(i) Disadvantaged home background which refers to homes that lack enrichment in terms of play materials and which children can interact during play and movement about.

(ii) Cultural background that does not conform to the kind of sophistication that mathematics requires.

(iii) Poor environment background which a child encounters as he leaves the home and his immediate surroundings

(iv) The poor background preparation of mathematics at the preprimary and primary education

Amoo (2002) also revealed that students display poor performance due to lack of interest in the subject. According to Obodo (2004) several

factors leads to lack of interest in mathematics. These factors are; negative attitude of students to mathematics, influence of other people's attitudes in mathematics, and nature of mathematics.

Adebola (1999) revealed that the teachers related problems include: poor teaching preparation, shortage of qualified and quality mathematics teachers, poor teacher devotion and dedication to duty, poor motivation/ remuneration, bad method of teaching, lack of career information and bad leadership quality. Another problem is that prospective mathematics teachers are not adequately equipped to teach practical and there is no adequate knowledge of subject matter (Oyedeji, 1998; Adedayo, 2001; Amoo, 2001).

Amoo (2001) and Adedayo (2001) opined that another problem of teaching and learning mathematics is the overloaded and unrealistic nature of the curriculum. In the recent past substantial changes have taken place in the mathematics curriculum particularly at the secondary school level. Changes in content have often been accompanied by recommendations for improving the teaching of mathematics unfortunately; new curricula in Nigeria are not often given appropriate trial testing before full-scale adoption. Students do not often get the needed aids from their older brothers and sisters because they are not familiar with the new curriculum contents.

And sometimes from teachers whose pre-service training is at variance with the contents and methods of the new curriculum and thus finds it difficult to teach them to the students. As a result, most children become frustrated and develop lack of interest in the subject. There is also the problem of lack of fit between school mathematics and socio-cultural context of the society (Adebola, 1999).

Agwagah (2001) also revealed that some of the problems facing the teaching and learning of mathematics are the poor method of teaching applied by the teacher and teachers' non-use of instructional materials in the teaching of mathematics concept. Obodo (2004) also supports this fact by stating that many of the professional teachers do not use appropriate methods and teaching aids in the classroom. Some use sterile and uninspiring methods. Instruction is usually didactic and most often pitched at an abstract level. Some teachers cannot improvise instructional materials for use in mathematics lessons. The teachers give little or no consideration to the psychology of the learner who may require concrete realities. Obodo (2004) went further to point out that the lack of mathematics laboratory is another problem facing the teaching and learning of mathematics. At all levels of our educational system, the mathematics laboratory is lacking.

Thus, students learn mathematics in abstract manner and under drudgery and duress. They cannot relate the learned abstract concepts into practical terms.

Obodo (1990) had shown that cognitive competence of the mathematics teaching with respect to his style of teaching influences students' performance in mathematics. Obodo (1990) opined that:

> *An effective and efficient teacher of mathematics is one who knows the mathematics to teach and approaches of teaching such concepts creatively, employing a variety of teaching procedures, materials and aids.*

Emenalor (1986) indicated some of the teachers characteristics that will make students not to participate effectively in Mathematics class as follows;

(1) The teacher who continually tells his or her students that mathematics is the most difficult subject is wrong and instills fear into many a beginner, for a student who feels that he cannot pass a subject ever before he starts the course is inhibited from trying to succeed.

(2) The teacher who marks only correct answers even though the method of solution is wrong is considered not a good teacher.

(3) Teacher who presents or encourages his students to make use of ready-made mathematical formula in solving mathematical problems is also not a good teacher even though most examination papers carry the warning that answers without proper statements of work will lead to considerable loss of mark.

Much attention thus needs to be given to the development of students who have a good intuitive feeling for mathematics. Teachers should concentrate more on the steps or processes involved in mathematical problem solving rather then the correct answers. It is noted that when students have the knowledge of the processes involved in the award of marks during the marking of their examination paper they will tend to have zeal to solve problems step by step. Their interest will be aroused thereby reducing the problems facing the teaching and learning of mathematics.

It is therefore necessary to investigate if the guided scoring strategy will reduce the problems facing the teaching and learning of mathematics and improve students' achievements and interest in mathematics.

Instructional strategies for teaching mathematics

Strategy is the art of planning the best way to achieve something (B.BC English Dictionary 2nd Edition)

Instructional strategies are thus the best ways or approaches employed during instruction or teaching in order to improve students' achievements in mathematics. Much of a teacher's success in the classroom is lunged on their use of teaching strategies, or to put at another way, their approach to their teaching, how they implement instructions, how they teach, how they communicate, how they deliver information, and how they communicate data to students (NET).

The different teaching strategies available to the teacher are too numerous to mention all of then here and in deed many strategies interlink and may even be used collaboratively within a given lesson. However using the work of Barry and King (1997) as a starting point, the following is a brief overview of some of the strategies that are more common

The guided Discovery Strategy method of implementation

1. Teacher sets a problem
2. The students explore the problem
3. Teacher and students discuss the problem and formulate conclusions

Usman (2002) discussed some effective approaches and materials for teaching mathematics. These include

- Laboratory Approach: In this approach, the students are made to carry out some measurements (often using simple equipment such as

rulers and compasses) collect data by experimentation or survey, make drawing and models, make computational devices and perform experiments with kits such as probability kit.

- Student – Direct Class Discussion Approach: In this approach students are made to demonstrate, report on enrichment topics or even the teaching of a regular lesson can be a wholesome experiment for the students' demonstration as well as the class
- Small-group instruction Approach: This approach can be used to promote cooperative learning among the students
- Enrichment Approach: This approach will enable the mathematics teachers to incorporate many wonderful and exciting mathematics ideas, which are not in the regular text for discussion, others are
- Communication Approach
- Individualized Instruction Approach
- Creative learning Approach Games
- Discovery Approach
- Use of Audio-visual presentation

The discovery approach is a method of teaching whereby the students are guided to build mathematical concepts, develop thought patterns and discover relationships. Students are encouraged to think critically to find,

use, and test various methods of solution and to validate their conclusion. According to Obodo (2004), discovery method is "a method of teaching/learning situation where students arrive at knowledge as a result of their own observations" Obodo (2004) has several types of discovery approaches in mathematics, these include;

(1) Target task approach: In this approach, students are first given a difficult problem (target task) to solve, which they may or may not be able to solve immediately. An easier problem is later solved with the aid of the teacher's direction. Finally, the students go back to the target task, with the acquired facts from the easier worked examples solve the target task, and consequently deduce generalizations.

(2) Delayed formalization approach: here the teacher delays the introduction of the topic and objectives of the lesson. The lesson begins by giving a mathematical expression and encouraging the students to generate all possible equivalent forms of the expression. It encourages students to think divergently first before narrowing down their thinking to an appropriate conclusion (Harbor-peters, 1989)

(3) Heuristic method: In this method, the students are led by the teacher to formulate their own definitions. The teacher helps the students by questions, by hints, by outlining a line of attack by starting the solution.

(4) Laboratory Approach: This proposes that the experimental origin of mathematics should be fully recognized. This means that the students should be led to feel the significance of the mathematics tool through some material equipment the students has made or things he has done.

(5) Concept mapping. This is also an instructional strategy that can be used to enhance the achievement of students in mathematics (Ezeugo and Agwagah, 2000). Another instructional strategy is the use of games, models, and simulations (Agwagah, 2001, Harbor-Peters 1998).

Institutions of higher learning across the nation are responding to political economic, social, and technological pressures to be more responsive to students, needs and more concerned about how well students are prepared to assume future societal roles. Teachers are already feeling the pressure to lecture less to make learning environments more interactive, to integrate technology into learning experience and to use collaborative learning strategies when appropriate (NET 25th May 2005).

From the foregoing, it can be observed that different instructional strategies are being suggested for the enhancement of students' achievement in mathematics. Hence, this study is investigating guided scoring as an instructional strategy.

Concept of Guided Scoring

A scoring guide is designed to help set and raise the bar of student achievements (Cindy 2002). Cindy further explains that guided scoring is based on the standards of what students should understand and be able to do. And a scale with characteristics that describe performance for each of the points on the scale. Guided scoring as an instructional strategy is an approach where emphasis are laid on the processes that attains M, B and A marks during the marking of their examinations especially external examinations (JSCE and SSCE). This strategy will enable the students to be conversant with the process of attaining and losing marks during marking exercise. The knowledge of this will make them avoid omitting important steps in mathematical problem solving process.

Guided scoring can be used as an instructional strategy by stressing the allocation of marks at different steps while teaching. The teacher show the students how the omission of certain steps will lead to the lost of marks for those steps. While teaching, the teacher also show the students some peculiar cases where the omission of a particular step will lead to the lost of marks for that step and the next step or answer. For example , 4 students are asked to solve without using tables $\sqrt[3]{27}$. A student that solves it as follows

$\sqrt[3]{27} = 3$, though got the answer right but has omitted three steps and will lose all four (4) marks meant for that question.

The student that solves as follows

$$\sqrt[3]{27} = \sqrt[3]{3^3} \quad B_1$$

$$= (3)^{3X1/3} \quad m_1 \text{ (4 marks)}$$

$$= 3^1 \quad m_1$$

$$= 3 \quad A_1$$

Arrived at the same answer but put down all the necessary steps and will gain all four (4) marks meant for that question.

Some students are not aware of the fact that marks are deducted during the marking exercise. While using guided scoring as an instructional strategy, this information is brought to the knowledge of the students. Students will thus realize for instance that if the answer to a problem is 26 cm^2 and he writes 26 or even 26 cm, he will definitely loss 1 mark. The following question was given to a set of students to solve : Solve $2x + 5 = 25$

Student A solves as follows

$$2x + 5 = 25$$

$$2x = 25 - 5 \quad B_1$$

$$2x = 20 \quad m_1$$

$$\frac{2x}{2} = \frac{20}{2} \quad m_1 \text{ (4marks)}$$

$$x = 10 \quad A_1$$

school certificate examinations (SSSCE), the boy got distinction at his first sitting while it took the girl 3 three sittings or examinations to make a credit.

Strategies and Achievement in mathematics

Learning achievement begins with a child ready and able to learn. A child's most important learning challenges and achievement occur before entering school. During the early years, a child learns to walk, to relate to people, to think and reason, to solve problems and so much more. If these learning achievements do not occur (and at the right time) future learning in school and in later life will be more difficult. Thus learning achievement in school depends on earlier learning achievement (NET 25/5/05).

According to Nworgu (2003) achievement test are constructed so as to assess what a student has mastered or understood in general or specific areas of knowledge to which he had been exposed. Ohuche and Akeju (1988) also stated that measures of achievement deal with what a person or group of persons has already learnt to do. From the foregoing one can confidently state that achievement is what a student has mastered or understood or learnt to do. Achievements in the three domains of educational objectives (Cognitive, affective and psychomotor) are usually measured.

For students to actually master or understand any area in mathematics there must be an effective instruction. That is where instructional strategies come in an effective instructional strategy will lead to a better achievement in students. Agwagah (2001) suggested that if games were more widely available and teachers were exposed to the theory and construction of games, they would happily consider them as an effective and necessary instructional approach.

Usman (2002) gave some effective approaches and materials for teaching mathematics and for the attainment of the Universal Basic Educations objectives. These include laboratory approach, student-direct class discussion approach, small group instruction approach, Enrichment approach communication approach, individualized instruction approach, games, creative learning approach, Discovery approach, use of the Audio-visual presentation and use of computer.

The results of school mathematics examinations have continued to be poor. This has generated much concern about the teaching and learning of mathematics. Akabue (1987) and Emeralor (1986) are in support of the above mentioned assertion. They have noted that achievement in school mathematics has deteriorated drastically.

The main cause of the above is attributed to the ineffective method of teaching and learning, (Emenalor 1986). In his study, he sought to find out the cause of failure in mathematics. He discovered among other factors; psychological barrier this he called mathematics phobia (fear) in the students themselves, inadequate number of mathematics teachers and poor performance of average mathematics teachers. He estimated that over 99% of secondary school leavers in Nigeria never wish to see any mathematics book again. On one of the questions he posed to some students;

"Do you like mathematics"?

the responses received include;

"I hate it"

"I fear it"

"If I had a free choice I would never do it again"

"I try to do my best, but just cannot understand it"

"I do but our class teacher makes me to fear it".

"No, I do not want to run mad".

Having observed students poor achievement in mathematics, would the teaching of mathematics using guided scoring strategy, help students to achieve more? Will it also generate interest in mathematics?

Mathematics and Gender

The general consensus of the research on mathematics and gender strongly rejects biological explanations of difference (Fennema and Lamon, 1990) or at least rejects their usefulness in constructing interventions (Leder 1992) Although some explanations slide into essentialist beliefs. Fennema (2000) stated that when ever she uses the work gender, she is inferring social or environmental causation of behaviour that differ for females and males. She personally believes that scholarly activity can facilitate the learning of mathematics by females. She went further to state that if one identifiable group of people is not learning as well as another group, then the educational environment should be modified to ensure that these group differences are eliminated.

Compared to the 1970s, there has been improvement in the number of girls and women studying mathematics. There are indications; however, that girl's interest in mathematics and their participation in mathematics courses are again beginning to decline. At the same time, the gender gap between top students in science is actually increasing.

This study however seeks to determine whether guided scoring as an instructional strategy will help to modify our educational environment to eliminate gender differences.

EMPERIICAL RELATED STUDIES

Studies on strategies for teaching Mathematics

Many researchers have carried out studies on strategies for teaching mathematics. Sanni and Ochepa (2002) discovered in their study that practical discussion outside the classroom could improve students' achievement in Mathematics. They adduced that teachers who try to take mathematics outside the four walls of the classroom, bring realities into the teaching of and learning of mathematics at secondary school level. A sample of 150 randomly selected junior secondary three (JS III) students from five secondary schools within Bauchi metropolis was selected for this study. The sample was divided into two groups: the experimental group and the control group. The t-test statistics was used to test the significance between the difference in the means of the pre-test and post test scores. A significant difference was observed in the mean achievement scores in the experimental group, while the control group showed no significant difference in the mean achievement score. From the result, it was concluded that every teacher of mathematics should endeavour to incorporate the additional work load, which in the end could yield better achievement in mathematics. Their study was on an instructional strategy

outside the classroom, this study is interested in investigating an instructional strategy inside the classroom, and using a different statistical tool, the Ancova; the researcher is interested in investigating whether the guided scoring strategy would yield better achievement using Ancova

Agwagah and Ezeugo (2000) investigated the effect of concept mapping on students' Achievement in Algebra. The study sample consisted of 387 SS II students from eight intact classes randomly selected from four secondary schools – two female and two male schools, in Onitsha Educational Zone of Anambra State. The Analysis of Covariance (ANCOVA) was used to analysis the data collected from Algebra Achievement Test (AAT). The result of the test revealed that there was a significant difference in the mean achievement scores of students taught with concept mapping and those taught with the traditional method in Algebra. The study was on a wide area, Algebra, will there be a different result if one concentrates on an integral part of Algebra. This study is interested in investigating student achievement in an integral part of Algebra, Quadratic equations, using the same statistical tool ANCOVA and the same level of senior secondary school II students.

Studies on Gender and Achievement in Mathematics

Several studies have been carried out to see the effect of gender on achievement in mathematics, some on how gender differences could be eliminated in the learning of mathematics. Idris and Momoh (2001) discovered in their study that there is a significant difference in the performance of boys and girls in both forms of Ahmedu Bellow University Mathematics Achievement Test (ABUMAT). Sixteen junior secondary schools and eight hundred and seventy-six (876) students served as active respondents to the instruments of this study. The t-test was used to test the hypotheses. The design used in this study was a survey design: what happens when an experimental design is used to investigate the effect of gender on achievement in mathematics? This is the interest of the researcher, to investigate, using the guided scoring strategy in an experimental design, the effect of gender on achievement.

Etukudo (2002) discovered in his study that there was no significant gender difference in the post test performance of the experimental group (EG) taught with the help of computer assisted instruction package, not withstanding the difference that existed in the pretest result in favour of the male gender. Two groups of forty (40) students each of which twenty (20) were male and twenty (20) female students in Junior secondary Three (JS

III) classes were sampled from a population of all junior secondary school students in Ogba/Egbema/Ndomi Local Government Area of Rivers State. The t-test was used and it was concluded that computer assisted instruction (CAI) is capable of completely eradicating gender differences if properly used. The statistical tool used in testing the hypotheses in this study was the t –test. Would using a different statistical tool that is more detailed, yield a different result? This study is interested in using the ANCOVA to test some hypotheses related to the effect of gender on achievement.

Salau (2001) has a contrary view. He found out that the proportions of pass and above grades in mathematics for boys and girls in co-educational schools are significantly higher than those of their counterparts in single sex schools. And also that in mathematics girls performed better than boys irrespective of whether the students are in single sex school or co-educational schools. The subject of the study was 90, 105 students from three hundred and twelve schools who sat for mathematics in the senior school certificate Examination (SSCE) between 1991 and 1995. To systematize the selection procedure, the country was stratified into six geopolitical zones. Two states were randomly selected from each zone. Twenty four schools were selected from each chosen state using variables such as location mode and sex as guides. Frequency counts and percentages

were used to analyse the data collected and the test for significance of difference was also employed. From his findings, it was suggested that teachers should create a more conductive learning environment most especially for girls in co-educational schools to facilitate good academic performance in mathematics. Based on this suggestion, the researcher is interested in investigating whether using guided scoring as an instructional strategy will create a more conducive learning environment which might increase achievement at the end.

Studies on Interest

If you have an interest in something, you want to learn or hear more about it and you enjoy doing it. Harbor – peters (2002) stated that interest is a tendency to become absorbed in an experience and continue it. It is the zeal to participate in an activity from which one derives some pleasure. Studies on interest are concerned with identifying different approaches in teaching that may be used to generate and sustain students' interest in science and mathematics for higher achievement. Some empirical studies on interest are identified below.

Ogbonna (2003) studied the effect of constructivist instructional approach on senior secondary school students' achievement and interest in

mathematics. The study sought to determine the effect of constructivist approach on the students' interest and the differential effect of the approach on the achievement of male and female students is mathematics. The sample for the study was two sampled intact classes from sampled schools in Umuahia educational zone of Abia State. Two instruments, mathematics Achievement Test and Quadratic Equation interest scale were used. The mean and Ancova were used to analyse the data. The results of the study indicated that sex was a significant factor in determining the interest of male and female students. The mean interest scores of males were higher. The study also revealed that gender was not a significant factor on students' achievement in mathematics. The study investigated the effect of the constructivist instructional approach using two instruments, an achievement test, and an interest scale. Using the same type of instruments but a different approach (strategy) guided scoring strategy; will there be an increase in the students' interest?

Obodo (2004) noted that interest is a very strong factor in the teaching and learning of mathematics. The degrees of direction of attitude towards mathematics are largely determined by the kind of interest developed by pupils for mathematics. Although studies have been carried out on appropriate approaches for facilitating, developing, and sustaining

interest in mathematics, there is none within the reach of the researcher on the use of guided scoring in enhancing students' interest in mathematics. Hence, the need for this study to see whether guided scoring as an instructional strategy will facilitate, develop, and sustain students interest in quadratic equation in particular and mathematics in general.

Summary

The review of literature as indicated has proved the assertion that students achieve poorly in mathematics. The issue of poor achievement has worried many individuals, the government, and organizations within the country. The trend in poor achievement in mathematics is such that year after year, students do poorer in mathematics as shown by available records. The review also indicated that students' poor achievement is mostly attributed to teachers' method of teaching and students lack of interest. Hence, it is important to investigate how different instructional strategy can enhance the achievement and interest of students in mathematics. This study therefore is interested in investigating the guided scoring strategy.

Researchers on sex as a factor in mathematics showed that contrary to the general belief that males achieve more in mathematics than females, some studies showed that males and females achieve equally. Some even

showed that females achieve more as a result of mathematics reading based on this contradictions this study investigated how male and female students will fare under the same instructional condition on a particular topic,that is, how they will fare when taught quadratic equations using guided scoring as an instructional strategy.

Studies on instructional strategies also indicated that some strategies have been introduced/experimented to enhance students' achievement in mathematics. There is the need to identify other strategies that might enhance achievement in mathematics. Hence, the need to investigate the effect of guided scoring strategy on students' achievement and interest in quadratic equations.

CHAPTER THREE

RESEARCH METHOD

In this chapter, the researcher will discuss the different methods used for carrying out the study, data collection, and analysis to ensure that valid conclusions are reached. The methods include: Research design, area of the study, population of the study, sample, and sampling technique, instruments for data collection, validation of instrument, reliability of the instrument, lesson plans, experimental procedure, control of extraneous variables, method of data collection and scoring, and method of data analysis.

Research Design

The quasi – experimental design will be used for this study. Specifically, the study will be non randomized control group pre test – posttest design. This design is considered appropriate because the researcher cannot randomly sample and assign her subjects, as this might alter and disturb the schools schedule of lessons.

The study made use of two groups, the experimental group and the control group. The design is represented in Table 1

Table 1:

Representation of the Research design

Sampling	Grouping	Pre testing	Research condition	Post testing
-	Experimental group	0	Treatment (x)	0
-	Control group	0	Control (-)	0

0 – Quadratic equation achievement test (QEAT)

x – Guided scoring instructional strategy

- - Conventional method of teaching

Area of the Study

This study was carried out in Ika North East and Ika South educational zones of Delta State. Ika North East educational zone is made up of twenty (20) secondary schools out of which Sixteen (16) are co – educational. Ika south educational zone is made up of eighteen (18) secondary schools out of which thirteen (13) are co – educational.

Population of the Study

The population of the study was all the senior secondary school II (SS II) students from thirty-eight (38) secondary schools in the Ika North and Ika South educational zones.

The population detail is shown below.

Table 2
Population and the number of schools in each educational zone

Educational zone	No. of schools	Population of students	Number of co – educational schools
Ika North East	20	4819	16
Ika South	18	4488	13
	38	9307	29

Sample and Sampling Techniques

The subject of this study was made up of the number in the selected intact classes of SS II students drawn from two co-educational senior secondary school in Ika North East and Ika South educational zones. The simple random sampling technique was used to sample one co-educational school from each educational zone.

The sample selected was classified into experimental and control groups by a flip of a coin. This was necessary in order to give the two schools equal chances of being the experimental or control group. In each

school selected, the simple random technique will be used to select an arm from SS II classes. Each arm selected will form the intact group to be used for the study.

Sample size was twenty eight (28) in control group and thirty one (31) in experimental groups.

Instrument for Data Collection

Two different instruments were used for the study. These instruments are: Quadratic equation Achievement Test (QEAT) and mathematics interest scale (MIS).

The QEAT will be essay test items consisting of nine (9) essay questions, (see Appendix I) covering the four subtopics (content) that will be taught during the experimentation. The MIS consist of twenty (20) items (see appendix J) presented in a written form to the students (respondents) who has to respond in writing. The test blueprint for the essay test is presented in table below. The educational objectives are classified under lower and higher cognitive thinking processes.

Table 3

The test blue print

Content	%	Lower cognitive Domain	Higher cognitive Domain	Total
Factorization method	22.22%	1	1	2
General formula method	22.22%	1	1	2
Completing the square method	22.22%	1	1	2
Graphical method	33.34%	1	2	3
Total	100%	4	5	9

For the essay test, two items were developed from each of the first three methods (factorization, formula and competing the square) while three items were developed from the graphical method. Four of the items are of the lower cognitive domain while five items are of the higher cognitive domains. The more emphasis given to the graphical method both in the blue print and marking scheme (as will be seen later), is due to more marks being allocated to graphical method by the examining bodies

Validation of the Instruments

The Quadratic Equation Achievement Test (QEAT) and the mathematics interest scale (MIS) were subjected to face validation by three specialists, two in measurement and Evaluation, and one in mathematics education. For the validation exercise copies of the title of the study, purpose of the study, research questions, hypotheses, QEAT, marking scheme on QEAT, and MIS were sent to the specified specialist. The specialists were expected to go through them, modify any item where necessary, remove any irrelevant item add any other item they feel is relevant to the study. After the specialists had done these, the researcher finally arrived at a set of items and later went to the field with these for the trial testing.

The content validity of the instrument was established by the test blue print.

Reliability of the Instrument and Trial testing of the instruments

A trial testing of the instruments was conducted using 20 SS II students from Ime–Obi Secondary School Agbor (co-educational school). The result of the trial test enabled the researcher to establish the reliability coefficient. The reliability of the test was established through the use of

1. Inter-scorer reliability for the Achievement test. Here the Kendal coefficient of concordance (W) was used in computing an estimate of the internal consistency of the test. It was found to be 0.98.
2. Cronbach Alpha was used to establish the internal consistency of the MIS , and it was found to be 0.94

The coefficient of stability for the QEAT was established using Spearman's test- retest coefficient of reliability. It was found to be 0.94

The coefficient of stability for the MIS was established using spearman's test –retest coefficient of reliability. It was found to be 0.96

The lesson plans

The initial lesson plans were validated by the three specified specialists and two secondary school mathematics teachers. After making the necessary corrections the final lesson plans were used for the teaching of the lessons. For lesson plans for control group see Appendices A, B, C and D, for experimental group see Appendices E, F, G and H.

Experimental procedure

At the beginning of the experiment, the pretest of the QEAT was administered to both the experimental and control groups on the same day

by the researcher with the help of some teachers. This ascertained the level of achievement of students in Quadratic equations. The pre test scale was also administered using MIS. After the pre test and pre interest scale, the researcher continued with the experiment in the respective schools. The lesson plans specifying the allocation of marks (See appendices E, F, G and H were used in teaching the experimental group. And those without the allocation of marks (See appendices A, B, C. & D) were used to teach the control group.

In the experimental group, the researcher emphasized the allocation of marks at each step in the solving process stressing that these marks will be lost if omitted. She went further to show students stages or steps where marks lost at any step will lead to the lost of marks for the subsequent step or steps.

The experiment was conducted during the normal school periods. Within the three weeks of the experiment, the four different sub-topics of quadratic equations were taught and covered. Each week contained three (3) periods of 40 minutes each. This give a total of nine (9) periods. Two (2) for factorization method, two (2), for formula method, and two (2) for completing the square method three (3) for graphical method.

Control of extraneous variables

To control extraneous variables the researcher personally carried out the teaching exercise. This eliminated the problem of teacher differences.

With the use of already existing classes, initial equivalence may not be achieved for the students in the two groups. In order to eliminate the errors associated with non equivalence arising from the non-randomization of the subjects the researcher used analysis of covariance (ANCOVA) for data analysis. This will correct the initial differences among the students.

To reduce the non-experimental mathematics experiences among the student participants of this study, no homework or out-of-class assignments was given to the students during the instructional period. The marked pre-test scripts were not given back to the students before the post test.

Method of Data Collection and Scoring

The Quadratic Equation Achievement Test (QEAT) and the mathematics interest scale (MIS) was administered to make available relevant information for analysis. At the end of the experimental teaching periods, the same post-test of the QEAT was administered to the students in the experimental and control groups on the same day with the help of some

teachers. This is to avoid interference between the groups. The same MIS was used for the pre - interest scale and post –interest scale

The QEAT answer scripts were scored out of a maximum of 100% and a minimum of 0%. Marks were allocated to items according to the marking scheme or guide (see Appendix K)

Method of Data Analysis

The Pre-test scores and the post test scores were collected, organized, and analysed. This analysis was used to answer the research questions 1 & 2. The responses of the pre – interest scale and post – interest scale were collected organized and analysed. This was used to answer research questions 3 & 4. All the hypotheses were tested using analysis of covariance (ANCOVA).

CHAPTER FOUR

RESULTS

This chapter presents the results of the study. The presentation of the results is according to the research questions and stated hypotheses.

Research Question 1

How do the mean achievement scores of students taught using guided scoring differ from those taught using the conventional method?

Table 4
The means and standard deviations of students' scores in QEAT

Group	No of students	Mean	Standard deviation
Control			
Pre –test	28	45.75	15.68
Post – test	28	46.00	15.28
Experimental			
Pre-test	31	47.68	16.47
Post –test	31	55.74	15.11

The above table shows that there is a remarkable increase in the mean of the post test of the experimental group compared to the mean of the pre –

test. The post- test has a mean achievement score of 55.74 and standard deviations of 15.11 while the pre – test has a mean achievement score of 47.68 and standard deviation of 16.47. There is an increase of 8.06 (55.74-47.68) in the mean achievement score. In the control group, the mean achievement score of the pre-test is 45.75 and standard deviation of 15.68, while the post –test has a mean achievement score of 46.00 and a standard deviation of 15.28. There is a slight increase of 0.25 (46.00-47.75) in the mean achievement score of the post – test compared to the pre –test but not as much as the increase seen in the experimental group. This is an indication that the experimental group achieved higher than the control group in the Quadratic Equation Achievement Test (QEAT) using guided scoring as an instructional strategy.

Research Question 2

How does the mean achievement scores of male and female students taught using guided scoring differ?

Table 5
The mean and standard deviation of male and female students in the

sex	Test	Mean	No of students	Standard deviation
Male	Pre –test	46.94	18	17.12
	Post – test	56.00	18	16.42
Female	Pre –test	48.69	13	16.14
	Post – test	55.31	13	13.77

Table shows that there is an increase in the mean achievement scores of the male students in the experimental group. The mean of the pre-test is 46.94 while the mean of the post –test is 56.00 which indicates an increase of 9.06. There is also an increase in the mean achievement scores of the female students. The mean of the pre- test is 48.69 while the mean of the post –test is 55.31 which indicates an increase of 6.62.The male student shows a higher increase compared to the female students. This is an indication that the male students achieved higher than the female students in the QEAT using guided scoring as an instructional strategy.

Research Question 3

How does the interest towards learning of students taught using guided scoring differ from those taught using the conventional method?

Table 6
The mean and standard deviation of students' scores in mathematics interest scale.

Group	Scale	Mean	No of students	Standard deviation
Control	Pre –interest scale	47.46	28	14.06
	Post – interest scale	47.86	28	13.43
Experimental	Pre –interest scale	45.75	31	14.07
	Post – interest scale	56.10	31	10.01

From table above, there is a very slight increase in the mean interest score of the pre – interest scale and post – interest scale of the control group.

The mean interest score of the pre –interest scale is 47.46 while that of the post –interest scale is 47.86 which indicates an increase of 0.40. There is a higher increase in the mean interest score of the pre –interest scale and post –interest scale of the experimental group. The mean interest score of the pre –interest scale is 45.75 while that of the post –interest scale 56.10 which indicate an increase of 10.35 this is an indication that students in the experimental group have a higher interest level than students using guided scoring as an instructional strategy

Research Question 4

How does the interest of male and female students taught using guided scoring differ?

Table 7
The mean and standard deviation of male and female students scores in mathematics interest scale of the experimental group

Group	Scale	Mean	No of students	Standard deviation
Male	Pre –interest scale	45.94	18	14.77
	Post – interest scale	56.39	18	10.78
Female	Pre –interest scale	45.46	13	13.63
	Post – interest scale	55.69	13	9.24

In table above, there is an increase in the mean interest score of the pre –interest scale and post – interest scale of the males in the experimental group. The mean interest score of the pre –interest scale is 45.94 while that of the post –interest scale is 56.39 which shows an increase of 10.45. There is about the same increase in the mean interest score of the pre –interest scale of female in the experimental group. The mean interest score of the pre –interest scale is 45.46 while that of the post –interest scale is 55.69 which shows an increase of 10.23. This indicates that male and female students in the experimental group are of the same interest level in mathematics using guided scoring as an instructional strategy.

Research Hypothesis 1

Ho1: There is no significant difference in the mean achievement scores of students taught with guided scoring strategy and students taught with the conventional method.

The data (scores) collected through the pretest and post –test of the QEAT were subjected to computer analysis using the Analysis of covariance (ANCOVA). The result is presented in the table below.

Table 8
Summary of two –way Analysis of covariance (ANCOVA) on the effects of the treatment and control and sex on QEAT

Source of variations	Sum of squares	Degree of freedom	Mean square	F	Significant of F	Decision at 0.05 level
Covariates	13288.77	1	13288.77	900.970	.000	
Pre Test	13288.77	1	13288.77	900.970	.000	
Main effect	864.135	2	432.067	29.295	.000	
Sex	25.697	1	25.697	1.742	.192	NS
Group	835.056	1	835.056	56.619	.000	S
2-way interaction						
Sex X Group	5.159	1	5.159	.350	.557	NS
Explained	14157.370	4	3539.343	239.978	.000	
Residual	796.426	54	14.749			
Total	14953.797	58	257.824			

NS – Not significant

S – Significant

Table 8 above indicates that the group as main factor is significant on students' achievement in quadratic equations studied. This is because the F value of 56.619 in respect of group as main effect is shown to be significant at 0.000 level. This then means that at 0.05 level, the F –value of 56.619 is significant. The direction of the difference is in favour of the experimental group which had a higher mean post-test achievement score as shown in table 4. This result shows that the use of guided scoring strategy significantly facilitates students' achievement in mathematics. Consequently, the null hypothesis of no significant difference in the mean achievement scores of students taught with guided scoring strategy and those taught with the conventional method is rejected.

Research **Hypothesis 2**

Ho2: There is no significant difference in the mean achievement scores of male and female students taught quadratic equation with guided scoring strategy.

From table 8 above, the data indicates that sex as a main factor is not significant on students' achievement in quadratic equations studied. This is because the F-value of 1.742 in respect of sex as main effect is shown to be

significant at 0.192 level. This then means that at 0.05 level, the F-value of 1.742 is not significant. This result shows that sex does not significantly enhance students' achievement in mathematics. Consequently, the null hypothesis of no significant difference in the mean achievement of scores of male and female students taught quadratic equations with the guided scoring strategy is retained.

Research Hypothesis 3

Ho3: There is no significant difference in the interest of students taught with the guided scoring strategy and students taught with the conventional method.

The data (scores) collected through the pre –interest scale of the MIS were subjected to computer analysis using the ANCOVA. The computer was used to statistically analyse the data for any significant difference in the mean interest scores of the experimental and control groups. The result is presented in the table below.

Table 9
Summary of two –way analysis of covariance (ANCOVA) on the effect of treatments and control and sex on MIS

Source of variations	Sum of squares	Degree of freedom	Mean square	F	Significant of F	Decision at 0.05 level
Covariates	6807.490	1	6807.490	489.258	.000	
Pre –interest	6807.490	1	6807.490	489.258	.000	
Main effect	1259.608	2	629.804	45.264	.000	
Sex	1.658	1	1.658	.119	.731	NS
Group	1257.197	1	1257.197	90.355	.000	S
2-way interaction						
Sex X Group	5.177	1	5.177	.372	.544	NS
Explained	8072.275	4	2018.069	145.040	.000	
Residual	751.352	54	13.914			
Total	8823.627	58	152.132			

NS – Not significant

S – Significant

Table 9 above indicates that the group as main factor is significant on students' interest in mathematics. This is because the F value of 90.355 in respect of group as main effect is shown to be significant at 0.000 level. This then means that at 0.05level, the F value of 90.355 is significant. This then means that the use of guided scoring strategy significantly enhance or increase students' interest in mathematics. The direction of the difference is in favour of the experimental group which had a higher mean as shown in

table 6. Consequently, the null hypothesis of no significant difference in the interest of students taught with guided scoring strategy and those taught with the conventional method is rejected.

Research Hypothesis 4

Ho4: Gender is not a significant factor on the interest of students taught quadratic equation with guided scoring strategy.

Table 9 above indicates that gender (sex) as main factor is not significant on students' interest in mathematics. This is because the F value of 0.119 in respect to sex as main effect is shown to be significant at 0.731 level. This then means that at 0.05level, the F value of 0.119 is not significant. This result shows that gender (sex) does not significantly enhance or increase students' interest in mathematics. Consequently, the null hypothesis of no significant difference in the interest of students due to gender is upheld.

Research Hypothesis 5

Ho5: There is no significant interaction effect between the treatment and gender on students' achievement relative to method used.

The interaction effect of sex by group as indicated by table 8 is not significant. This is because the F – value of 5.159 in respect of interaction between treatment and gender (sex and Group) is shown to be significant at 0.557 level. This indicates that at 0.05 level, the F value of 5.159 is not significant. The null hypothesis of no significant interaction effect between treatment and gender on students' achievement is therefore retained. This means that there is no significant interaction effect between treatment and gender on student achievement relative to method used.

Research **Hypothesis 6**

Ho6: There is no significant interaction effect between the treatment and gender on students' interest relative to method used.

The interaction effect of treatment by gender (sex by group) as indicated by table 9 is not significant. This is because the F – value of 0.372 in respect of interaction between treatment and is shown to be significant at 0.544 level. This indicates that at 0.05 level, the F value of 0.372 is not significant. The null hypothesis of no significant interaction between the treatment and gender on students' interest related to method used is upheld. Therefore, there is no significant interaction between treatment and gender on students' interest relative to method used.

Research findings

The findings of the study from the research questions and hypotheses are summarized as follows.

1. There is a significant difference in the mean achievement scores of students taught with guided scoring strategy and those taught with the conventional method
2. Despite the fact that the mean indicated that the male students achieved higher than the female student in the QEAT with the guided scoring as an instrument strategy, the ANCOVA revealed that the difference is not significant. Therefore, there is no significant difference in the mean achievement scores of male and female students taught quadratic equations using the guided scoring strategy.
3. There is a significant difference in the interest of students taught with the guided scoring strategy and those taught with the conventional method
4. Gender does not significantly enhance or increase students' interest in mathematics.

5. The research findings revealed that there is no significant interaction effect between treatment and gender on students' achievement relative to method used
6. It was also revealed that there is no significant interaction effect between treatment and gender on students' interest relative to method used.

CHAPTER FIVE

DISCUSSION OF FINDING, RECOMMENDATIONS, CONCLUSION, AND SUMMARY

This chapter deals with the discussion of findings, recommendations, conclusion, and implications of the findings, suggestions for further research and summary of the study.

Discussion of findings

The discussion of the findings of this study is focused around the purpose of the study.

The result of the analysis on table 8 revealed that students' taught with the guided scoring strategy achieved higher than those taught with the conventional method. This result agrees with some earlier research findings on the relationships that exist between some strategies in teaching mathematics and achievement in mathematics. This is in line with Sanni and Ochepa(2002) who discovered in their study that practical discussion outside the classroom can improve students achievement in mathematics. this result also agrees with Agwagah and Ezeugo (2000) whose study also revealed a significant difference in the mean achievement scores of students taught with concept mapping (another instructional strategy) and those taught with the traditional method in Algebra. From the aforementioned assertions

above, it is certain that there is a strong relationship between instructional strategy and achievement in mathematics. Teachers need to identify different instructional strategies and utilize them for better achievement in mathematics.

In table 8, it was also revealed that there is no significant difference in the mean achievement scores of male and female students' taught with quadratic equation. This finding is in line with the findings of Etukudo (2002). He discovered in his study that there was no significant gender difference in the post test performance of the experimental group (EG) taught with the help of computer assisted instruction package, not withstanding the difference that existed in the pretest result in favour of the male and gender Ogbonna (2003) also revealed that gender was not a significant factor on students achievement in mathematics. These indicate that with the use of any good instructional strategy male and female students will achieve equally. Teachers should thus modify teaching environment with the help of instructional strategies to ensure that gender differences are eliminated.

The result of the analysis in table 9 revealed that the level of interest of students taught with guided scoring strategy is higher than those taught with the conventional method. This finding is in line with Obodo (2004)

who observed that appropriate approaches (i.e. instructional strategies) can facilitate, develop and sustain interest in mathematics. Teachers should therefore explore different approaches to increase students' interest in mathematics.

Table 9 also shows the levels of interest of male and female students taught with guided scoring strategy are the same. This indicates that no matter the instructional strategy employed by the teacher gender is not a significant factor on the interest of the students.

Conclusion

The study has shown that teaching with guided scoring strategy can improve or increase students achievement in quadratic equation. It also revealed that the achievements of male and female students taught with the guided scoring strategy were the same, though there was a slight difference but it was not significant.

It was discovered in the study that the interest level of students taught with the guided scoring strategy increased much more than those taught with the conventional method. The researcher also discovered that the interest level of male and female students taught with guided scoring strategy increased equally.

Educational Implications

The findings of this study have some educational implications. The use of guided scoring strategy appeals to students. This is because students are guided to discover how marks are awarded and lost. And this in turn will make them to be more careful in order not to lose marks but rather gain all possible marks and make a better result at the end.

Guided scoring strategy if properly and relevantly used will help teachers to teach most of their students and lead them to achieve more in mathematics. Since the students will be made to follow certain steps sequentially, teachers will be required to do more work. They will need more time to prepare their lesson notes because they will need different and many marking schemes to prepare their lesson notes.

The educational authorities will need to make provisions (financial and otherwise) for the teachers that will attend co ordinations and will not partake in the marking exercise. Since the examining bodies make provisions for only those that, they invited and that will be partaking in the marking exercise.

Recommendations

Considering the fact that guided scoring strategy has been found effective both in increasing achievement and enhancing or increasing interest level of students in mathematics, the following recommendations has been made by the researcher.

1. One of the main aims of secondary school mathematics is for students to achieve high in mathematics. The use of guided scoring strategy can achieve thus, hence it should be included as an integral part of the methodology used in presenting mathematics in the secondary schools.
2. Teachers should make use of the guided scoring strategy more often so that students will inculcate the habit of putting down all necessary steps in the answer sheets and gain all possible marks.
3. Secondary school mathematics teachers should attend marking coordination whether they are participating in the marking exercise or not.
4. Administrators should allow teachers to attend marking cordinations.
5. The government should ask examining bodies to give out marking schemes of all subjects to all teachers and not to collect them back

after the marking exercise. They should also ensure that the examining bodies allow teachers to use marking schemes freely.

Limitations

1. The use of only WEAC marking scheme for the study instead of WEAC and NECO
2. The use of senior secondary school II for the study instead of SS III students who ought to have covered all the topic for SSSCE

Suggestion for Further Research

In relation to the results of this study, the researcher suggests that further research be carried out in the following areas

1. Examining more units of instruction with guided scoring strategy.
2. investigating the difference between urban and rural students with guided scoring strategy
3. Finding out the effect of teaching with guided scoring strategy on student achievement and interest in other school subjects.
4. Investigating the effect of teaching with guided scoring strategy on other classes.

Summary

The purpose of this study was to investigate the effect of guided scoring strategy on senior secondary school II (SSII) students in quadratic aspect of mathematics. Four research questions and six hypotheses guided the study. The design used in the study was quasi-experimental design called non –equivalent control group design. Fifty –nine SSII students drawn from two schools, one from Ika North East, one from Ika South educational zones of Delta state form the subjects for the study. The two schools were randomly grouped into experimental and control group.

Two classes, experimental in one school, control in the other school. The two groups were taught by the researcher. Two main instruments Quadratic Equation Achievement test QEAT and mathematics interest scale MIS were developed, validated, and used by the researcher in the study. a trial test was carried out to ascertain the reliability and stability of the instruments. The reliability coefficient of the QEAT was established using Kendal coefficients of concordance (W), while that of the MIS was established using Cronbach Alpha. The coefficients of stability of both the QEAT and the MIS were established using spearman's test –retest coefficient of reliability.

The data generated from the study were analysed using the means, standard deviations, and analysis of covariance (ANCOVA) technique in which the respective pre-test of the two dependent variables served as covariate. The result of this study shows that guided scoring strategy had significantly improved students' achievement and interest in mathematics. It also revealed that gender is not a significant factor on achievement and interest in mathematics.

The implication of the study on students is that it will make them to be very careful during examination and inculcate in them the habit of putting down all the relevant steps in their answer sheets. Its implication on teachers is that it will encourage them to use this strategy more often since they are aware that it will enhance achievement. Its implication on administrators and the government is that it will make them allow teachers to go for coordinations. And ask the examining bodies to provide marking scheme for all teachers in all subjects.

This study recommended that the strategy should be included as an integral part of the methodology used in presenting mathematics in secondary schools. it was also recommended that teachers should make use of the guided scoring strategy more often. This study recommended that mathematics teachers should attend marking coordinations. It also

recommended that administrators should permit teachers to attend coordinations and that the government should ask examining bodies to give marking schemes to all teachers and allow them to use them freely.

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APPENDIX A

LESSON PLAN FOR FACTORISATION METHOD

Name of Teacher: Memeh, Isioma M.

Name of School: Owa-Alero Secondary Commercial School

Subject: Mathematics

TOPIC: Factorization method of solving quadratic equations

Class: SS II

Duration: 40 minutes

Average Age of student : 16 years

Specific objectives : By the end of the lesson, the students will be able to

i) Identify factors of any number

ii) Use factorization method to solve quadratic problems.

Entry behaviour: The students have learnt and can find the factors of any number.

Teaching strategy: Conventional method (Problem solving process)

Instructional Material: Textbooks and charts

Entry behaviour test: The following questions related to the entry behaviour will be asked orally

1) what are the factors of 21

2) what are the factors of –12

INTRUCTIONAL PROCEDURE

Content Development	Teacher's Activity	Students' Activity,	Strategies
Introduction	Asks students the following questions 1) What are the factors of 21 2) What are the factors of –12 Help to answer the question where some students fail and others get them right. The teacher introduces the topic of the lesson. Factorisation is a method of finding the linear factors of quadratic equation and then simplifying to get the value of the unknown	Attempt to answer to questions Listens attentively	Set induction and questioning

Generalization	The illustration below is used to explain the full meaning of the above definition on the chalk board general quadratic equation is $ax^2 + bx + c$
	Find linear factors $(x+k)(x+l)$ such that $ax^2 + bx + c\ (x + k)\ (x + l) = 0$
	If $(x + k)\ (x + l) = 0$
	Then either
	$x + k = 0$ or
	$x + l = 0$
	if $x + k = 0$ then
	$x = 0 - k = -k$
	if $x + l = 0$ then
	$x = 0 - l = -l$
	$\therefore x = -k$ or $x = -l$
		Students' listens attentively and ask questions when necessary; After the explanation, they take down notes	Explanation and illustration.

Application	The following examples are used to illustrate further. Example I: solve the quadratic equation $X^2 - 7x + 10 = 0$, using factorization method. **Solution** Teacher asks students to find the factors of 10 that can be added to gather to get (-7) factorizing $X^2 - 7x + 10 = 0$ $= (x - 5)(x - 2) = 0$ either $x - 5 = 0$ $x - 2 = 0$	Students listen attentively, ask questions when necessary and equally answer the teacher's question take down notes on the chalkboard	Use of example and questioning

	if $x - 5 = 0$ then $x = 0+5 = 5$ if $x - 2 = 0$ then $x = 0 + 2 = 2$ $\therefore x = 5$ or $x = 2$ Example 2: solve the quadratic equation $2x^2 - 3x - 5 = 0$ using factorization method **Solution** $2x^2 - 3x - 5$ $= 2x^2 - 5x + 2x - 5$ $= x(2x - 5) + 1(2x - 5)$ $= (2x - 5)(x + 1) = 0$ either $2x - 5 = 0$ or $x + 1 = 0$ if $2x - 5 = 0$ then $2x = 0 + 5 = 5$ $x = 5/2 = 2.5$ if $x + 1 = 0$ then $x = 0 - 1 = 1$ $\therefore x = 2.5$ or $x = -1$		
Evaluation / Summary.	Teacher asks students to solve $x^2 - 4x + 4 = 0$ and moves round the class to ensure that they are all solving. Later one student is called on to solve the question on the chalkboard.	Students attempts to solve the question and later listens attentively as their classmate solve the problem on the chalkboard	Self evaluation

APPENDIX B

LESSON PLAN FOR GENERAL FORMULA METHOD

Name of Teacher: Memeh,Isioma M.

Name of School: Owa – Alero Secondary Commercial School

Subject: Mathematics

Topic: General formula method of solving quadratic equations

Class: SS II

Duration: 40 minutes

Average Age of Student : 16 years

Specific objectives : By the end of the lesson students will be able to

1) Substitute numbers into any formula
2) Use formula method to solve quadratic problems

Entry behaviour: The students have learnt how to substitute and simplify numbers.

Teaching Strategy: Conventional methods (Problem Solving process)

Instructional materials: Textbooks

Entry behavior test: The following questions related to the entry behaviour will be asked:

1) What is the value of x in the equation $x = 2a + c$ where $a = 5$, $c = 2$
2) What is the value of b in the equation $b = \sqrt{\frac{3a}{c}}$ where $a = 6$, $c = 2$

INSTRUCTIONAL PROCEDURE

Content Development	Teacher's Activity	Student's Activity,	Strategies
Introduction	Asks students the following questions 1) What are the value of x in the equation x = 2a +c value of b in the equation b = $\sqrt{\frac{3a}{c}}$ where a = 6, c = 2 Help to answer the students question when some students listens fail. The teacher attentively introduces the topic of and ask the lesson: There is questions a general formula derived where necessary solve quadratic equation. This equation can solve any quadratic equation. The general formula is $X = \frac{-b+\sqrt{b^2-4ac}}{2a}$	Attempt to answer to questions	Set induction and explanation
Generalization and application	Example 1: used the general formular to solve the equation $2x^2 + 15x + 7 = 0$ **Solution:** Asks students to compare first. Comparing $2x^2 + 15x + 7 = 0$ With the general equation $ax^2 + bx + c = 0$ a = 2, b = 15, c = 7 Substituting into the formular $X = \frac{-b+\sqrt{b^2-4ac}}{29}$ $X = \frac{-15+\sqrt{15^2-4\times2\times7}}{2\times2}$ $= \frac{-15\pm\sqrt{225-54}}{4}$ $= \frac{-15\pm\sqrt{169}}{4} = \frac{-15\pm13}{4}$ $X_1 = \frac{-15+13}{4} = \frac{-12}{4} = -0.5$	They later take down notes Students' listens attentively ask questions and equally answers the teacher's questions they later take down notes.	Explanation, use of examples and questioning

	$X_2 = \frac{-15-13}{4} = \frac{-28}{4} = -7$ X = -0.5 or X = -7 Mores round the class while students are copying notes.		
Application	Example 2: Use quadratic formula to solve $3n^2 + 2 = 8n$ **Solution** Ask students what they observe in the question $3n^2 + 2 = 8n$ make RHS = 0 $3n^2 - 8n + 2 = 0$ asks what the values of a, b & c are here a = 3, b = -8, c = 2 Substituting into $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{29}$ we have $x = \frac{-(-8) \pm \sqrt{-8)^2}}{2 \times 3} = 4 \times 3 \times 2$ $= \frac{8 \pm \sqrt{64-24}}{6}$ $= \frac{8 \pm \sqrt{40}}{6} = \frac{8 \pm 6.32}{6}$ $X_1 = 2.39$ $X_2 = \frac{8-6.32}{6} = \frac{1.68}{6}$ $X_2 = 0.28$ $\therefore X = 2.39$ or $X = 0.28$	Answers questions and listens attentively and asks questions where necessary and later take down notes	Explanation use of examples and questioning
Evaluation / Summary.	Teacher asks students to solve $2X^2 - 3X + 9 = 0$ and moves round the class to ensure that they are all solving. Later one student is called on to solve the problem on the chalk board.	Attempts to solve the question and later listens attentively as one of them solve the problem.	Self evaluation.

APPENDIX C

LESSON PLAN FOR COMPLETING THE SQUARE METHOD

Name of Teacher: Memeh,Isioma M.

Name of School: Owa – Alero Secondary Commercial School

Subject: Mathematics

Topic: Completing the square method of solving quadratic equations

Class: SS II

Average Age of student : 16 years

Specific objectives : By the end of the lesson students will be able to

1) Solve quadratic equations using completing the square method

Entry behaviour: The students have learnt how to factorize and simplify numbers.

Teaching Strategy: Conventional methods (problem solving process)

Instructional materials: Textbooks

Entry behavior test: The following questions related to the entry behaviour will be asked.

1) Factorise $X^2 + 4X + 4 = 0$

2) Find the value of X in the equation $(x + 3)^2 = 16$.

INSTRUCTIONAL PROCEDURE

Content Development	Teacher's Activity	Students' Activity,	Strategies
Introduction	Asks students the following questions 1) Factorise $X^2 + 4X + 4 = 0$ 2) What are the values of x in the equation $(x + 3)^2 = 16$ Help to answer the question when some students fail it. The teacher introduces the topic of the lesson: The method of completing the square is a situation where the LHS of an equation is made a perfect square and then we simplify the result to get the values of the unknown	Attempt to answer the question	Set induction and questioning
Generalization	There are several steps involved in this method, these include Step 1: Make coefficient of x unity Step 2: Rearrange RHS = 0 Step 3: Transfer constant term to RHS Step 4: Make LHS a perfect square by adding the square of half the coefficient of x to both sides of the equation Step 5: Factorize the LHS Step 6: Take the square root of both sides	Students listens attentively, ask question when necessary and take down notes later.	Explanation and illustration
Application	Example 1: Solve the equation $2X^2 + 3X - 2 = 0$ Using the method of completing the squares. **Solution** $2X^2 + 3X - 2 = 0$ Divide through by 2 $X^2 + \frac{3}{2}X - 1 = 0$ $X^2 + \frac{3}{2}X = 1$ Add $(3/4)^2$ to both sides $X^2 + \frac{3}{2}X + (\frac{3}{4})^2 = 1 + (\frac{3}{4})^2$ Factorizing	Listens Attentively, as questions when necessary and equally answers the teachers questions. They take down notes later (after the explanation)	Explanation and illustration using examples

	$(X + \frac{3}{4})^2 = 1 + \frac{9}{16} = 25$ $= \frac{25}{16.5}$ Take square root of both sides $X + \frac{3}{4} = \pm\sqrt{\frac{25}{16}} = \pm\frac{5}{4}$ $X = \frac{-3}{4} \pm \frac{5}{4} = \frac{-3 \pm 5}{4}$ $X_1 = \frac{-3+5}{4} = \frac{2}{4} = \frac{1}{2}$ Or $X_2 = \frac{-3-5}{4} = \frac{-8}{4}$ $\therefore = \frac{1}{2}$ or X = -2		
Application	Example 2: Solve the equation $3X^2 - 5X - 7 = 0$ **Solution** $3x^2 - 5x - 7 = 0$ Divide both sides by 3 $X^2 - \frac{5}{3}x - \frac{7}{3} = 0$ $X^2 - \frac{5}{3}x = \frac{7}{3}$ Add $(\frac{-5}{6})^2$ to both sides $X^2 - \frac{5}{3}x + (\frac{-5}{6})^2 = \frac{7}{3} + (\frac{-5}{6})^2$ **Factorising** $(X - \frac{5}{6})^2 = \frac{7}{3} + \frac{25}{36} = \frac{84+25}{36}$ $= \frac{109}{36}$ Take square root of both sides $X \frac{-5}{6} = \pm \frac{\sqrt{109}}{36} = \frac{\pm\sqrt{109}}{6}$ $\therefore X = \frac{5}{6} \pm \frac{\sqrt{109}}{6} = \frac{5 \pm \sqrt{109}}{6}$ $X_1 = \frac{5+\sqrt{109}}{6} = \frac{5+\sqrt{10.44}}{6} = \frac{15.44}{6}$ $X_1 = 2.57$ Or $X_2 = \frac{5-10.44}{6} = \frac{-5.44}{6}$	Listens attentively asks questions when necessary and equally answer the teacher's questions. They later take down notes.	Explanation and illustration using examples.

	= -0.91 ∴ X = 2.57 or X = -0.91		
Evaluation / Summary.	Teacher asks students to solve $2x^2$ + 9x = 5 and moves round the class to ensure that they are all solving. Later one student is called on to solve the question on the chalkboard	Attempts to solve the question and later listens attentively as one of them solve the problem	Self evaluation

APPENDIX D

LESSON PLAN FOR GRAPHICAL METHOD

Name of Teacher: Memeh,Isioma M.

Name of School: Owa – Alero Secondary Commercial School

Subject: Mathematics

Topic: Graphical method of solving quadratic equations.

Class: SS II

Duration: 80 minutes periods of 40 minutes each

Average Age of student : 16 years

Specific objectives : By the end of the lesson, students will be able to

i) find roots of equation from graph

ii) find roots of similar equations from graph.

Teaching Strategy: Conventional method (Problem solving process)

Entry behaviour: The students are familiar with (i) finding values of an unknown from a given equation.

(ii) Drawing linear graphs.

Instructional materials: Textbooks and mobile graph board

Entry behaviour test: The following questions related to the entry behaviour will be asked.

(1) What is the value of y when $x = 2$ in the equation $y = 2x - 1$

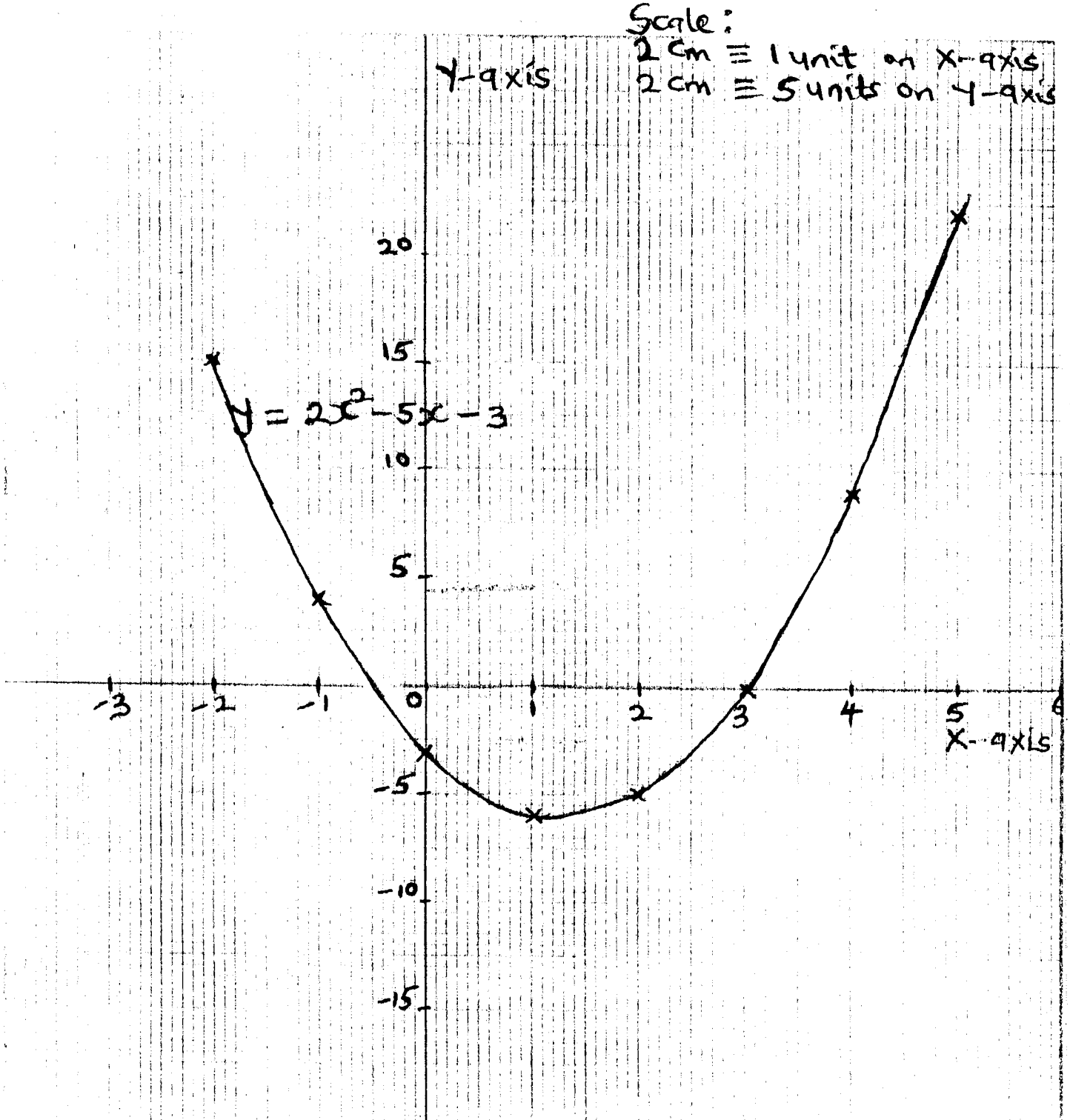
(2) What is the value of y when $x = 2$ in the equation $y = x^2 - 3x + 4$

INSTRUCTIONAL PROCEDURE

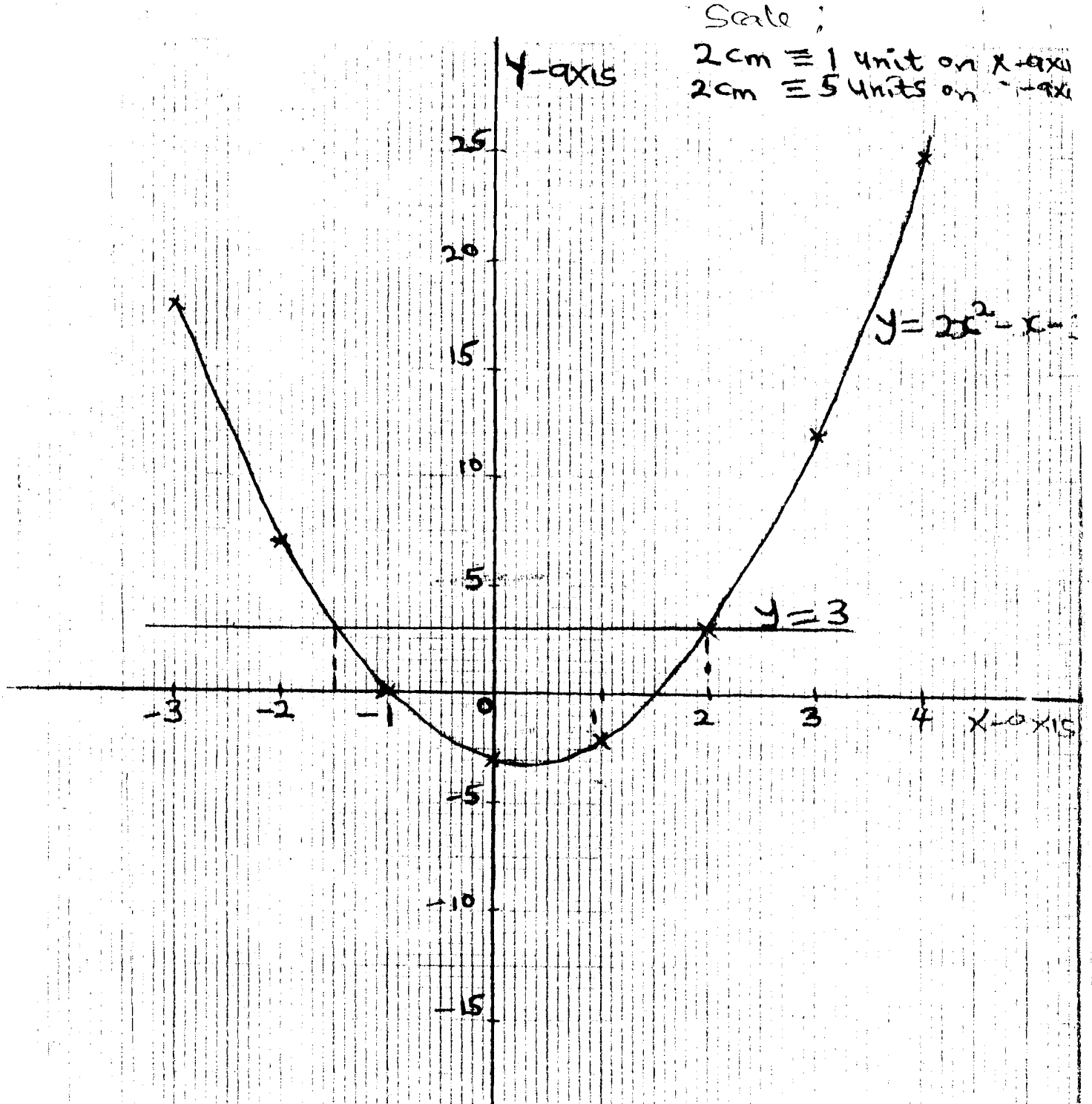
Content Development	Teacher's Activity	Students' Activity,	Strategies
Introduction	Asks student to solve for y when x = 2 in (i) $y = x^2 - 3x + 4$ Later solves these problems on the chalk board for the benefit those that could not get the right answer. Explains that quadratic equations can be solved graphically, by drawing the graph of the function or equation $y = ax^2 + bx + c$ which is obtained by plotting the function $y = ax^2 + bx + c$ against x. The x –coordinate of the points where the graph meets the x – axis (when y = 0) are the roots of the equation $ax^2 + bx + c = 0$	Attempt to solve these problems Listens attentively and asks questions	Questioning and use of examples.
Generalization	The following techniques will be used in drawing smooth and accurate graphs 1) Construct a table of values for y against x (taking the range of x between any 2 given numbers) 2) Choose suitable scales for both x and y axes 3) Plot the tabulated values accurately 4) Joint the plotted points 5) Title your graph always	Listens attentively and asks questions when necessary	Explanation.

<table>
<tr>
<td>Application</td>
<td>Example 1 Draw the graph of $y = 2x^2 - 5x - 3$ for values of x from –2 to + 5, using a scale of 2cm to 1 unit on x – axis and 2cm to 5 units on the y – axis. From your graph solve $2x^2 - 5x - 3 = 0$
Solution
Teacher asks students to calculate each row and column of the table of value and guides them in the calculation.
Table of value
<table>
<tr><td>X</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>$2x^2$</td><td>8</td><td>2</td><td>0</td><td>2</td><td>8</td><td>18</td><td>32</td><td>50</td></tr>
<tr><td>-5x</td><td>10</td><td>5</td><td>0</td><td>-5</td><td>-10</td><td>-15</td><td>-20</td><td>-25</td></tr>
<tr><td>-3</td><td>-3</td><td>-3</td><td>-3</td><td>-3</td><td>-3</td><td>-3</td><td>-3</td><td>-3</td></tr>
<tr><td>y</td><td>15</td><td>4</td><td>13</td><td>16</td><td>15</td><td>0</td><td>9</td><td>22</td></tr>
</table>
Moves round the class and ensures that all the students are participating. They are later guided on how to draw the x- and y axes, plot each point and join the points by a smooth curve using either free hand or a flexible broom stick.
The teacher uses the mobile graph board to illustrate and draw her own. Graph is on the graph sheet. The values of x when $2x^2 - 5x - 3 = 0$ are X = -0.5 and 3
Ensures that students read the values of x from their own graphs.</td>
<td>Listens attentively participates in the necessary calculations ask questions when necessary and draw their own graphs following the teachers guide lines</td>
<td>Questioning use of examples illustrations and use of instructional material</td>
</tr>
<tr>
<td>Application.</td>
<td>Example 2 (a) Copy and complete the table below for the relation
$y = 2x^2 - x - 3$
<table>
<tr><td>X</td><td>-3</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>y</td><td></td><td></td><td>0</td><td></td><td></td><td>3</td><td></td><td>25</td></tr>
</table>
(b) using a scale of 2cm to 1 unit on x – axis and 2cm to 5 unit on x – axis and 2 cm to 5 units on the y – axis, draw the graph of the relation
$y = 2x^2 - x - 3$ for $-3 \leq 4$
(c) from your graph, correct to 1</td>
<td>Listens attentively participate in the necessary calculations asks questions when necessary and draws their own</td>
<td>Questioning use of examples and illustrations and use of instructional material.</td>
</tr>
</table>

Example 1


Scale:
2 cm ≡ 1 unit on X-axis
2 cm ≡ 5 units on Y-axis
Y-axis
X-axis
y = 2x² − 5x − 3
20
15
10
5
−5
−10
−15
−3
−2
−1
0
1
2
3
4
5

Example 2


Scale ;
2cm ≡ 1 unit on x-axis
2cm ≡ 5 units on y-axis
y-axis
x-axis
y = 3
25
20
15
10
5
0
-5
-10
-15
-3
-2
-1
1
2
3
4

	decimal place, solve the equations (i) $2x^2 - x - 3 = 0$ (ii) $2x^2 - x - 6 = 0$ **Solution** Teacher follows the same guidance procedure in example 1 to solve the problem. Table of value for $Y = 2x^2 - x - 3$ (b) is on the graph sheet (c) (i) the roots of the equation $2x^2 - x - 3 = 0$ are -1 and 1.5 (ii) $2x^2 - x - 6 = 0$ Students are asked to make the LHS look like that of the equation of the graph i.e. $2x^2 - x - 6 = 0$ $= 2x^2 - x - 3 - 3 = 0$ $= 2x - x - 3 = 3$ find the values of x when y = 3. They are asked to draw the line of y = 3 on the graph and trace the values of x (intercept) The roots of the equation $2x^2 - x - 6$ are x = -1.5 and 2 Ensures that students read the values of x from their own graphs	graphs following the teachers guide lines	

X	-3	-2	-1	0	1	2	3	4
$2x^2$	18	8	2	0	2	8	18	32
-5x	3	2	1	0	-1	-2	-3	-4
-3	-3	-3	-3	-3	-3	-3	-3	-3
y	18	7	0	-3	-2	3	12	25

APPENDIX E

LESSON PLAN FOR FACTORISATION METHOD

Name of Teacher: Memeh,Isioma M.

Name of School: Ogbemudia mixed secondary school.

Subject: Mathematics

TOPIC: Factorization method of solving quadratic equations

Class: SS II

Duration: 40 minutes

Average Age of student : 16 years

Specific objectives : By the end of the lesson, the students will be able to

i) Identify factors of any number

ii) Use factorization method to solve quadratic problems.

Entry behaviour: The students have learnt and can find the factors any number.

Teaching strategy: Guided scoring implied in problem solving process

Instructional Material: Textbooks and charts

Entry behaviour test: The following questions related to the entry behaviour will be asked orally

1) what are the factors of 21

2) what are the factors of –12

INTRUCTIONAL PROCEDURE

Content Development	Teacher's Activity	Students' Activity,	Strategies
Introduction	Asks students the following questions 1) What are the factors of 21 2) What are the factors of –12 Help to answer the question where some students fail and others get them right. The teacher introduces the topic of the lesson. Factorisation is a method of finding the linear factors of quadratic equation and then simplifying to get the value of the unknown	Attempt to answer to questions Listen attentively	Set induction and questioning
Generalization	The illustration below is used to explain the full meaning of the above definition on the chalk board general quadratic equation is $ax^2 + bx + c$ Find linear factors $(x+k)(x+l)$ such that $ax^2 + bx + c = (x + k)(x + l) = 0$ If $(x + k)(x + l) = 0$ Then either $x + k = 0$ or $x + l = 0$ if $x + k = 0$ then $x = 0 - k = -k$ if $x + l = 0$ then $x = 0 - l = -l$ $\therefore x = -k$ or $x = -l$	Students' listens attentively and ask questions when necessary; After the explanation, they take down notes	Explanation and illustration.
Application	The following examples are used to illustrate further. Emphasises the allocation of marks Explains that B mark is for Basic knowledge A mark is for accuracy. Example I: solve the quadratic equation $X^2 - 7x + 10 = 0$, using factorization method. **Solution** Teacher asks students to find the factors of 10 that can be added to gather to get (-7) factorizing $X^2 - 7x + 10 = 0$ $= (x - 5)(x - 2) = 0$ B_1 either $x - 5 = 0$ $x - 2 = 0$ M_1	Students listen attentively, ask questions when necessary and equally answer the teacher's question take down notes on the chalkboard	Use of example and questioning

	if $x - 5 = 0$ then $x = 0+5 = 5$ $M_1 A_1$ if $x - 2 = 0$ then $x = 0 + 2 = 2$ $M_1 A_1$ $\therefore x = 5$ or $x = 2$ Example 2: solve the quadratic equation $2x^2 - 3x - 5 = 0$ using factorization method **Solution** $2x^2 - 3x - 5$ $= 2x^2 - 5x + 2x - 5$ B_1 $= x(2x - 5) + 1(2x - 5)$ M_1 $= (2x - 5)(x + 1) = 0$ M_1 either $2x - 5 = 0$ or $x + 1 = 0$ if $2x - 5 = 0$ M_1 then $2x = 0 + 5 = 5$ $x = 5/2 = 2.5$ A_1 if $x + 1 = 0$ then $x = 0 - 1 = 1$ $M_1 A_1$ $\therefore x = 2.5$ or $x = -1$		
Evaluation Summary	Teacher asks students to solve $x^2 - 4x + 4 = 0$ and moves round the class to ensure that they are all solving. Later one student is called on to solve the question on the chalkboard.	Students attempts to solve the question and later listens attentively as their classmate solve the problem on the chalkboard	Self evaluation

APPENDIX F

LESSON PLAN FOR GENERAL FORMULA METHOD

Name of Teacher: Memeh, Isioma M.

Name of School: Ogbemudhen Mixed Secondary School

Subject: Mathematics

Topic: General formula method of solving quadratic equations

Class: SS II

Duration: 40 minutes

Average Age of Student : 16 years

Specific objectives : By the end of the lesson students will be able to

1) Substitute numbers into any formula

2) Use formula method to solve quadratic problems

Entry behaviour: The students have learnt how to substitute and simplify numbers.

Teaching Strategy: Guided scoring implied in problem solving process

Instructional materials: Textbooks

Entry behavior test: The following questions related to the entry behaviour will be asked.

1) What is the value of x in the equation $x = 2a + c$ where $a = 5$, $c = 2$

2) What is the value of b in the equation $b = \sqrt{\frac{3a}{c}}$ where $a = 6$, $c = 2$

INSTRUCTIONAL PROCEDURE

Content Development	Teacher's Activity	Student's Activity,	Strategies
Introduction	Asks students the following questions 1) What are the value of x in the equation x = 2a +c value of b in the equation $b = \sqrt{\frac{3a}{c}}$ where a = 6, c = 2 Help to answer the students question when some students listens fail. The teacher attentively introduces the topic of and ask the lesson: There is questions a general formula derived where necessary solve quadratic equation. This equation can solve any quadratic equation. The general formula is $X = \frac{-b+\sqrt{b^2-4ac}}{2a}$	Attempt to answer to questions	Set induction and explanation
Generalization and application	Example 1: used the general formular to solve the equation $2x^2 + 15x + 7 = 0$ **Solution:** Asks students to compare first. Stresses the allocation of marks Comparing $2x^2 + 15x + 7 = 0$ With the general equation $ax^2 + bx + c = 0$ a = 2, b = 15, c = 7 B1 Substituting into the formular $X = \frac{-b+\sqrt{b^2-4ac}}{29}$ $X = \frac{-15+\sqrt{15^2-4\times2\times7}}{2\times2}$ M1 $= \frac{-15\pm\sqrt{225-54}}{4}$ $= \frac{-15\pm\sqrt{169}}{4} = \frac{-15\pm13}{4}$ M1 $X_1 = \frac{-15+13}{4} = \frac{-12}{4} = -0.5$ M1A1	They later take down notes Students' listens attentively ask questions and equally answers the teacher's questions they later take down notes.	Explanation, use of examples and questioning

	$X_2 = \frac{-15-13}{4} = \frac{-28}{4} = -7$ $X = -0.5$ or $X = -7$ Moves round the class while students are copying notes.		
Application	Example 2: Use quadratic formula to solve $3n^2 + 2 = 8n$ **Solution** Ask students what they observe in the question. Asks students to observe how marks are allocated. $3n^2 + 2 = 8n$ make RHS = 0 $3n^2 - 8n + 2 = 0$ asks what the values of a, b & c are here a = 3, b = -8, c = 2 Substituting into B1 $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{29}$ we have $x = \frac{-(-8) \pm \sqrt{-8)^2 - 4 \times 3 \times 2}}{2 \times 3}$ M1 $= \frac{8 \pm \sqrt{64-24}}{6}$ M1 $= \frac{8 \pm \sqrt{40}}{6} = \frac{8 \pm 6.32}{6}$ $X_1 = 2.39$ M1 A1 $X_2 = \frac{8-6.32}{6} = \frac{1.68}{6}$ M1 $X_2 = 0.28$ A1 $\therefore X = 2.39$ or $X = 0.28$	Answers questions and listens attentively and asks questions where necessary and later take down notes	Explanation use of examples and questioning
Evaluation / Summary.	Teacher asks students to solve $2X^2 - 3X + 9 = 0$ and moves round the class to ensure that they are all solving. Later one student is called on to solve the problem on the chalk board.	Attempts to solve the question and later listens attentively as one of them solve the problem.	Self evaluation.

APPENDIX G

LESSON PLAN FOR COMPLETING THE SQUARE METHOD

Name of Teacher: Memely Isioma M.

Name of School: Ogbemudia mixed secondary school

Subject: Mathematics

Topic: Completing the square method of solving quadratic equations

Class: SS II

Average Age of student : 16 years

Specific objectives : By the end of the lesson students will be able to

1) Solve quadratic equations using completing the square method

Entry behaviour: The students have learnt how to factorize and simplify numbers.

Teaching Strategy: Guided scoring implied in problem solving process

Instructional materials: Textbooks

Entry behavior test: The following questions related to the entry behaviour will be asked.

1) Factorise $X^2 + 4X + 4 = 0$

2) Find the value of X in the equation $(x + 3)^2 = 16$.

INSTRUCTIONAL PROCEDURE

Content Development	Teacher's Activity	Students' Activity,	Strategies
Introduction	Asks students the following questions 1) Factorise $X^2 + 4X + 4 = 0$ 2) What are the values of x in the equation $(x + 3)^2 = 16$ Help to answer the question when some students fail it. The teacher introduces the topic of the lesson: The method of completing the square is a situation where the LHS of an equation is made a perfect square and then we simplify the result to get the values of the unknown	Attempt to answer the question	Set induction and questioning
Generalization	There are several steps involved in this method, these include Step 1: Make coefficient of x unity Step 2: Rearrange RHS = 0 Step 3: Transfer constant term to RHS Step 4: Make LHS a perfect square by adding the square of half the coefficient of x to both sides of the equation Step 5: Factorize the LHS Step 6: Take the square root of both sides	Students listens attentively, ask question when necessary and take down notes later.	Explanation and illustration
Application	Example 1: Solve the equation $2X^2 + 3X - 2 = 0$ Using the method of completing the squares. Emphasises how marks are allocated **Solution** $2X^2 + 3X - 2 = 0$ Divide through by 2 $X^2 + \frac{3}{2}X - 1 = 0$ B_1 $X^2 + \frac{3}{2}X = 1$ B_1 Add $(3/4)^2$ to both sides B_1 $X^2 + \frac{3}{2}X + (\frac{3}{4})^2 = 1 + (\frac{3}{4})^2$ M_1 Factorizing	Listens Attentively, as questions when necessary and equally answers the teachers questions. They take down notes later (after the explanation)	Explanation and illustration using examples

	$(X + \frac{3}{4})^2 = 1 + \frac{9}{16} = \frac{25}{16}$ B_1 $= \frac{25}{16}$ Take square root of both sides $X + \frac{3}{4} = \pm\sqrt{\frac{25}{16}} = \pm\frac{5}{4}$ M_1 $X = \frac{-3}{4} \pm \frac{5}{4} = \frac{-3 \pm 5}{4}$ $X_1 = \frac{-3+5}{4} = \frac{2}{4} = \frac{1}{2}$ $M_1 A_1$ Or $X_2 = \frac{-3-5}{4} = \frac{-8}{4}$ $M_1 A_1$ $\therefore = \frac{1}{2}$ or $X = -2$		
Application	Example 2: Solve the equation $3X^2 - 5X - 7 = 0$ Emphasises the allocation of marks **Solution** $3x^2 - 5x - 7 = 0$ Divide both sides by 3 $X^2 - \frac{5}{3}x - \frac{7}{3} = 0$ B_1 $X^2 - \frac{5}{3}x = \frac{7}{3}$ M_1 Add $(\frac{-5}{6})^2$ to both sides B_1 $X^2 - \frac{5}{3}x + (\frac{-5}{6})^2 = \frac{7}{3} + (\frac{-5}{6})^2$ M_1 **Factorising** $(X - \frac{5}{6})^2 = \frac{7}{3} + \frac{25}{36} = \frac{84+25}{36}$ $B_1 M_1$ $= \frac{109}{36}$ Take square root of both sides $X \frac{-5}{6} = \pm \frac{\sqrt{109}}{36} = \frac{\pm\sqrt{109}}{6}$ M_1 $\therefore X = \frac{5}{6} \pm \frac{\sqrt{109}}{6} = \frac{5 \pm \sqrt{109}}{6}$ M_1 $X_1 = \frac{5+\sqrt{109}}{6} = \frac{5+\sqrt{10.44}}{6} = \frac{15.44}{6}$ $X_1 = 2.57$ $M_1 A_1$ Or $X_2 = \frac{5-10.44}{6} = \frac{-5.44}{6}$ M_1	Listens attentively asks questions when necessary and equally answer the teacher's questions. They later take down notes.	Explanation and illustration using examples.

	= -0.91 A1 ∴ X = 2.57 or X = -0.91		
Evaluation / Summary.	Teacher asks students to solve $2x^2 + 9x = 5$ and moves round the class to ensure that they are all solving. Later one student is called on to solve the question on the chalkboard	Attempts to solve the question and later listens attentively as one of them solve the problem	Self evaluation

APPENDIX H

LESSON PLAN FOR GRAPHICAL METHOD

Name of Teacher: Memeh, Isioma M.

Name of School Ogbemudien mixed Secondary school.

Subject: Mathematics

Topic: Graphical method of solving quadratic equations.

Class: SS II

Duration: 80 minutes (2 periods of 40 minutes each)

Average Age of student : 16 years

Specific objectives : By the end of the lesson, students will be able to

i) find roots of equation from graph

ii) find roots of similar equations from graph.

Teaching Strategy: Guided scoring implied in problem solving process

Entry behaviour: The students are familiar with (i) finding values of an unknown from a given equation.

(ii) Drawing linear graphs.

Instructional materials: Textbooks and mobile graph board

Entry behaviour test: The following questions related to the entry behaviour will be asked.

(1) What is the value of y when $x = 2$ in the equation $y = 2x - 1$

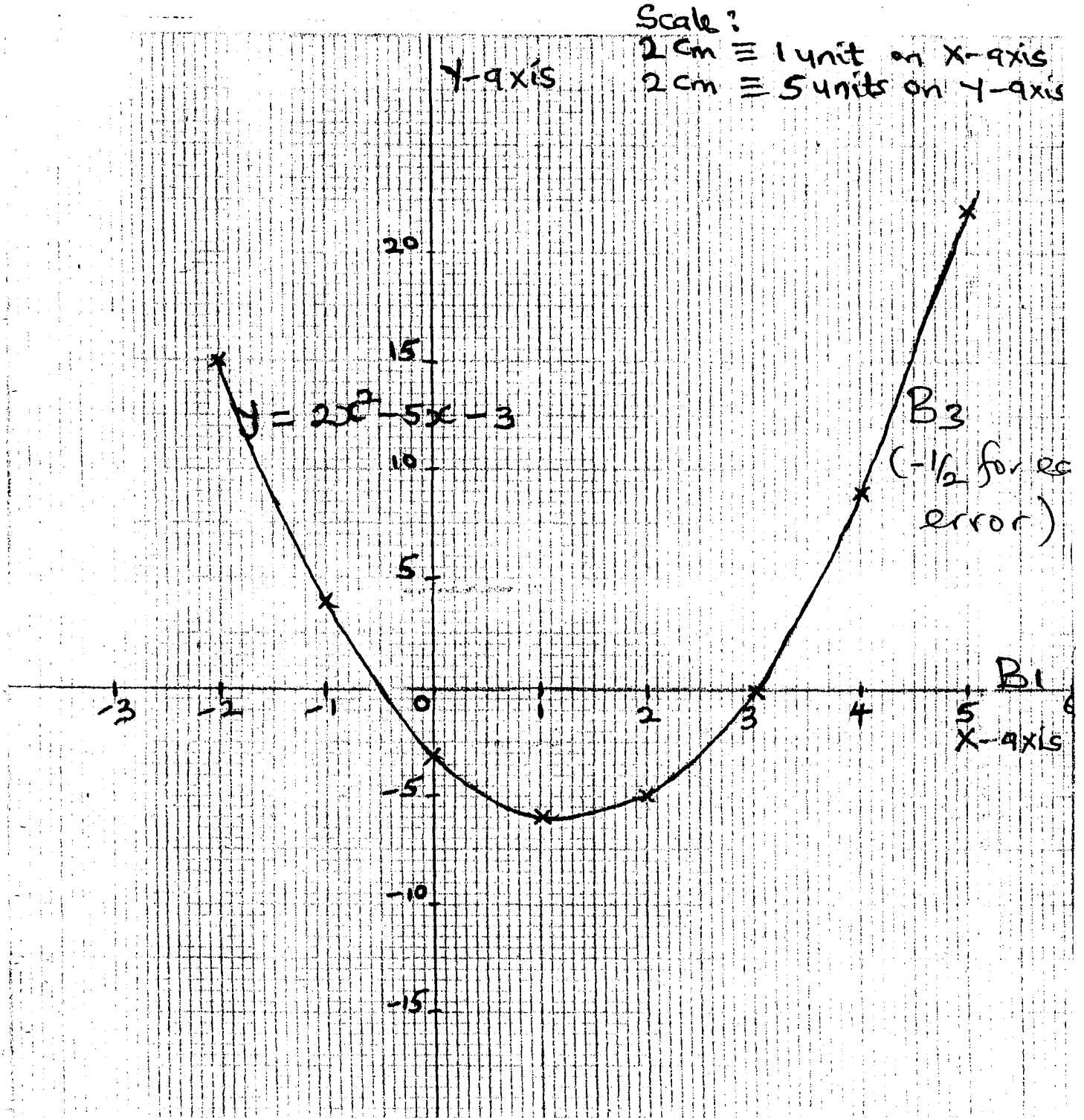
(2) What is the value of y when $x = 2$ in the equation $y = x^2 - 3x + 4$

INSTRUCTIONAL PROCEDURE

Content Development	Teacher's Activity	Students' Activity,	Strategies
Introduction	Asks student to solve for y when x = 2 in (i) $y = x^2 - 3x + 4$ Later solves these problems on the chalk board for the benefit those that could not get the right answer. Explains that quadratic equations can be solved graphically, by drawing the graph of the function or equation $y = ax^2 + bx + c$ which is obtained by plotting the function $y = ax^2 + bx + c$ against x. The x –coordinate of the points where the graph meets the x – axis (when y = 0) are the roots of the equation $ax^2 + bx + c = 0$	Attempt to solve these problems Listens attentively and asks questions	Questioning and use of examples.
Generalization	The following techniques will be used in drawing smooth and accurate graphs 1) Construct a table of values for y against x (taking the range of x between any 2 given numbers) 2) Choose suitable scales for both x and y axes 3) Plot the tabulated values accurately 4) Join the plotted points 5) Title your graph always	Listens attentively and asks questions when necessary	Explanation.

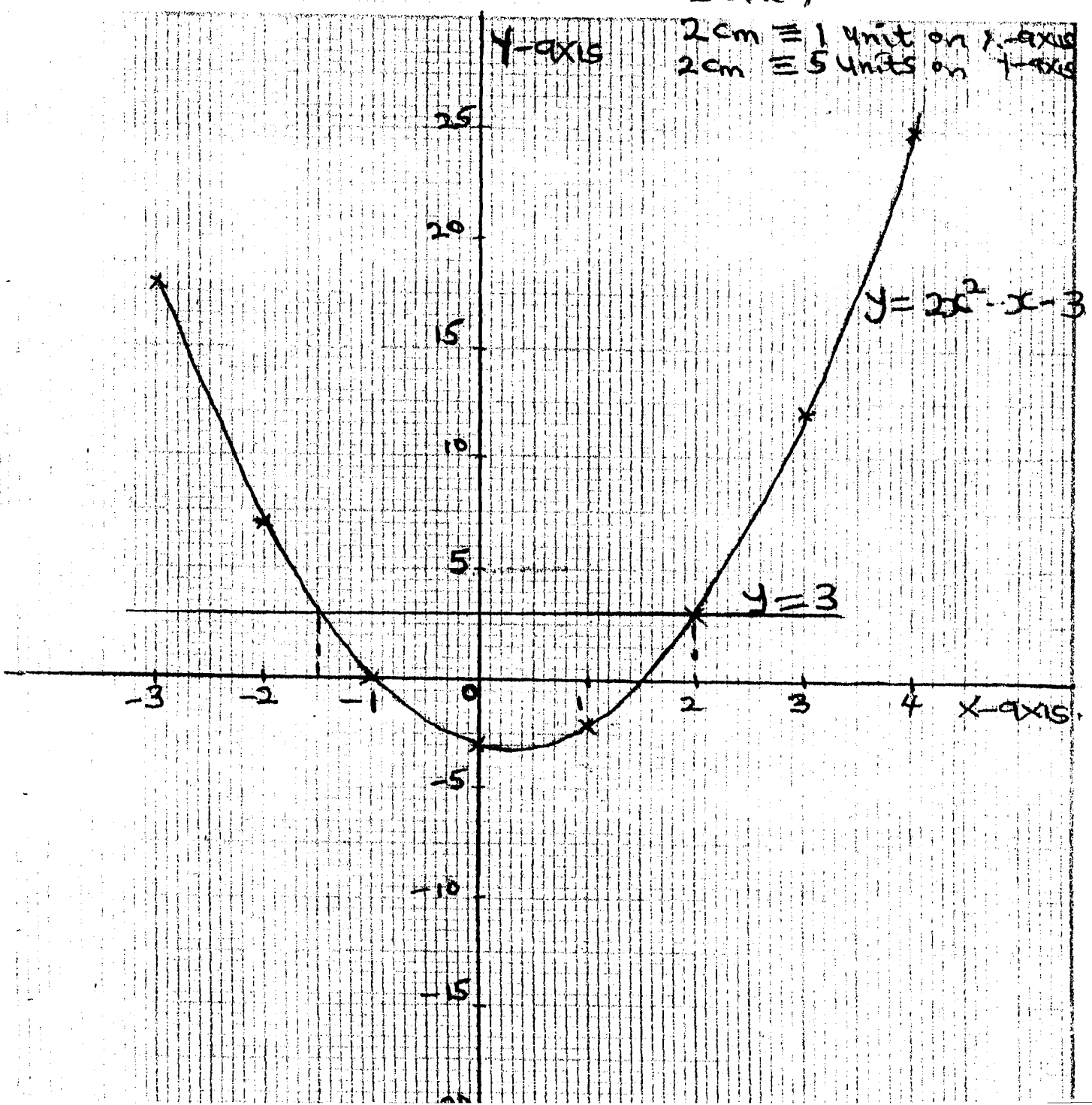
<table>
<tr>
<td>Application</td>
<td>Example 1 Draw the graph of $y = 2x^2 - 5x - 3$ for values of x from –2 to + 5, using a scale of 2cm to 1 unit on x – axis and 2cm to 5 units on the y – axis. From your graph solve $2x^2 - 5x - 3 = 0$: Emphasises how marks are allocated and deducted.
Solution
Teacher asks students to calculate each row and column of the table of value and guides them in the calculation.
Table of value
<table>
<tr><td>X</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>$2x^2$</td><td>8</td><td>2</td><td>0</td><td>2</td><td>8</td><td>18</td><td>32</td><td>50</td></tr>
<tr><td>-5x</td><td>10</td><td>5</td><td>0</td><td>-5</td><td>-10</td><td>-15</td><td>-20</td><td>-25</td></tr>
<tr><td>-3</td><td>-3</td><td>-3</td><td>-3</td><td>-3</td><td>-3</td><td>-3</td><td>-3</td><td>-3</td></tr>
<tr><td>y</td><td>15</td><td>4</td><td>13</td><td>16</td><td>15</td><td>0</td><td>9</td><td>22</td></tr>
</table>
B3 (–½ for each error)
Moves round the class and ensures that all the students are participating. They are later guided on how to draw the x- and y-axes, plot each point and join the points by a smooth curve using either free hand or a flexible broom stick.
The teacher uses the mobile graph board to illustrate and draw her own. Graph is on the graph sheet. The values of x when $2x^2 - 5x - 3 = 0$ are X = -0.5 and 3 $M_1 A_1 A_1$
Ensures that students read the values of x from their own graphs.</td>
<td>Listens attentively participates in the necessary calculations ask questions when necessary and draw their own graphs following the teachers guide lines</td>
<td>Questioning use of examples illustrations and use of instructional material</td>
</tr>
<tr>
<td>Application</td>
<td>Example 2 (a) Copy and complete the table below for the relation
$y = 2x^2 - x - 3$
<table>
<tr><td>X</td><td>-3</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>y</td><td></td><td></td><td>0</td><td></td><td></td><td>3</td><td></td><td>25</td></tr>
</table>
(b) using a scale of 2cm to 1 unit on x – axis and 2cm to 5 unit on x – axis and 2 cm to 5 units on the y – axis, draw the graph of the relation
$y = 2x^2 - x - 3$ for $-3 \leq 4$
(c) from your graph, correct to 1</td>
<td>Listens attentively participate in the necessary calculations asks questions when necessary and draws their own</td>
<td>Questioning use of examples and illustrations and use of instructional material.</td>
</tr>
</table>

Example 1


Scale:
2 cm ≡ 1 unit on X-axis
2 cm ≡ 5 units on Y-axis
Y-axis
X-axis
$y = 2x^2 - 5x - 3$
B3
(-½ for eg error)
B1
20
15
10
5
-5
-10
-15
-3
-2
-1
0
1
2
3
4
5

Example 2

(B)


Scale;
2cm ≡ 1 unit on x-axis
2cm ≡ 5 units on y-axis
Y-axis
X-axis
y = 2x² - x - 3
y = 3
25
20
15
10
5
-5
-10
-15
-3
-2
-1
0
1
2
3
4

	decimal place, solve the equations (i) $2x^2 - x - 3 = 0$ (ii) $2x^2 - x - 6 = 0$ **Solution** Teacher follows the same guidance procedure in example 1 to solve the problem. Emphasises the allocation and deduction of marks Table of value for $Y = 2x^2 - x - 3$	graphs following the teachers guide lines	

X	-3	-2	-1	0	1	2	3	4
$2x^2$	18	8	2	0	2	8	18	32
-5x	3	2	1	0	-1	-2	-3	-4
-3	-3	-3	-3	-3	-3	-3	-3	-3
y	18	7	0	-3	-2	3	12	25

B3 (-½ for each error)

(b) is on the graph sheet

(c) (i) the roots of the equation $2x^2 - x - 3 = 0$ are -1 and 1.5 $M_1 A_1 A_1$

(ii) $2x^2 - x - 6 = 0$

Students are asked to make the LHS look like that of the equation of the graph

i.e. $2x^2 - x - 6 = 0$

$= 2x^2 - x - 3 - 3 = 0$ B_1

$= 2x - -x - 3 = 3$ M_1

find the values of x when

y = 3. They are asked to draw the line of y = 3 on the graph and trace the values of x (intercept) The roots of the equation

$2x^2 - x - 6$ are

x = -1.5 and 2 $M_1 A_1 A_1$

Ensures that students read the values of x from their own graphs

APPENDIX I

QUADRATIC EQUATION ACHIEVEMENT TEST (QEAT)

Instruction: Answer all questions.

1. What are the possible values of x in the following equation
   (a) $(x - 3)(x - 4) = 0$
   (b) $(x - 2)^2 = 0$

2. Solve the following quadratic equations using factorization method.
   (a) $X^2 + 3x - 10 = 0$
   (b) $6y^2 - 149y - 102 = 0$

3. Use the quadratic formula to solve
   (a) $X^2 + 5x + 6 = 0$

4. Use the quadratic formula to solve
   (a) $5g^2 + 32g + 10 = 0$

5. Solve the equation $2x^2 - x - 8 = 0$, using completing the square method.
6. Solve the equation $3a^2 = 31a + 22$ using completing the square method.
7. (a) Copy and complete the table for the relation $y = 2x^2 + 3x - 6$

X	-4	-3	-2	-1	0	1	2	3
Y	14				-6		8	

(b) Draw the graph of $y = 2x^2 + 3x - 6$ using the scale of 1 cm to I unit on the x-axis and 2cm to 5 units on they y-axis

(c) From the graph solve the equation $2x^2 + 3x - 6 = 0$

8 (9) Copy and complete the table of values below for $y = 2x^2 - 3x - 7$

X	-3	-2	-1	0	1	2	3	4
Y		7					2	

(b) Using a scale of 1 cm to unit on the x – axis and 1 cm to 5 units on the y – axis, draw the graph of $y = 2x^2 - 3x - 7$

(c). From your graph, find the
   i) minimum value of $2x^2 - 3x - 7$
   ii) roots of the equation $2x^2 - 3x - 7 = 0$
   iii) roots of the equation $2x^2 - 3x - 4 = 0$

9 (a) Copy and complete the table $y = x^2 - 2x - 2$ or $-4 \leq x \leq 4$

X	-4	-3	-2	-1	0	1	2	3	4
Y	22				-2			1	6

(b) Using 9 scale of 2cm to 1 unit on the x – axis and 2 cm to 5 units on the Y – axis draw the graph of $y = x^2 - 2x - 2$

(c) Use your graph to find
   (i) the roots of the equation $x^2 - 2x - 2 = 0$
   (ii) the values of x for which $x^2 - 2x - -4\frac{1}{2} = 0$

APPENDIX J
MATHEMATICS INTEREST SCALE

Students Questionnaire.

This instrument is designed to explore your interest in mathematics. The researcher demands your honest response to the items. Please answer the following questions by ticking " " in the appropriate column that best suit your response. Please do not leave any item unresponded to.

Note that the columns are ranked in order of
SA- Strongly Agree.
A- Agree
D- Disagree
SD- Strongly Disagree.

Gender: Male ☐ Female ☐

Name of school:

S/No	Item	SA	A	D	SD
1	I like Mathematics				
2	I find the steps in solving quadratic equations complex.				
3	Following the steps in solving quadratic equation problems makes them easy for me				
4	I can sit for two hours solving mathematics problem without getting bored.				
5	Mathematics makes me sleepy in the class.				
6	I am always happy when it is time for mathematics lesson				
7	I find mathematics classes lively				
8	Mathematics is everyday in my personal reading time-table.				
9	I often discuss mathematics problems with my classmates during free periods in the classroom.				
10	The knowledge of how marks are allocated during marking makes me careful.				

S/No	Item	SA	A	D	SD
11	The knowledge of how marks are deducted makes me careful				
12	Many steps in mathematics problems makes me leave the class				
13	It is not necessary to put all the steps in the answer sheet				
14	Mathematics is very important in the development of the nation.				
15	I do not like mathematics because some teachers do not teach it well.				
16	Some teachers encourage me to pay attention to mathematics classes with their methods of teaching				
17	I am, happier solving mathematics than reading other subjects				
18	Mathematics is an examination I enjoy writing.				
19	I do not like mathematics examination and it scares me.				
20	I find solving quadratic equations fascinating and fun.				

APPENDIX K

MARKING SCHEME FOR QEAT

1. (a) $(x - 3)(x - 4) = 0$ **(4 marks)**

either $x - 3 = 0$

or $x - 4 = 0$ $\mathbf{M_1}$

If $x - 3 = 0$

$X = 0 + 3$ $\mathbf{M_1}$

$X = 3$ $\mathbf{A_1}$

If $X - 4 = 0$

$X = 0 + 4$

$X = 4$ $\mathbf{A_1}$

$\therefore$ $X = 3$ or $X = 4$

(b) $(X - 2)^2 = 0$ **(4 marks)**

$X - 2 = 0$ $\mathbf{M_1}$

$X = 0 + 2$ $\mathbf{M_1}$

$X = 2$ $\mathbf{A_1}$

Repeated values of X $\mathbf{B_1}$

2 (a) $X^2 + 3x - 10 = 0$ **(5 marks)**

$(X + 5)(X - 2) = 0$ $\mathbf{B_1}$

either $X + 5 = 0$

or $X - 2 = 0$ $\mathbf{M_1}$

If $X + 5 = 0$ $\mathbf{M_1}$

then $X = 0 - 5 = -5$ $\mathbf{A_1}$

If $X - 2 = 0$

$X = 0 + 2 = 2$ $\mathbf{A_1}$

$\therefore$ $X = -5$ or $X = 2$

(b) $y^2 - 149y - 10_2 = 0$ **(5 marks)**

$6y^2 + 4y - 153y - 102 = 0$ $\mathbf{M_1}$

$2y(3y + 2) - 51(3y + 2)$

$(2y - 51)(3y + 2)$ $\mathbf{B_1}$

$2y - 51 = 0$

or $3y + 2 = 0$ $\mathbf{M_1}$

if $2y - 15 = 0$

$2y = 51$

$y = \frac{51}{2} = 25\frac{1}{2}$ $\mathbf{A_1}$

If $3y + 2 = 0$

$3y = -2$

$y = \frac{-2}{3} = \frac{-2}{3}$ $\mathbf{A_1}$

3. $X^2 + 5x + 6 = 0$ **(8 marks)**

General quadratic equation

$$X = \frac{-b \pm \sqrt{b2 - 4ac}}{2a}$$

Here $a = 1$, $b = 5$ and $c = 6$ $\mathbf{B_1}$

Substituting

$$X = \frac{-5 \pm \sqrt{5^2 - \times 1 \times 6}}{2 \times 1} \ \mathbf{M_2}$$

$$= \frac{-5 \pm \sqrt{25 - 24}}{2}$$

$$= \frac{-5 \pm \sqrt{1}}{2} = \frac{-5 \pm 1}{2} \ \mathbf{M_1}$$

$$X_1 = \frac{-5+1}{2} = \frac{-4}{2} \ \mathbf{M_1}$$

$$X = -2 \ \mathbf{A_1}$$

$$X_2 = \frac{-5-1}{2} = \frac{-6}{2} \ \mathbf{M_1}$$

$$X_2 = -3 \ \mathbf{A_1}$$

$\therefore X_1 = -2 \quad X_2 = -3$

4. $5g^2 + 32g + 10 = 0$ **(10 marks)**

General formula : $X = \frac{-b \pm \sqrt{b2 - 4ac}}{2a}$

Here a = 5, b = 32 C = 10 $\mathbf{B_2}$

Substituting

$$X = \frac{-32 \pm \sqrt{32^2 - 4 \times 5 \times 10}}{2 \times 5} \ \mathbf{M_2}$$

$$= \frac{-32 \pm \sqrt{1024 - 200}}{10} = \frac{-32 \pm \sqrt{824}}{10} \ \mathbf{M_1}$$

$$X = \frac{-32 \pm 28.7}{10} \mathbf{M_1}$$

$$X_1 = \frac{-32 + 28.7}{10} = \frac{-3.3}{10} = -0.33 \ \mathbf{M_1 A_1}$$

$$X_2 = \frac{-32 + 28.7}{10} = \frac{60.7}{10} = -6.07 \ \mathbf{M_1 A_1}$$

$\therefore X = -0.33$ or $X = -6.07$

5. $2X^2 - X - 8 = 0$ **(8 marks)**

Divide through by 2

$X^2 - \frac{1}{2} X - 4 = 0 \ \mathbf{M_1}$

$X^2 - \frac{1}{2} X = 4$

Add $(-1/4)^2$ to both sides

$X^2 - \frac{1}{2} X + -(1/4)^2 = 4 + (-1/4)^2 \ \mathbf{B_1}$

$$(X - \tfrac{1}{4})^2 = 4 + \frac{1}{16} = \frac{65}{16} \ \mathbf{B_1 M_1}$$

Taking square root of both sides

$$X - \tfrac{1}{4} = \pm \frac{\sqrt{65}}{16} = \frac{\pm \sqrt{65}}{4} \mathbf{M_1}$$

$$X = \frac{1}{4} \pm \frac{\sqrt{65}}{4} = \frac{1 \pm \sqrt{65}}{4}$$

$$X = \frac{1 \pm 8.06}{4}$$

$$X_1 = \frac{1 + 8.06}{4} = \frac{9.06}{4} = 2.27 \ \mathbf{M_1A_1}$$

$$X_2 = \frac{1 - 8.06}{4} = \frac{-7.06}{4} = -1.77 \ \mathbf{A_1}$$

$\therefore X = 2.27$ or $X = -1.77$

6. $3a^2 = 31a + 22$ **(10 marks)**

$3a^2 - 31a - 22 = 0$

Divide both sides by 3

$$a^2 - \frac{31a}{3} - \frac{22}{3} = 0 \ \mathbf{B_1}$$

$$a^2 - \frac{31a}{3} = \frac{22}{3} \ \mathbf{B_1}$$

Add $\left(\frac{-31}{6}\right)^2$ to both sides

$$a^2 - \frac{31a}{3} + \left(\frac{-31}{6}\right)^2 = \frac{22}{3} + \left(\frac{-31}{6}\right)^2 \ \mathbf{B_1}$$

$$\left(\frac{a - 31}{6}\right)^2 = \frac{22}{3} + \frac{961}{36} = \frac{264 + 961}{36} \ \mathbf{B_1M_1}$$

$$= \frac{1225}{36}$$

Taking square root of both sides

$$a - \frac{31}{6} = \pm\sqrt{\frac{1225}{36}} = \pm\frac{35}{6} \ \mathbf{M_1}$$

$$a = \frac{31}{6} \pm \frac{35}{6} = \frac{31 \pm 35}{6} \ \mathbf{M_1}$$

$$a_1 = \frac{31 + 35}{6} = \frac{66}{6} = 11 \ \mathbf{A_1}$$

$$a_2 = \frac{31 - 35}{6} = \frac{-4}{6} \ \mathbf{M_1}$$

$$a_2 = \frac{-2}{3} \ \mathbf{A_1}$$

Add $\left(\frac{31a}{3} + \left(\frac{-31}{6}\right)^2 = \frac{22}{3} + \left(\frac{31}{6}\right)^2\right.$

7. Table of value for $y = 2x^2 + 3x - 6$

X	-4	-3	-2	-1	0	1	2	3
Y	14	3*	-4*	-7*	-6	-1*	8	21*

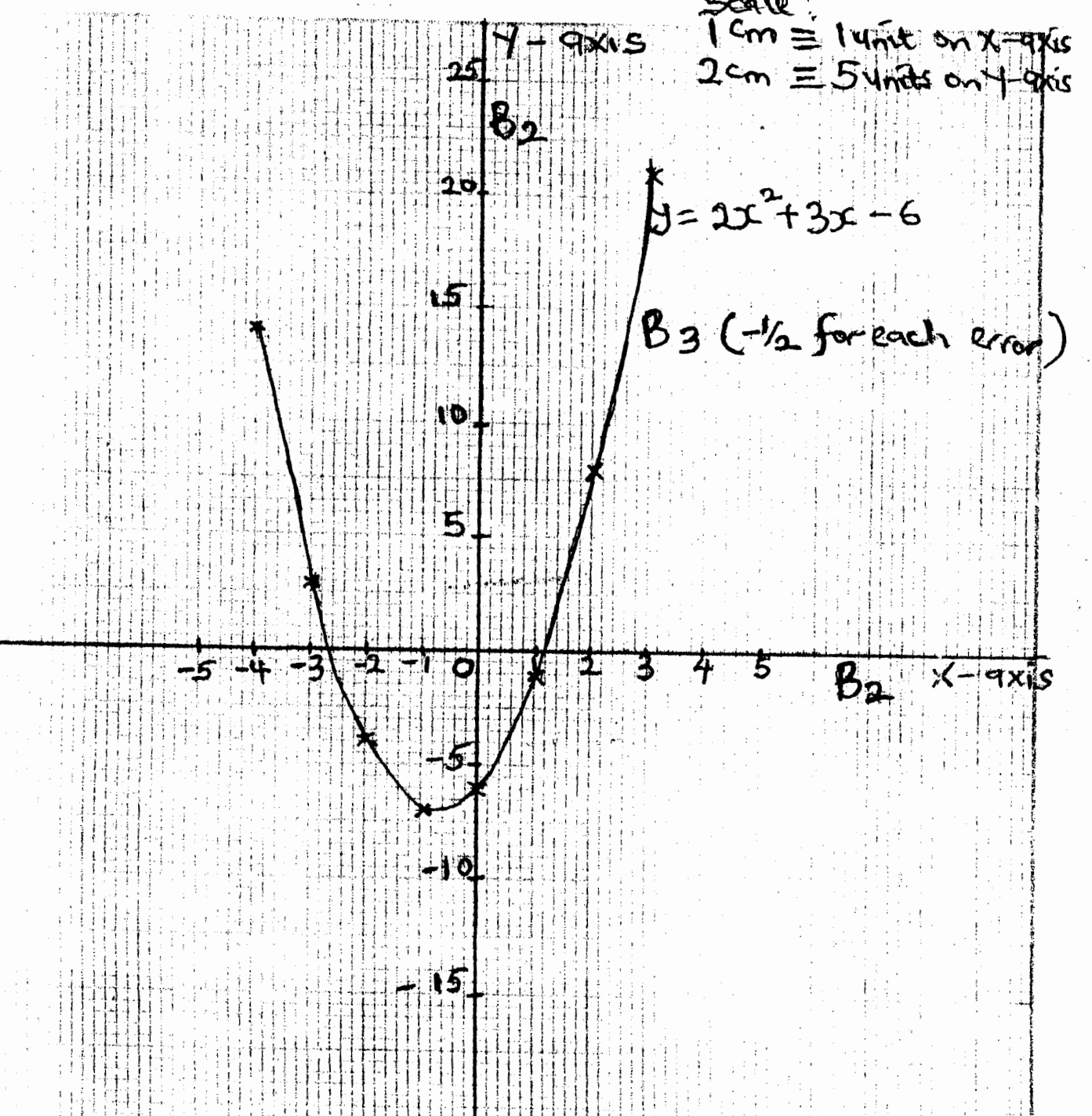
B_3 (-1/2 for each error)

(c) $2x^2 + 3x - 6 = 0$

when $y = = \mathbf{B_1} \ \mathbf{M_2}$

QUESTION 7

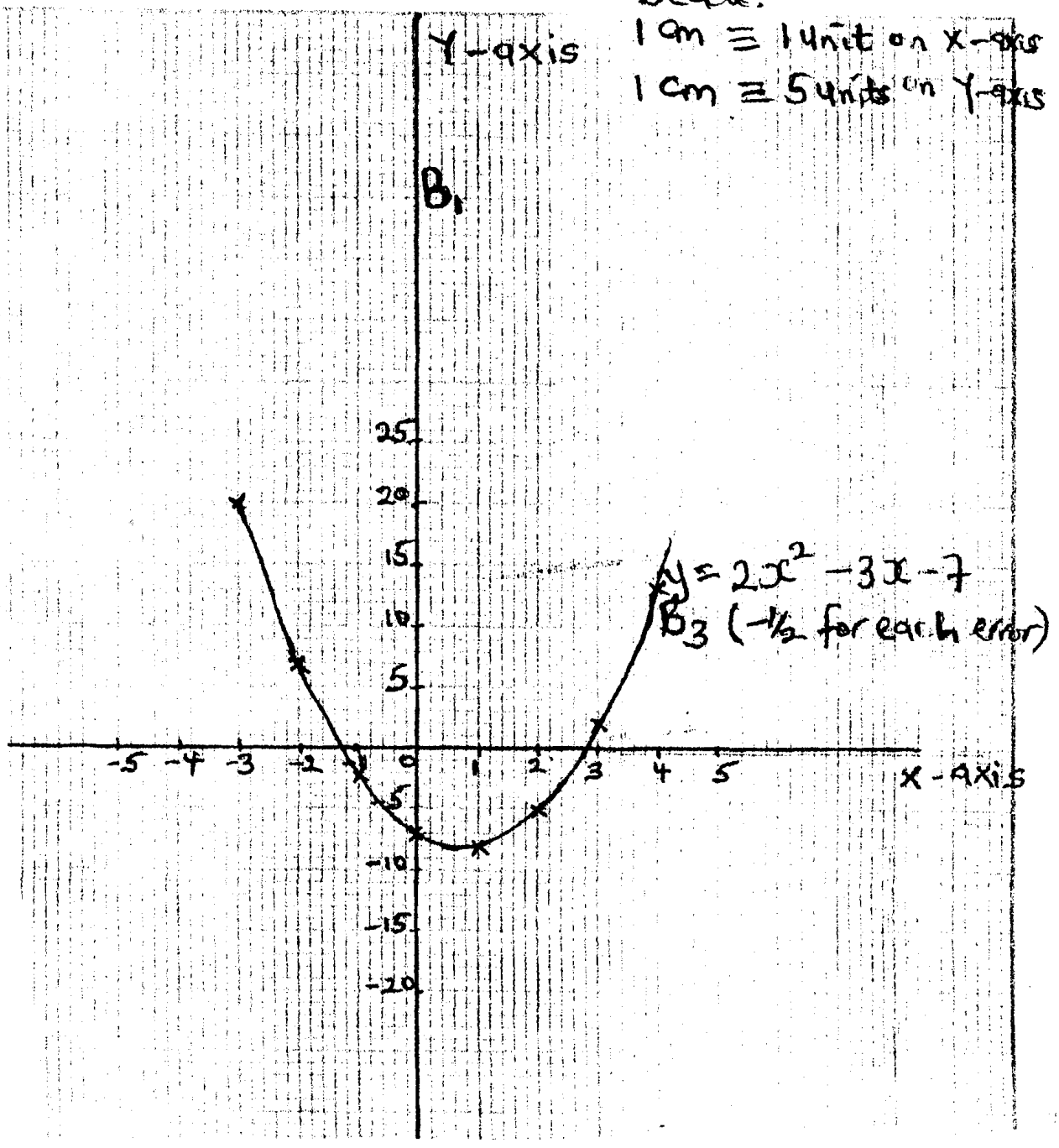
B


Scale:
1cm ≡ 1unit on x-axis
2cm ≡ 5units on y-axis
y-axis
x-axis
$y = 2x^2 + 3x - 6$
B_2
B_2
B_3 (-½ for each error)
25
20
15
10
5
-5
-10
-15
-5 -4 -3 -2 -1 0 1 2 3 4 5

QUESTION 8

(B)

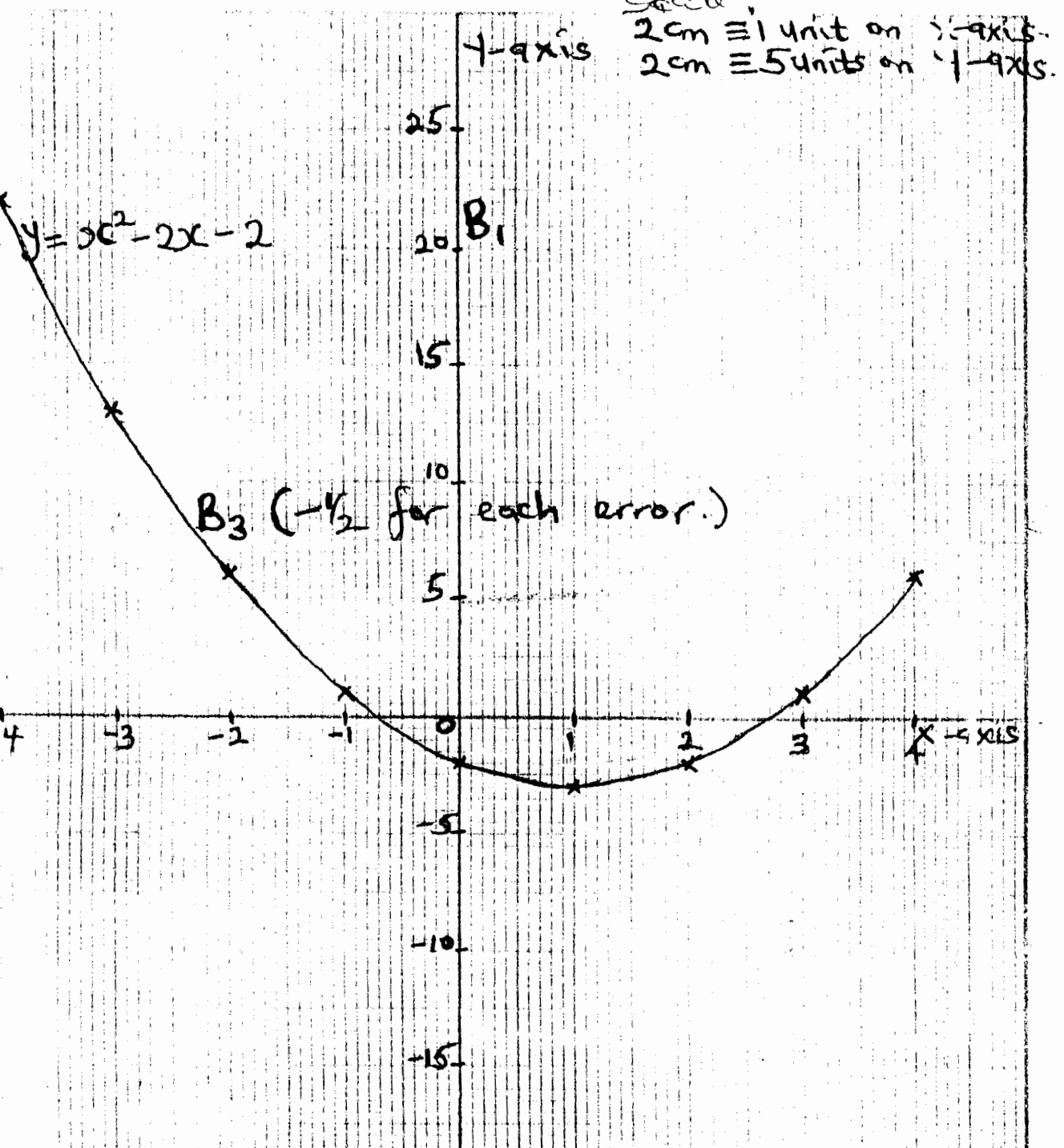
Scale:
1 cm ≡ 1 unit on X-axis
1 cm ≡ 5 units on Y-axis



B3 (−½ for each error)

QUESTION 9

B


Scale:
2cm ≡ 1 unit on x-axis.
2cm ≡ 5 units on y-axis.
y-axis
25
20
15
10
5
-5
-10
-15
$y = x^2 - 2x - 2$
B_1
B_3 (-½ for each error.)
-4
-3
-2
-1
0
1
2
3
4
x-axis

X = -2.6 and 1.2 (± 0.05) **A_1A_1**

8. Table of value for $y = 2x^2 - 3x - 7$

X	-3	-2	-1	0	1	2	3	4
Y	20*	7	-2*	-7*	-8*	-5*	2	13*

B_3 (-1/2 for each error)

(b) (i) Minimum value of $2x^2 - 3x - 7$ = -8 **M_1 A_1**

(ii) Roots of the equation $2x^2 - 3x - 7$
are –1.3 and 2.8 (±0 0.1) **M_1 A_1A_1**

(iii) Roots of the equation $2x^2 - 3x - 4 = 0$
are -0.8 and 2.4 (± 0.1) **$M_1A_1A_1$**

9. (a) Table of value for $y = x^2 - 2x - 2$

X	-4	-3	-2	-1	0	1	2	3	4
Y	22	13*	6*	1*	-2	-3*	-2*	1	6

B_3 (-1/2 for each error)

(b) (i) The roots of the equation $x^2 - 2x - 2 = 0$
are –0.7 and 2.7 (± 0.1) **M_2 A_1A_1**

(ii) The values of x for which $x^2 - 2x - 4\frac{1}{2} = 0$
are –1.3 and 3.3 (± 0.1) **M_2 A_1A_1**

Appendix L

S/NO	Name	Scores		
		1st scorer	2nd scorer	3rd scorer
1	Edebatu Jones	54	51	53
2	Isiafel Happy	34	33	30
3	Ebozim	14	15	14
4	Tinudon Rita	68	65	66
5	Okpara Daniel	21	22	20
6	Eluma Mary	47	14	44
7	Okonkwo Juliet	62	60	61
8	Oshogbor S. Stanley	34	31	25
9	Amarah Rex	10	11	11
10	Okechukwu Amara	11	08	10
11	Ojugbeli Cyril	25	23	27
12	Okoh Emmauel Uzor	17	14	17
13	Ekpenisi Fredrick	08	08	09
14	Nubilie Jeremiah	11	12	11
15	Ananyo Tonnia	01	00	01
16	Ohen Kenneth James	08	14	18
17	Ozuor Lucky	01	01	01
18	Owuzo Okah	24	27	29
19	Lilian Iworh	11	04	10
20	Iwelu Augustine	33	31	32

KENDALL'S COEFFICIENT OF CONCORDANCE (W)

Students	Ranks			Sum of		
	A	B	C	Ranks	D	D^2
1	3	3	3	9	-225	506.25
2	5.5	5	6	16.5	-15	225
3	13	11	13	37	5.5	30.25
4	1	1	1	3	-28.5	812.25
5	10	10	10	30	-1.5	2.25
6	4	4	4	12	-19.5	380.25
7	2	2	2	6	-25.5	650.25
8	5.5	6.5	9	21	-10.5	110.25
9	17	15	14.5	46.5	15	225
10	15	17.5	16.5	49	17.5	306.25
11	8	9	8	25	-6.5	42.25
12	12	12.5	12	36.5	5	25
13	18	17.5	18	53.5	22	484
14	15	14	14.5	43.5	12	144
15	19.5	20	19.5	59	27.5	756.25
16	11	12.5	11	34.5	3	9
17	19.5	19	19.5	58	26.5	702.25
18	9	8	7	24	-7.5	56.25
19	15	16	16.5	47.5	16	256
20	7	6.5	5	18.5	-13	169
				630		5892
			$\frac{\Sigma R}{N}$	31.5		

$$W = \frac{12 \times \Sigma D^2}{M^2 (N) (N^2 - 1)}$$

Where D = Difference between the sum of ranks for each row and the average total sum of ranks

M = number of scorers

N = number of students

ΣD^2 = 5892

M = 3

N = 20

$$W = \frac{12 \times 5892}{3^2 (20) (20^2 - 1)}$$

$$W = \frac{70704}{71820}$$

$$= 0.9845$$

$$W \cong 0.98$$

ITEMS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	S^2
1	3	4	2	2	4	3	3	2	4	3	2	3	2	3	3	4	3	4	2	1	0.7658
2	2	4	2	1	3	2	2	2	3	3	2	2	2	2	3	3	2	3	1	1	0.6184
3	3	4	2	2	3	2	2	3	1	3	1	2	1	2	3	1	2	4	2	1	0.9974
4	2	4	2	2	4	3	2	2	3	1	2	2	2	2	1	3	2	3	2	2	0.6421
5	3	4	3	2	4	3	3	3	4	3	3	3	2	3	2	4	3	3	2	2	0.4710
6	3	4	2	2	4	2	3	2	4	2	2	2	2	3	2	4	3	3	2	1	0.7789
7	3	4	2	1	4	2	2	2	3	2	1	3	1	3	2	3	3	3	1	2	0.8710
8	3	4	2	2	4	3	3	2	4	2	2	2	2	2	2	4	2	3	2	2	0.6736
9	3	3	2	2	3	2	2	2	3	3	2	3	2	2	3	3	2	3	2	2	0.3684
10	3	3	3	3	4	3	3	3	4	3	3	4	3	3	3	4	3	4	3	3	0.1974
11	3	4	3	3	4	3	3	3	4	3	3	4	3	3	3	4	3	4	3	3	0.2210
12	3	3	2	2	4	3	3	3	4	2	3	3	3	3	2	4	3	3	2	2	0.4500
13	3	4	3	2	4	3	3	3	4	3	2	3	2	2	3	4	2	4	2	2	0.6211
14	3	4	3	2	4	3	3	2	3	4	2	3	2	2	4	3	2	4	2	2	0.6605
15	2	2	3	3	2	3	2	3	2	4	4	2	4	2	4	2	2	3	3	3	0.6421
16	3	4	3	2	4	3	3	3	3	4	2	3	2	3	4	3	3	4	2	2	0.5263
17	3	4	2	1	4	3	2	2	4	1	1	2	1	2	1	4	2	2	1	1	1.2921
18	3	3	2	1	3	3	3	2	3	2	1	3	1	3	2	3	3	3	1	1	0.7474
19	3	3	2	2	4	3	3	2	4	3	4	3	4	3	3	4	2	3	2	2	0.5763
20	2	3	2	1	3	2	2	2	3	3	2	2	3	2	3	3	2	3	1	2	0.4316
Σ	52	72	47	38	73	54	52	48	67	52	44	54	44	50	53	67	49	66	38	37	12.5524

$$\alpha = \frac{n}{n-1}\left[\frac{\sigma_t^2 - \Sigma\sigma_i^2}{\delta t^2}\right]$$

n = number of items

δt^2 = variance of the total score

$\Sigma\sigma_i^2$ = sum of the item variances

$\delta t^2 = 120.0289$

$$\alpha = \frac{20}{19}\left(\frac{120.0289 - 12.5524}{120.0289}\right.$$

$= 1.0526 \times 0.8954$

$= 0.9425$

$\alpha \cong 0.94$

APPENDIX N

COEFFICIENT OF STABILITY OF QEAT USING SPEARMAN RANK CORRELATION

S/NO	1st Score	2nd Score	1st Rank	2nd Rank	D^2
1	54	58	3	3	0
2	34	37	5.5	7	2.25
3	14	16	13	12	1
4	68	67	1	2	1
5	21	27	10	9	1
6	47	56	4	4	0
7	62	71	2	1	1
8	34	38	5.5	5.5	0
9	10	10	17	16	1
10	11	13	15	15	0
11	25	29	8	8	0
12	17	26	12	10	4
13	08	10	18	16	4
14	11	15	15	13	4
15	01	07	19.5	19	0.25
16	08	09	11	18	49
17	01	05	19.5	20	0.25
18	24	26	9	10	1
19	11	15	15	13	4
20	33	38	7	5.5	2.25
					∑76

Coefficient of stability (test –retest coefficient of reliability) using spearman rank correlation

$$S = 1 - \frac{6\sum D^2}{N(N^2-1)}$$

$\sum D^2 = 76$

$N = 20$

$$S = 1 - \frac{6x76}{20(400-1} = 1 - \frac{456}{798}$$

$S = 0.94$

APPENDIX O

COEFFICIENT OF STABILITY OF MIS USING SPEARMAN RANK CORRELATION

S/NO	1st Score	2nd Score	1st Rank	2nd Rank	D^2
1	57	58	4.5	5	2.25
2	45	47	18	15	9
3	44	44	19.5	18	2.25
4	44	43	19.5	19.5	0
5	56	57	6.5	6.5	0
6	52	52	9.5	10.5	1
7	47	49	13.5	13.5	0
8	052	51	9.5	12	6.25
9	049	52	12	10.5	2.25
10	65	67	2	1	1
11	66	65	1	2	1
12	57	63	4.5	3	2.25
13	58	59	3	4	1
14	55	55	8	8	0
15	51	54	11	9	4
16	56	57	6.5	6.5	0
17	43	43	17	19.5	6.25
18	26	49	15.5	13.5	4
19	47	46	13.5	16	6.25
20	46	45	15.5	17	2.25
					∑51

Coefficient of stability (test –retest coefficient of reliability) using spearman rank correlation

$$S = 1 - \frac{6\sum D^2}{N(N^2-1)}$$

$\sum D^2 = 51$

$N = 20$

$$S = 1 - \frac{6x51}{20(400-1} = 1 - \frac{306}{798}$$

$S = 0.96$

Results of the data analyses of Mrs. Memeh, Isioma

PRETEST POSTEST PREINTER POSTINTE * SEX

SEX		PRETEST	POSTEST	PREINTER	POSTINTE
Male	Mean	46.4412	51.7353	46.2059	52.0000
	N	34	34	34	34
	Std. Deviation	17.1644	17.0477	14.7171	13.2322
Female	Mean	47.2000	50.2800	47.0400	52.4400
	N	25	25	25	25
	Std. Deviation	14.5774	14.3397	13.1735	11.3544
Total	Mean	46.7627	51.1186	46.5593	52.1864
	N	59	59	59	59
	Std. Deviation	15.9907	15.8420	13.9720	12.3700

PRETEST POSTEST PREINTER POSTINTE * GROUP

GROUP		PRETEST	POSTEST	PREINTER	POSTINTE
Experimental	Mean	47.6774	55.7419	45.7419	56.0968
	N	31	31	31	31
	Std. Deviation	16.4689	15.1128	14.0688	10.0078
Control	Mean	45.7500	46.0000	47.4643	47.8571
	N	28	28	28	28
	Std. Deviation	15.6811	15.2849	14.0646	13.4322
Total	Mean	46.7627	51.1186	46.5593	52.1864
	N	59	59	59	59
	Std. Deviation	15.9907	15.8420	13.9720	12.3700

```
DATA LIST /SN 1-2 SEX 3 GROUP 4 PRETEST 5-6 POSTEST 7-8 PREINTER 9-10
                  POSTINTE 11-12.
VALUE LABELS SEX 1 'MALE' 2 'FEMALE'.
BEGIN DATA.
END DATA.
     59 cases are written to the compressed active file.

This procedure was completed at  0:53:56
ANOVA POSTEST BY SEX(1,2) GROUP(1,2) WITH PRETEST
      /STATISTICS = 1.

'ANOVA' PROBLEM REQUIRES       500 BYTES OF MEMORY.
```

* * * A N A L Y S I S O F V A R I A N C E * * *

POSTEST
BY SEX
GROUP
WITH PRETEST

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	13288.077	1	13288.077	900.970	.000
PRETEST	13288.077	1	13288.077	900.970	.000
Main Effects	864.135	2	432.067	29.295	.000
SEX	25.697	1	25.697	1.742	.192
GROUP	835.056	1	835.056	56.619	.000
2-way Interactions	5.159	1	5.159	.350	.557
SEX GROUP	5.159	1	5.159	.350	.557
Explained	14157.370	4	3539.343	239.978	.000
Residual	796.426	54	14.749		
Total	14953.797	58	257.824		

59 Cases were processed.
0 Cases (.0 PCT) were missing.

---

* * * M U L T I P L E C L A S S I F I C A T I O N A N A L Y S I S * * *

POSTEST
By SEX
GROUP
With PRETEST

Grand Mean = 51.373

Variable + Category	N	Unadjusted Dev'n	Unadjusted Eta	Adjusted for Independents Dev'n	Adjusted for Independents Beta	Adjusted for Independents + Covariates Dev'n	Adjusted for Independents + Covariates Beta
SEX							
1 MALE	34	.36				.57	
2 FEMALE	25	-.49				-.77	
			.03				.04
GROUP							
1	31	4.95				3.59	

* * * M U L T I P L E C L A S S I F I C A T I O N A N A L Y S I S * * *

POSTEST
By SEX
GROUP
With PRETEST

Grand Mean = 51.373

Variable + Category	N	Unadjusted Dev'n	Eta	Adjusted for Independents Dev'n	Beta	Adjusted for Independents + Covariates Dev'n	Beta
2	28	-5.48				-3.98	
			.33				.24

Multiple R Squared .946
Multiple R .973

This procedure was completed at 0:54:13

```
ANOVA POSTINTE BY SEX(1,2) GROUP(1,2) WITH PREINTER
      /STATISTICS = 1.
```

'ANOVA' PROBLEM REQUIRES 500 BYTES OF MEMORY.

* * * A N A L Y S I S O F V A R I A N C E * * *

POSTINTE
BY SEX
GROUP
WITH PREINTER

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Covariates	6807.490	1	6807.490	489.258	.000
PREINTER	6807.490	1	6807.490	489.258	.000
Main Effects	1259.608	2	629.804	45.264	.000
SEX	1.658	1	1.658	.119	.731
GROUP	1257.197	1	1257.197	90.355	.000
2-way Interactions	5.177	1	5.177	.372	.544
SEX GROUP	5.177	1	5.177	.372	.544
Explained	8072.275	4	2018.069	145.040	.000
Residual	751.352	54	13.914		
Total	8823.627	58	152.132		

59 Cases were processed.
0 Cases (.0 PCT) were missing.

---

* * * M U L T I P L E C L A S S I F I C A T I O N A N A L Y S I S * * *

POSTINTE
By SEX
GROUP
With PREINTER

Grand Mean = 52.153

Variable + Category	N	Unadjusted Dev'n	Eta	Adjusted for Independents Dev'n	Beta	Adjusted for Independents + Covariates Dev'n	Beta
SEX							
1 MALE	34	-.15				.14	
2 FEMALE	25	.21				-.20	
			.01				.01
GROUP							
1	31	3.85				4.39	

---

* * M U L T I P L E C L A S S I F I C A T I O N A N A L Y S I S * * *

POSTINTE
By SEX
GROUP
With PREINTER

Grand Mean = 52.153

Variable + Category	N	Unadjusted Dev'n	Eta	Adjusted for Independents Dev'n	Beta	Adjusted for Independents + Covariates Dev'n	Beta
2	28	-4.26				-4.86	
			.33				.38
Multiple R Squared							.914
Multiple R							.956

This procedure was completed at 0:54:30
FINISH.

End of Include file.