

OBSTACLES TO STUDENTS UNDERSTANDING OF SOME SOLUTION PROCESS FOR SIMULTANEOUS EQUATIONS

By

Maureen Enogie Omorogbe

*Department of Business Administration
Edo state Polytechnic, Usen*

Abstract

Simultaneous linear equation is an important foundational topic in the study of Mathematics. The paper highlight some obstacles to students understanding of some solution process for teachers attention. Effective teaching of simultaneous equation is not about getting correct answers only, some assumption of the teachers solution statement, identification/appropriate choice of solution method and clarification of plausible misconceptions of students are important factors for the effective teaching. Drawing from teaching experience of the author, solution statement from trial test of samples of students, and mathematics notes of student, the paper posits that poor teaching of simultaneous equation is one of the big problems that discourage students from understanding mathematics in Nigeria.

Keywords: Elimination, Obstacles, solution fallacies, substitution, surplus guessing equivalent

The importance of simultaneous equation in mathematics and applications cannot be over-emphasized. It is used in linear programming an important topic in operation research and business applications, word problems, indices and logarithms, arithmetic and geometric progression etc.

A linear equation in two variables x and y is an equation of the form $ax + by + c = 0$ where a , b , and c are constants and a and b are not zero. This paper is concerned with obstacles to solving 2-systems of linear simultaneous equation. A two systems of simultaneous equation is a system of two linear simultaneous equation in two variables. The problem of poor general mathematics performance has been a lingering issue in Nigeria. Analysis of percentage of at least credit grade in West Africa School Certificate mathematic result of Nigeria in Ozoro (1978) from 1965 to 1973 showed a range of 4.6% to 43% with consecutive downward trend for 5 years in some cases, for example, from 1965 to 1969 the

Academic Excellence

percentage of at least credit grade in Maths were (43, 42, 41, 36, 23) Onabamiro and Odunlami (2017) stated that the West African School Certificate result between 2006 and 2015 has been persistent failure. He further stated that the 2008 result was catastrophic 86.24% failure. Agwagah (2008) stated that the manner in which most teachers teach the subject is one major reason mathematics education experts ascribe to students low achievement and interest in mathematics. Matawal (2013) lamented that despite the relevance of Mathematics in national development, students still perform abysmally low in the subject. This paper identifies simultaneous equation as one of the problem areas responsible for students poor performance and interest in mathematics. It bring out “what is poor in the poor performance” of students and teachers in mathematics for the attention of stake holders desirous of solving the lingering poor general mathematics performance.

Observations from trial test and teachers worked examples

Studying written answers of students, can be valuable tool in identifying learning difficulties. A trial Test (1) was given to a small sample of 15 students. This group of students has an average of 3.06 of 5 in directed numbers. In solving the simultaneous equations, 6 of the students did not write anything in the theory part. The remaining 9 students that attempted the theory part could not solve any of the simultaneous equation. One of the best attempts who got 5 of 5 in the directed numbers part, attempted the simultaneous Equation

$$4x - 3y = 6$$

$-6x + 5y = 11$ by elimination as follows:

$$\text{Equation (2) } \times 4 = -24x + 18y = 44$$

$$\text{Equation (1) } \times -6 = -24x - 20y = 36$$

$$-28y = 80$$

$$Y = 80/-28 \quad y = 2.857$$

Substituting y in equation (2)

$$-6x + 5(2.857) = 11$$

$$8.285 = 11$$

$$x = 1.3293$$

This show that a good knowledge of directed numbers may not guarantee ability to solve simultaneous equation. There are some maze of confusion observed in students and teachers solution statements in the trial test and students Mathematics notes some of these are:

- Inclusion of signs in the multiplication to the make the size of the variable to be eliminated equal
- A careless swapping of result was also observed e.g Equation (1) $\times -6$ was stated to be equal to $-24x - 20y = 36$ whereas it ought to be $-24x + 18y = 44$
- Some of the students rightly substituted the result of the first variable in some of the equations but could not solve the resulting simple equation and also show poor solution statement.

Obstacles to Students Understanding...

- Some of the students neither understood the substitution nor elimination methods. For example, when asked to solve the equation:

$$4x - 3y = -6 \quad (1)$$

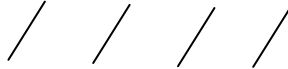
$$-6x + 5y = 11 \quad (2)$$

A student wrote: solve using elimination method

$$4x - 3y - 6x + 5y = -6 + 11$$

$$10x = 5$$

$$x = 2$$



Observe he added the two equations and embarked on an erroneous cancellation of x and y . The simplification of directed number on the right was ok, how he got $10x$ on the left is a mystery! e.g in the previous example, to eliminate x , the student wrote:

$$\text{Equation (2)} \times 4$$

$$\text{Equation (1)} \times -6$$

The negative sign in 6 is unnecessary.

Furthermore, to solve the simple equation $10x = 5$, the students wrote

$x = 5/10 = 1/2$ therefore $x = 2$. which implies that the students thinks that $1/2$ is equal to 2 .

A student attempted to solve the equation as follows:

$$4x - 3y = -6$$

$$1xy = -6$$

$$xy = -6$$

Note that the students know that $4x - 3x = 1x$ and since $4 - 3 = 1$, and x and y is involved, he concluded that $4x - 3y = 1xy$

- Some students have difficulties adding or subtracting one equation from another. In case of subtraction, the teacher should clearly state the equation to be subtracted and when there are alternative methods for the subtraction, the reason for preference of a particular method should be explained.
- For example to eliminate x if the size of the coefficient of x are equal in size, we check the signs if the signs are the same we should subtract to eliminate x , if the signs are different we should add to eliminate x .
- Some teachers in solving simultaneous equation by substitution when there is a variable of size one will be solving for a variable whose size is not one.
- If a simultaneous equation is to be solved by elimination, one variable of equal size and another variable of unequal size, It is easier to eliminate the variables of equal size first.
- Some students in checking for signs may check wrongly, for example, some students may be checking the sign of y instead of x and where they ought to add, they will subtract.
- Some teachers in making the size of the coefficient of simultaneous equation equal, do it by "Surplus guessing equivalent for example, if the term in x equation (1) is $3x$ and $5x$ in equation (2), a teacher may guess 30 and work

Academic Excellence

towards making the size of the coefficient equal by stating: Multiply equation (1) by 10 and equation (2) by 6. This type of guessing is surplus and confusing.

A trial Test (2) given to 100. National Diploma (ND2) Business Administration student of a Nigerian Polytechnic revealed that none of the students could solve the simultaneous Equation. a trial Test (3) on simultaneous Equation given to 50 National Diploma (ND 1) students of Pharmaceutical Technology of a Nigerian Polytechnic reveals that only one of 50 passed the test.

Students solution fallacies on simultaneous equation__evidence of poor performance.

A National Diploma (ND1) Pharmaceutical technology student who completed secondary education from an urban school in Ondo, attempted the simultaneous equation.

$5x + 2y + 8 = 0$
 $3x - y = 6$ by substitution as follows:
 $a = 5, b = 2y, c = 8$

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
$$\frac{-2 \pm \sqrt{2^2 - 4 \times 5 \times 8}}{2 \times 5}$$

In other words, he erroneously used quadratic formula to solve simultaneous equation. Another student who completed secondary education from a private school in Benin City attempted the simultaneous Equation

$4x - 3y = -6$
 $-6x + 5y = 11$
By elimination as follows:
 $4x - 6x - 3y + 5y = -6 + 11$
 $2x - 2y = 5$

And to solve
 $5x + 2y + 8 = 0$
 $3x - y = -6$
Her solution was
 $5x + 3x + 2y - y = 8 - 6$
 $8x + y = 6$

Or
 $-6x + 5y = 11$
 $-6(4x - 3y) =$
 $-6(6x + 5y) = 11$
 $-24x - 18y = -6$
 $-36x + 30y = 11$
 $= 12x - 12y$
 $= -5$

Obstacles to Students Understanding...

A pharmaceutical student who completed secondary Education from a school in Ondo solved the simultaneous Equation

$$4x - 3y = -6$$

$-6x + 5y = 11$ by elimination as follows

a. $4x - 3y = -6$
 $4/x - 3/y = -6$
 $7/xy = -6$
 $X = 7 + 6 = 13$
Answer = 13xy

(b) $-6x + 5y = 11$
 $-6x = 11 - 5y$
 $-6x = 6y$
 $-6 + 6 = xy$
Answer xy = 0

A student from a rural School in Delta State solved the simultaneous equation

$$4x - 3y = -6$$

$-6x + 5y = 11$ by elimination as follows:

(i) $4x - 3y = -6$
 $4^2x - 3^2y = -6^2$
 $16 - 9x = 36$
 $= 7x$ answer

(ii) $-6x + 5y = 11$
 $+6 + 5 = 11$
 $= 2xy$

The same student attempted the simultaneous equation

$$5x + 2y + 8 = 0$$

$3x - y = -6$ by substitution as follows:

$$8x + 2y + 8 - 6$$

$$10x + 2$$

$$= 12xy$$

A pharmaceutical student who completed secondary education from an urban school in Lagos attempted the simultaneous equation.

$$5x + 2y + 8 = 0$$

$3x - y = -6$ by substitution as follows:

(i) $3x - y = -6$
 $-6(3x - y)$
 $-18x + 6y$
 $x + y = -18 + 6$
 $x + y = -12$

(ii) $5x + 2y + 8 = 0$
 $8(5x + 2y) = 0$
 $40x + 16y = 0$
 $x + y = 40 - 16 - 0$
 $x + y = 24 = 0$
 $= 24$

One of the secondary school student in Benin City Solved the simultaneous equation

$$4x - y = -11$$

$$2x + 3y = 5$$

By elimination as follows:

$$4x - y = -11$$

$$4x + 6y = 10$$

$$5y = -1$$

$$Y = -1/5$$

He got y correctly, but to substitute and find x, his solution statement was as follows:

$$2x + 3y = 5$$

$$2x + 1/5 = 5$$

He threw away the 3 in the equation $2x + 3y = 5$ and the minus in $y = -1/5$, and thought that 5 in $+1/5$ on the left of the equation, can cancel 5 on the right. Consequently, he concluded that:

$$2x = 1$$

$$x = 1/2$$

A student from one of the schools in Edo State attempted the simultaneous Equation

$$5x + 2y + 8 = 0$$

$$3x - y = -$$

By substitution as follows

$$5x + 2y + 8 + 3x - y = 0 + 6$$

$$18y = 6$$

$$x = 2$$

Using equation $3x - y = -6$,

$$3 \times 2 - y = -6$$

$$6 - y = -6$$

$$6y/6 = -6/6$$

$$x = 2, y = 0$$

There seem to be a tendency in some cases, to solve the equation separately by erroneous method. There are also algebraic deficiencies for example, the students stated that $6-y$ is equal to $6y$ and -6 divided by 6 is equal to zero. These are pointers to serious deficiencies in some student knowledge of solution method for simultaneous equation in Nigeria. Findings from sample test have raised new questions on whether the integrated approach of teaching simultaneous equation motivate student to learn the solution method. Adequate attention has to given to clarify the solution method before talking of applications.

Conclusion

Simultaneous Equation is an important foundation topic in the study of mathematics and its application. Most student do not attempt solving simultaneous equation few that attempt, show far departure from correct solution. Observations from teaching /research experiences of the author from 2003-2020 show that poor knowledge of solution method for simultaneous Equation is a very serious problem adversely affecting a conservative estimate of at least 85% of students in Nigeria considering inappropriate solution methods of some teachers worked examples ,and fallacies in students solution statements some of which are highlighted herein for stakeholders attention, the paper posits that poor teaching of simultaneous equation is one of the great obstacles discouraging many students from understanding Mathematics in Nigeria

Recommendations

The following recommendations are proffered for solving the poor performance problem on simultaneous Equation

Obstacles to Students Understanding...

- ❖ Research efforts to solve the lingering poor General Mathematics performance should be focused on bringing out (what is poor) in the poor performance and addressing it rather than establishing significant differences of Gender performance, or Teacher's qualification or game in teaching Mathematics
- ❖ Mathematics Association of Nigeria in conjunction with Federal /state Governments should organize problem solving /capacity building workshops on simultaneous Equation for Teachers.

References

- Odunalami.I.A and Onabamiro A.A (2017) Relationship between study habit and secondary school students academic performance in ETI-OSA local Government area of Lagos state. Nigeria academic forum 25 (1) 2 August.
- Agwagah U.N.V.(2018) Laboratory approach to Mathematics instruction . A situation report on Nigeria Secondary schools in the 1990's. Journal of liberal studies 5(2)116-124.
- Matawal D.B. (2013) Analysis of the relationship between students achievement in Maths in SSCE and remedial studies programme, university of Jos –Nigeria. Comprehensive Journal of educational research, 1(3)42-46.
- Omorogbe M.E.(2020). Observations from selected secondary school Mathematics notes. unpublished.
- Omorogbe M.E. (2020) personal Mathematics research /teaching experiences in secondary school /tertiary institutions 2003-2020.
- Omorogbe M.E.(2020) Mathematics trial test (1) of 15 secondary schools students on simultaneous equation.
- Omorogbe M.E.(2020) Mathematics trial test (2) of 100 National Diploma (ND2) Business Administration students of a Nigeria polytechnic.
- Omorogbe M.E.(2020). Trial test (3) National Diploma (ND1) pharmaceutical Technology students of a Nigeria polytechnic.
- Ozoro.O. (1978) Towards unified Mathematics curriculum for Nigeria secondary schools appendix 1:WASC Mathematics result pp.35.