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ERROR ANALYSIS IN SOLVING SIMULTANEOUS AND QUADRATIC EQUATIONS IN SOME SELECTED SENIOR SECONDARY SCHOOLS IN SABON GARI ZARIA IN KADUNA STATE

By

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**ABSTRACT**

*This paper focuses on analyzing the common errors made by secondary school students in solving Simultaneous and quadratic equations with an aim of highlighting this error especially to the teachers so that they can devise means of reducing such errors made by their students. The research aims at addressing the current poor performances in mathematics by our secondary school students especially in the areas of solving linear and quadratic equations. The research shows that most of the errors committed by majority of the students are additive errors, multiplicative errors, wrong treatment of fractional expressions, and incorrect choices of coefficients when solving quadratic equations using formula. It is being also observed that these errors are not only student centered, as some of this error are also committed by teacher especially as a result of inadequate preparation of lesson and other human factors. The research is limited to Sabon Gari local government area of Kaduna state due to time and financial/logistics constraints. It is hope that the outcome of this research will go a long way in promoting better understanding of mathematics especially in the areas of linear and quadratic equations and hence aids the development of mathematics education in Nigeria. The researcher advises that the concerned authorities at both state and local government levels should play a good role by organizing seminars and workshops to teachers with the aim of educating them on how to guide their student to avoid such errors.*

**INTRODUCTION**

Mathematics is one of the most useful and fascinating division of human knowledge which has helped in many important areas of study. As it is rightly said "mathematics stands as a pivot of all other subjects" Its concept and ideas have been in the use for so many centuries and there is yet no drop in its importance up to date. This importance has its climax in the study of most science subject. No wonder "The book of popular science" described mathematics as the queen of all science.

Anibueze (2015) stated that mathematics plays important roles in four areas which are; mathematics as a core skill in life; mathematics as a key for economic prosperity; mathematics full of beauty; and mathematics education. According to

Norris (2012), Mathematics develops the habit of praise and logical argument succinctly and clearly. The development. Batiku (2002) opined that for a person to be able to function very well within his immediate environment, the knowledge of rudimentary mathematics is very important

Babalola (1991) viewed mathematics as a basic tool in the development of science based knowledge such as technology and industry and even for sound analytical reasoning in daily living in modern society like ours.

Unfortunately, there has been a remarkable decline in students' performance in mathematics. It is in the light of this that the researcher of this study is motivated to examine critically the topic: linear and quadratic

equation which is an important topic in elementary algebra.

Mastering of mathematics depends on a sound understanding of algebra. It is interesting to know that engineers, physicists, and chemists use algebra every day in their various fields, for example, calculating the frequency of oscillations in an electric circuit requires solution of quadratic equation as pointed out by Mitchelmore (1969). Business and industries also rely on linear and quadratic equation (algebra) to help solve many worded problems; linear programming in solving problems of minimization and maximization of profit in industries is an example as pointed out by Swokowsk (1979). Because of its importance in modern living, linear and quadratic equations under algebra is studied in schools and colleges in all parts of the world at large.

Quadratic equation as defined under the definitions of terms as an algebraic equation of the second order in one variable. If there are two variables, the resulting curves are conic sections. The root of general quadratic equation is given by quadratic formula, which was apparently known to the Greek mathematicians, for in geometric terms, it is found in Euclid's books called "element" (about 300BC). This equation (formula) is also called the Hindu method for quadratic equation.

There are other methods used in solving quadratic equation in secondary schools e.g factorization, completing the square and graphical methods respectively. Due to the vast importance of algebra, particularly linear and quadratic equations in various fields of endeavors, a research like ours has to be made. Some of the importance includes;

- I. Applications in designing a machine.
- II. Applications in calculations that involves graphs.
- III. Applications in determining quantities of values etc.

Obviously, it would be difficult to mention all its importance. Nevertheless, there is a need for critical

analysis of errors been committed by both teachers and students in solving linear and quadratic equations.

Problems are meant to be solved and when they are being solved, they bring about efficiency, i.e. a problem known is already half solved, in order to find solutions to any problem, one has to identify the problem itself. This study seeks to identify errors committed by students and teachers alike in presentation of solution to linear and quadratic equations and critically analyze them. Hence, the following errors are analysed:

The errors committed in solving linear equations are as follows:

- I. Additive error,
- II. Multiplicative error,
- III. Error committed when the equation involve fraction
- IV. Error committed when the denominator is unknown.

Various errors committed in finding solution to quadratic equation in:

#### I. Factorization Method

- I. Error committed in placing the right sign at the wrong place.
- II. Error committed in factorizing an expression in quadratic equation when the co-efficient of its highest degree is greater than or less than one (1) but not zero.
- III. Error committed in factorizing a quadratic expression when the co-efficient of the second degree carry a negative sign.
- IV. Error in recognizing difference of two squares.

#### 2. Completing the Square Method

- I. Error committed in dividing the expression of quadratic equation through by the co-efficient of the second degree of the variable.
- II. Error committed when the co-efficient of the first degree, if it is fraction.

#### 3. Quadratic Formula Method

- I. Error committed in placing the denominator of the formula in an appropriate place.

- II. Error committed when substituting the values of the co-efficient a, b, c in the formula
- III. Error committed when substituting the value of b into the equation  $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

#### 4. Graphical Method

- I. Error committed in interpreting the range.
- II. Error committed in squaring the negative values.
- III. Errors committed when reading the root from the graph.

#### Purpose of the Study

The purpose of the study is to appraise the students' low performance in the area of linear and quadratic equations with a view of finding solution to the errors identified in linear and quadratic equations. It is also to let the students know the area in which they commit errors while solving linear and quadratic equation problems.

#### Research Question

According to Mitchelmore (1969), persistent errors of students in solving linear and quadratic equations has been of great concern to mathematics educators, this has generated a lot of controversy as to where the problem lies as pointed out by M. Mitchelmore and others in their book "Joint school mathematics project" Linear and quadratic equation being the basic foundation in understanding mathematics better has generated questions in the mind of researchers of this study and the following are the questions.

1. How successful are JSS 2 students in solving linear equations?
2. What type of error do JSS 2 students commit while solving linear equations?
3. How successful are JSS 2 students in solving quadratic equations?
4. What type of errors does an SS 2 student commit while solving quadratic equations?

#### LITERATURE REVIEW

##### *Mathematics as a subject, Linear and Quadratic Equations*

The world book encyclopedia defined mathematics as the study of quantities and relations through the use of numbers and symbols. Mathematics helps us in many important areas of study and has the power to solve some of the deepest puzzles man must face. Emozoku (1987) saw mathematics as a branch of science which deals with quantities, shapes, sizes and their relationship as determined by number and signs. The book of popular science defined it as "Queen and servant of science" defined it as the field of study of magnitude and numbers and of the relation that exist among them.

Linear equation as formally defined in the definition of terms requires a broader explanation. Linear equation is an algebraic equation of the first degree in one variable which gives a straight-line graph in a practical sense. Though, students at this level prefer solving linear equation directly and logically to the use of graph. Therefore, thus they will be limited to only direct method. In this type of equation, there is only one variable. The equation can be written in many forms according to Ojo (1985). It could be in additive, multiplicative and fraction forms.

Quadratic equation as earlier said is a branch of mathematics "which the world book encyclopedia defined as one on which the variable is squared. For example,  $x^2 - 8x = -16$  is a quadratic equation in one unknown while encyclopedia Britannica on the other hand defined it as an algebraic equation with one unknown variable. In the following, from (general quadratic equation in one variable)  $ax^2 + bx + c = 0$  in which a, b, c are arbitrary constants where a cannot take the value of zero (0), such an equation has two roots not necessarily distinct.

For example, c is a constant and if  $c = 0$ ; then x takes two distinct values of which zero is one and the additive value of  $\frac{b}{a}$  is the other e.g  $2x^2 - 8x = 0$ . This means  $x = 0$  or  $x = \frac{8}{2} = 4$ . If  $b = 0$ , then the

resulting roots of the equation is  $\pm\sqrt{\frac{-c}{a}}$ . For instance, if  $a = 1$  and  $c = -36$  and the co-efficient of  $b = 0$ , then  $x - 36 = 0$ . This means that  $x = \pm(36) = \pm 36 = 6 - 6$ . If  $b$  is not equal to zero. There are three other methods for solving this type of equation.

The first method is to further factor the equation if possible. One example is  $x^2 + 8x + 15 = 0$ , this implies that,  $(x + 3)(x + 5) = 0$ . Then the solution is  $x = -3$  or  $x = 5$ . Another example  $2x^2 + 3x - 2 = 0$ . To factorize this, multiply  $a$  by  $c$  that is,  $2 \times (-2) = -4$ , then find the factor of  $-4$  and see that the addition of two of its factors gives  $b = 3$  thus the factors of  $-4$  are  $\pm 1, \pm 2, \pm 4$ . Its only  $4$  and  $-1$  that gives rise to  $3$ . Therefore,  $2x^2 + 3x - 2 = 2x^2 + 4x - x - 2 = 0 = 2x(x + 2) - 1(x + 2) = (x + 2)(2x - 1) = 0$ . This means that the root of this problem is  $\frac{1}{2}, -2$ .

The second method is called completing the square. An expression such as  $a^2 + 2ab + b^2$  is called a perfect square because it can be rewritten as  $(a + b)^2$ . One can change an equation such as  $x^2 + 8x + 15 = 0$  so that the left-hand number is a perfect square. To do this, rewrite the equation as  $x^2 + 8x = -15$  to make the left expression  $(x^2 + 8x)$  perfect. Add  $16(\frac{1}{2} \text{ of } 8)$  to both sides of this equation to give  $x^2 + 8x + 16 = -15 + 16$ . Factorizing this you find root. In the equation  $(x + 4)^2 = 1$ ,  $x + 4$  must be equal to the square root of  $1$ , it is either  $1$  or  $-1$  so  $x + 4 = 1$  or  $x + 4 = -1$  thus  $x = -3$  or  $x = -5$

#### 1. Factorization Method

- a. Error committed in finding repeated roots or perfect square.

e.g.  $(x + 2)^2 = 0$

Students write  $x + 2 = 0$

$$x = 2 \text{ instead of}$$

$$x = -2 \text{ (twice)}$$

- b. Error committed while placing the right sign at the right place.

e.g.  $x^2 - 5x - 6 = 0$

Students write  $(x - 2)(x - 3) = 0$

Instead of  $(x + 1)(x - 6) = 0$

- c. Error in recognizing difference of two squares.

e.g.  $x^2 - 4 = 0$

$$x^2 = 4$$

The third method is the use of a formula developed by mathematicians. The formula is  $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$  you can have obtained the co-efficient  $(a, b, c)$  from any quadratic equation met in the form  $ax^2 + bx + c = 0$ , substituting this in the formula will give the value of  $x$ . This is another method which is basically different from the three mentioned above called graphical method. The world book encyclopedia, volume 8, (page 314) (1968) defined graph as a drawing that shows the relationship between numerical quantities. It is used to present facts in a pictorial form so that the solution of quadratic equation will be clearer and easier to understand while the new encyclopedia Britannica volume 4, page 683 (1974) defined graph of an equation as the locus of all points satisfying the equation.

A graphical method is where values of an equation corresponding to a given range of a variable are obtained. The values of the variables are plotted against those of the equation using the co-ordinate point  $(x, y)$  of  $x$  and  $y$  axes respectively.

However, from the above definition, and explanation on what the concept of quadratic equation is all about and the various methods involved, students often made series of errors in solving quadratic equation in each method. These are some of the errors committed while solving quadratic equation as a problem.

Students write  $x = 2$  instead of  $x = \pm 2$

## 2. Completing the Square Method

- a. Error committed in dividing the expression of quadratic equations through by the co-efficient of the second degree of the variable.

Example;

$$4x^2 + 14x + 3 = 0$$

Students write:

$$\frac{4x^2 + 14x}{4} = -\frac{3}{4} \text{ instead of}$$

$$\frac{4x^2}{4} + \frac{14x}{4} = -\frac{3}{4}$$

- b. Error in finding half ( $\frac{1}{2}$ ) of the co-efficient of the first degree especially where it is fraction.

e.g.  $y^2 + \frac{7}{2}y + \frac{3}{2} = 0$

Students write  $y^2 + \frac{7}{2}y + (\frac{7}{2} \times 2)^2 = -\frac{3}{2} + (\frac{7}{2} \times 2)^2$

Instead of  $y^2 + \frac{7}{2}y + (\frac{7}{2} \times \frac{1}{2})^2 = -\frac{3}{2} + (\frac{7}{2} + \frac{1}{2})^2$

## 3. Quadratic Formula

- a. Error committed in placing the denominator of the formula in an appropriate place

e.g.

Students write

$$x = -b^2 \pm \frac{\sqrt{b^2 - 4ac}}{2a}$$

Instead of  $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

### ***Teachers Instructional Errors and their Attitude toward Them.***

Brunner (1960) in his book "The process of education" said that, any subject can be taught effectively in some intellectual and honest manner to any child in any stage of education. The application of this statement is that teachers should bring themselves to the level of the children. This could be regarded as an instructional error if teachers delivered their lesson in a different language.

This is further supported by Lassa (1975) that most teachers cannot teach properly due to the fact that they have not been adequately trained and lack mastery of the subject matter. Since most of the teachers are incompetent and mastery, it follows that

they cannot give their students the desired orientation. This leads the students to commit various kinds of errors.

Cronwill (1961) as reported by Inehue asserted that teachers often give faulty explanations. This is further worsened, when teachers have to use new teaching techniques or strategies to solve a given problem other than the ones they have mastered in the previous class or school.

### ***Past and Present Approaches to Error Analysis.***

In 1950s and 1960s, errors were obtained due to poor methods of teaching. However, according to Taylor (1967) even if good teaching methods and strategies were employed, errors can still be

committed by either teachers or students or both. Therefore, mathematics teachers who are known to be impatient with them as earlier stated, students need plenty time for revision of the topic taught, varieties of exercise and games.

**METHODOLOGY**

The population for the study public and private secondary schools in Sabon-Gari Local Government area of Kaduna state. The following schools are some of the public secondary schools in the local government area.

1. Government Girls Secondary School Samaru Zaria
2. Government Day Secondary School Bomo
3. Demonstration Secondary School ABU Zaria
4. Government Commercial College, Sabon-Gari
5. Government Girls Secondary School Dagon-Bauchi

6. Government Day Secondary School Aminu, Sabon-Gari
7. Government Secondary School Kwangila

The sample for this was drawn from the selected public schools in Sabon-Gari Local Government as listed below; A random sampling was conducted for the study where the following three schools were sampled randomly.

1. Demonstration Secondary school ABU, Zaria
2. Government Day secondary school Bomo Zaria
3. Government Girls Secondary School Dagon-Bauchi

In each of the sampled schools, JSS 2 and SS 2 students were tested. The researcher have decided to use the code as shown in the table below for the schools used as sample so as to ease the filling of table in the subsequence topic of the study.

**Table 3.1** The Code for the Sample Schools

S/N	SCHOOL NAME	CODE
1.	Demonstration secondary school A.B.U Zaria	A
2.	Government day secondary school Bomo Zaria	B
3.	Government Girls Secondary School D/Bauchi	C

In the process of examining the student in the sample schools through the diagnostic test, the data on the table below were observed.

**Table 3.2** The Number of Student Participants for JSS 2 Class test

SCHOOL CODE	NUMBER OF PARTICIPANT
A	186
B	235
C	116
<b>TOTAL</b>	<b>537</b>

**Table 3.3** The Number of Participant for SS 2 Class Test

SCHOOL CODE	NUMBER OF PARTICIPANT
A	161
B	213
C	88
<b>TOTAL</b>	<b>462</b>

Meanwhile the table below shows the code of the errors committed as defined by the researcher of the

study. The code is for the use in the area of number of students that commit such errors.

**Table 3.4** Code of Error for Linear Equation

S/N	ERROR	CODE
1.	In clearing the denominator	J
2.	Of expansion of bracket	K

**Table 3.5** Quadratic Code of Error

S/N	ERROR	CODE
1.	In factorizing an algebraic expression	R
2.	Error in placing the denominator of the quadratic formula in its appropriate position	S
3.	Error in substituting the value of a, b, c into the formula, given the standard representation of quadratic equation to be $ax^2 + bx + c = 0$	T
4.	Error in recognizing the co-efficient of x is one (1)	U
5.	Error in adding the square of half of the co-efficient of x to both side while using completing the square method	V
6.	Error in forgetting to multiply the co-efficient of x using factorization method as a means of solving quadratic equation of the form $ax^2 + bx + c = 0$	W

Two instruments were used. The first instrument was a diagnostic test for JSS 2, in which six questions were set on linear equation which comprised the following:

- i. Two questions involve simply linear equation.
- ii. Two questions in which the variable in each case has fraction as co-efficient.
- iii. One question, the variable appearing on both sides of the equation and with Fraction as co-efficient

- iv. One question, the variable appearing as denominator.

A few questions were set on quadratic equation which includes the following sub-questions.

- 1. Four on factorization method.
- 2. Two on completing the square method.
- 3. Two on graphical method.
- 4. Two on formula method.

The table below shows the arrangement on which the questions were set based on the method which tallied with the number as appeared on the question paper.

**Table 3.6** Arrangement of Question in Appendix 2

METHOD	QUESTION NUMBER
Factorization method	1
Completing the square	2
Formula	3
Graphical	4

The questions on the diagnostic test were set by the the researcher based on the syllabus for JSS 2 and SS 2 classes. The time allocated for the JSS 2 diagnostic test was one hour (1hr), while that of SS 2 was one and half hours (1½hrs). These questions were

taken to some senior lecturers in Mathematics Department, F.C.E Zaria. This was done to meet the standard of the classes they are designed for. The questions were taken to the sample schools and administered in the respective classes by the help of

some of the teachers in the sample schools. For the purpose of analysis for the subsequent chapters, the following scores determine the pass mark or otherwise in the test conducted.

**Table 3.7:** Percentage of Score

Marks %	0 – 39	40 - 100
Grade	F	P
Remark	Fail	Pass

**PRESENTATION OF RESULTS**

The result of the diagnostic test is of two folds namely, the linear equation results and the quadratic equation results. This is done in this way, since the students that are involved in the linear equation differ from that of quadratic equation. Thus, the behavior of each result shall be analyzed while

answering the research questions based on the data collected.

*Research Question 1:* How successful are JSS2 students in solving linear equations? The data of table 4.1 below showed the result of the students of the sampled school that participant in the linear equation diagnostic test.

**TABLE 4.1**

SCHOOL	F	%	P	%	TOTAL
A	137	37.7	69	26.3	163
B	149	63.6	86	26.6	235
C	89	76.7	27	23.3	186
<b>Total</b>	<b>315</b>	<b>69.9</b>	<b>162</b>	<b>30.1</b>	<b>537</b>

It is clearly shown from the table that most students failed the test in each school. The failure rate among the three schools on this test ranged between 63.4 – 76.7 percent. The average success rate on the test was 30.1 percent.

**ANALYSIS OF THE DIAGNOSTIC TEST RESULT ON TABLE 4.1**

The data on table 4.1 indicates the poor performance of the students in solving linear equation in Junior Secondary School. The finding is able to justify the errors that the students made while solving linear equations.

Table below shows the number of schools that solved the equation on the diagnostic test (Appendix 1) correctly or incorrectly.

**Table 4.2:** Responses of student in each classification of linear equation

School	ADDITIVE				MULTIPLICATIVE				FRACTION			
	Correct	%	incorrect	%	correct	%	incorrect	%	correct	%	incorrect	%
A	152	81.7	34	18	60	32.3	126	67.3	20	16.8	166	89.2
B	204	86.8	31	13	52	22.1	183	77.9	18	7.7	217	92.



	ADDITIVE				MULTIPLICATIVE				FRACTION			
												3
<b>C</b>	93	80.2	23	20	35	30.3	81	69.8	9	7.8	107	92.2
<b>TOTAL</b>	<b>449</b>	<b>83.6</b>	<b>88</b>	<b>16</b>	<b>147</b>	<b>24.4</b>	<b>390</b>	<b>72.6</b>	<b>47</b>	<b>8.8</b>	<b>490</b>	<b>91.2</b>

The performances of the JSSII students in each classification of linear equation are displayed on table 4.2. The result as displayed in the table indicated fractions. About 91% of the students failed the questions in fractional linear equation, while the questions on the additive operation were not difficult for the students to solve. About 84% of the students passed the additive questions. Thus, from the above findings, the JSII students did not perform well in solving linear equation

**Research Question 2:** What type of errors do JSS2 students commit while solving linear equation?

The research shows that, the following errors were committed by the JSS2 students while solving linear equation. This was achieved by critically checking the processes the students adopt when solving each of the problems.

**1. Error in Clearing the Denominators**

The samples of error responses from the participants in the diagnostic test on appendix I are displayed below.

1.1.1  $\frac{1}{2x} + 3 = 1$

$$\frac{1+3}{2x} = 1$$

$$\frac{4}{2x} = 1$$

$$x = 2$$

Error's Starting Point

Error's range

Wrong answer

1.1.2  $\frac{3}{2x} = 1$

$$\frac{1}{2x} = 1 - 3$$

$$\frac{1}{2x} = -2$$

$$x = \frac{-1}{4}$$

Genesis of error

Range of error

Wrong answer

1.1.3

$$\frac{5x}{4} + 1 = \frac{-2x}{3}$$

$$= \frac{2x}{3} - \frac{5x}{4}$$

$$= \frac{2x-5x}{3-4}$$

$$= \frac{-3x}{-1}$$

$$| \times -1 = -3x$$

$$x = \frac{-1}{-3}$$

$$x = \frac{1}{3}$$

2. Error of expansion of bracket where necessary. Here are error responses from the participants in the diagnostic test on appendix I.

a.

$$\frac{5x}{4} + 1 = \frac{2x}{3}$$

$$\frac{5x+4}{4} = \frac{2x}{3}$$

$$3(5x+4) = 4(2x)$$

$$15x + 4 = 8x$$

$$15x - 8x = -4$$

$$7x = -4$$

$$x = \frac{-4}{7}$$

b.

$$\frac{3}{x+2} = \frac{4}{x+4}$$

$$3(x+4) = 4(x+2)$$

$$3x + 4 = 4x + 2$$

$$3x - 4x = 2 - 4$$

$$-x = -2$$

$$x = 2$$

The table below shows the number of students that committed the errors as identified above

**Table 4.3:** Error Classifications in Linear Equation

ERROR	NUMBER OF STUDENTS THAT COMMIT	PERCENTAGE
J	123	22.9
K	219	40.8

**Research Question 3:** How successful are SSII students in solving quadratic equations?

The assessment on this part of the study was based on each method as shown on table 3.4. In Chapter three, the researcher decided to base the

assessment on each method in order to be able to distinguish among the methods.

The result of the students that participated in solving in quadratic equation is shown on appendix 2 is hereby displayed in the table below.

**Table 4.4:** Number of Students That Passed

SCHOOL	Q1	Q2	Q3	Q4
A	30	15	43	9
B	32	20	51	12
C	23	7	26	5
<b>TOTAL</b>	<b>85</b>	<b>42</b>	<b>120</b>	<b>28</b>

**Table 4.5:** Number of Students That Failed

SCHOOL	Q1	Q2	Q3	Q4
A	131	146	118	152
B	181	193	162	201
C	65	81	62	83
<b>TOTAL</b>	<b>377</b>	<b>420</b>	<b>332</b>	<b>434</b>

**ANALYSIS OF THE DIAGNOSTIC TEST OF TABLE 4.4**

From the above data on table 4.4. It is clearly shown that using the formula method (Method 3) produced the best result (26.0%) while method 4 (graphical method) produced the poorest result (6.1)

**Research Question 4:** What type of error JSS2 students commit while solving linear equations?

The following errors are committed by some of the students in the sample schools identified by this research.

1. Error in factorizing an algebraic expression (coded as r)
2. Error of placing the denominator of the quadratic formula in the appropriate place (coded as s)
3. Error in substituting the values of a, b, c into the formula (coded as T)

**Table 4.5:** Error Classification in Quadratic Equation

ERROR	R	S	T	U	V	X
Z	315	150	129	97	301	43
%	68.2	32.2	27.9	20.9	65.2	9.3

**SUMMARY OF FINDINGS.**

Looking at the results obtained on the dates on table 4.1 the research shows that the percentage of the students solving linear and quadratic equation correctly was too low. This shows that the students often committed errors while handling problem in

4. Error in recognizing the co-efficient of  $x^2$  if it is one (coded as L)

5. Error in adding the square of half ( $1/2$ ) of the co-efficient of x to both sides while using completing the square method (coded as V)

6. Error in Interval (coded as x)

In this part of the diagnostic test in appendix 2 i.e. graphical method, very few of the participants attempted it, whereof most of them followed the value of y in order as the interval on y-axis.

The table below shows the number of students that committed similar errors at least once. That are identified above where the letter "Z" stands for the number of students that commit the error in each case.

these areas. It was found that the dominants errors on linear equations that student at JSS 2 level committed were in the clearing the denominator of fraction and expansion of brackets. Errors associated in factorizing algebraic expression was moving pronounced when solving quadratic equation among the SS 2 students

placement of quotient of quadratic formula is another error and the substitution of the values of  $a$ ,  $b$ , and  $c$  in the quadratic formula.

It was found that most of the student have problem in the recognition of the value " $a$ " in algebraic equation when it is one (1). Most students also found it difficult to find the square of half ( $\frac{1}{2}$ ) on the co-efficient of the first degree in algebraic equation and it to both side of the equation most especially when the co-efficient is in fraction form or a negative number.

Finally, the researcher deduced from this study that most of the students could not follow the scale given them neither do they know how to choose on their own.

## CONCLUSION

The findings indicate that most of the JSS II and SS II students were not able to solve linear and quadratic equation successfully. Different types of errors were committed while solving these equations and the errors identified where outline in chapter 4.6A and 4.6

## RECOMMENDATIONS

The researcher recommended as follows.

1. Teachers on their part should try to put in more effort in teaching the students:
  - (a) Finding the least common multiple (L.C.M) of the denominators of an expression.
  - (b) Removing brackets when necessary.
  - (c) Factorization i.e. in the general equation, the multiplication of  $a$  and  $c$ , and the sum of two of its factors say  $r_1$  and  $r_2$  that gives  $b$  such that  $bx$  will be able to be express as  $rx + r_2x$
  - (d) Identification of the co-efficient.
  - (e) Choosing the correct interval most especially on  $y$ -axis

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