Students' Preference Method of Solving Simultaneous Equations

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ABSTRACT

The study focused on students' preference of method of solving simultaneous equations: challenges to mathematics curriculum developers. The researcher adopted three research questions and three hypotheses. The research questions were answered using the descriptive statistics of percentages, while, the hypotheses were tested using the chi-square. The study research design was survey. The total population of SSS2 students in Sa-pele local government area in 2007/2008 Session was 776. Using proportionate stratified random sampling tech-nique to obtained equitable sample size in the three-urban, semi-urban and rural areas. The total sample size used for the study was 458. The instrument for data collection was a Structured Test Questions (STQ) for the SSS2 stu-dents taught by the researcher using the two methods (elimination and substitution) adopted in solving simultane-ous equations. The STQ given to the SSS2 students was named Students' Preference of Method Assessment Test Questions (SPMATQ). The SPMATQ was face-validated by eight mathematics teachers. Kudder Richardson – 21 was applied to test the reliability of SPMATQ to obtained r = 0.73. The findings revealed that SSS2 students' pre-ferred substitution method irrespective of their gender for solving simultaneous equations. A recommendation was that students' preference order should be encouraged or followed in teaching and learning of simultaneous equa-tions.

Keywords: student, structured, simultaneous equations,

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1. INTRODUCTION

Preference is showing greater interest in or desire for something than something else. This means that students have a particular interest in one method of solving simultaneous equations. Interest is an important variable in learning because when one becomes interested in an activity, one is likely to be more deeply involved in that activ-ity. Interest is a subjective feeling of concentration or curiosity over something (Harbor-Peters, 1992). Interest is the quality in something that attracts somebody's attention and makes them want to know more about it. It is some-thing one concerns oneself or about which one is enthusiastic (Hornby, 2003). It is the preference for particular types of activities, that is, tendencies to seek out and participate in certain activities (Agwagah, 1993). It can be ex-pressed through simple statements made by individuals of their likes and dislikes (Imoko and Agwagah, 2006). Preference is the act of preferring, choosing or favoring one above another; that which is chosen or preferred; prior rights; advantage given to one method over others. Students' interest cannot be shoved aside when inculcat-ing knowledge of simultaneous equations. The mathematics teachers who are sole givers of mathematics knowledge must realize that mathematics teaching end result or success depends on adopted method. The act of inducing one method on students is against heuristic. Heuristic is the theory in education that a learner (student) should discover things by himself.

Students' preference can be change when various methods are used in teaching mathematical concept. Con-cept is an idea or a principle or proposition (Imoko and Agwagah, 2006). Novak and Godwin (1984) defined a concept as an abstract idea or principle that is not limited to one place or time. Method is a particular way of doing something in order to enhance effective behavioural change (Harpercollins, 2001 and Hornby, 2003). Effective behavioural change is the desired effect that makes something different in the way of somebody which qualifies him to function in a particular situation. This enhances meaningful learning that leads to the development of me-ta-cognitive strategies (Cliburn in Imoko and Agwagah, 2006). Novak (1990), meta-cognitive strategies are those strategies that empower the student/learner to learn in a highly meaningful way.

Meaningful learning implies achieving a deep understanding of complex ideas that are relevant to students' lives (Jonassen, Peck and Wilson, 1999). Meaningful learning assumes that students or learners already have some knowledge that is relevant to new experiences they encounter and that they are willing to do the mental work nec-essary to create connections between adopted methods. Geddies and Grosset (2005) see method as the mode or procedure of accomplishing something; orderliness of thought, an orderly arrangement or system; while, method-ology is a system of methods or principles for doing something. It is the philosophical analysis of method and pro-cedure employed in classroom interaction. There is need for mathematics teachers to master the set of methods involved in solving simultaneous equations to enable students apply them accordingly.

Good methodologies in teaching stimulate students' and promote proper understanding of simultaneous equa-tions. The key factor for changing students' preference in a mathematics concepts teaching and learning is carefully designed good methods adopted by the adept mathematics teacher (Ugboduma, 2006). Nigeria needs mathemat-ics teachers who are adept at imparting mathematical knowledge on students using good methodology. Thus, the National Policy on Education (FRN) (2004), states that mathematics teaching in primary and secondary schools shall be by practical, exploratory and experimental methods. This will encourage, sustain and motivate students' interest towards learning. Learning is a relatively permanent change in behaviour as a result of experience (Mallum and Haggai, 2004). The most glaring thing that occurs when learning has taken place is change. That is, change in the behaviour of the individual student.

A linear equation in two variables has an infinite number of solutions. Anyone of the infinite number of x-values can be substituted into an equation and each one has a corresponding y-value. However, for two such equations, there may be just one pair of x and y- values that satisfy both equations simultaneously. Jaggi (2006) defined an equation as a statement of equality. If the equality (being equal) is true only for certain values of the unknown qualities involved in the equation, then, it is called conditional equation and the = sign is used. If the equality is true for all values of the unknown qualities involved, the equation is called an identity (equivalence) and ≡ sign is used. Geddies and Grosset (2005), described equation as an act of equaling; the state of being equal; a usually formal statement of equivalence (as in logical and mathematical expressions) with the relations denoted by the sign = • Equation is a mathematical statement showing that two amounts or values are the same. For example, $6 \times 4 = 12 \times 2$ and $2x + y = 54$. Simultaneous is two events done, happening or occurring at the same time (Geddies and Grosset, 2005; Harpercollins, 2001 and Hornby, 2003).

Simultaneous equations are two or more equations that are true at one end and the same time, and are therefore satisfied by the same values of the unknowns involved. For example, the equations $2x + y = 3$ and $3x + 4y = 2$ are simultaneous equations having solution of $x = 2$ and $y = -1$. Education workability should be done with laid down methods to enhance students' full participation in learning. Learning is the knowledge obtained by study (Hornby, 2003). Learning cannot be learning when the desired method adopted by the adept mathematics teacher is not done to the best interest of the students. The various methods of driving in simultaneous equations solutions to the understanding of students and integration to other areas must be stressed by the mathematics teacher.

Mathematics teachers occupy a central position in edu-cational system of science and technology since they serve as the pivot on which the school continuously revolves (Dosunmu, 2006). The progress of any student depends largely on the kind of mathematics teachers that form and instruct him mathematically. Okafor (2004) sees the mathematics teacher as an executive, a supervisor of students, a programme planner, a manager of time in teaching, materials usage, knowledge application and an expert communicator with various methods, a maker- making decisions in one class period and often, on the sport- decisions. This is mathematics goals achievement. Understanding is the gene that kills discouragement in stu-dents. Many students in school see simultaneous equations problems or questions as demanding and difficult involving numerous processes to solutions (products). They either stop attempting it in examinations or study personally to build interest. They term simultaneous equations is vigorous and heterogeneous, detrimental to heuristic. Heuristic is what is needed to arrest this trend, hence, this paper sets to examine two methods [solution by substitution and solution by equating coefficient (elimination)] for solving simultaneous equations and determine the one students' prefer in schools.

2. PURPOSE OF STUDY / OBJECTIVE

a) Examine the proportion of senior secondary II stdents (SSS2) in Sapele Local Government who showed prefer-ence for one method of solving simultaneous equations.
b) Find out whether sex differences influence SSS2 students preference for method of solving simultaneous equa-tions
c) Determine whether urbanization and ruralization factor influence SSS2 students preference for method of solving simultaneous equations.

3. RESEARCH QUESTIONS

The following research questions were asked:

1) What proportion of SSS2 students showed preference for one type of method of solving simultaneous equations?
2) What proportion of male and female SSS2 students showed preference for one method of solving simultaneous equations?
3) What proportion of urban and rural SSS2 students showed preference for one method of solving simultaneous equations?

4. HYPOTHESES

The following hypotheses were postulated for the study:
Ho1: SSS2 students have no preference for any method of solving simultaneous equations.
Ho2: there is no gender barrier in SSS2 students' preference of method of solving simultaneous equations.
Ho3: schools locations have no effect on SSS2 students' preference of method of solving simultaneous equations.

5. METHODS

The study was a survey research design. The reason for adopting this design is because it consisted of group of people in studied by collecting and analyzing data from few people considered to be representative of the entire group (Nworgu, 2006) and successful researchers employed it in related studies (Dosunmu, 2006; Kosemani, 2006).The study covered SSS2 students of eight (8) out of the fourteen (14) public secondary schools in Sapele Local Government Area of Delta State.

The total population of SSS2 students in the fourteen (14) public secondary schools in the Sapele Local Government of Delta State in 2007/2008 academic session was 776 from two (2) sin-gle girls' schools, two (2) single boys schools and ten (10) co-educational schools respectively. The proportionate stratified random sampling technique was used to have equitable sample size. The fourteen (14) secondary schools were divided into three segments – urban, semi-urban and rural by the researcher. The urban consisted of eight (8) secondary schools with four (4) schools selected; three (3) semi-urban schools with two (2) schools se-lected; and three (3) rural schools with two (2) selected. The researcher believes that these eight (8) secondary schools selected is a true representation of the population.

The proportion of the sample to the population known as sampling fraction is determined as 458/776 = 0.59 (59%).The sample size for each segment was computed as: Urban segment = 0.59 x 474 = 280; Semi-urban=0.59x 239 = 141 and Rural segment =0.59 x 63 = 37.Total sample size of SSS2 used was 458. The instrument for data collection was a Structured Test Questions (STQ) for the SSS2 students taught by the re-searcher using the two methods (elimination and substitution) adopted in solving simultaneous equations. The example used for the students was $3x + 2y = 16$ and $4x – 3y = 10$ for fifteen minutes each (30 minutes) for the two methods adopted. The Structured Test Questions (STQ) given to the SSS2 students was named Students' Preference of Method Assessment Test Questions (SPMATQ).

The SPMATQ was face-validated by eight (8) mathematics teachers of the schools selected whether it is in line with simultaneous equations mathematics sylla-bus. The suggestions given were used in producing the final SPMATQ for the study. The Kudder-Richardson (K-R) 21 was applied to test the reliability of the SPMATQ. The reason is for the dichotomous nature (elimination and substitution) methods for solving simultaneous equations (Nworgu, 2006). It was administered to eighty (80) SSS2 mathematics students of both sexes in a school that did not participate in the main study. A reliability co-efficient of $r = 0.73$ was obtained and by implication, the instrument was reliable. The assessment question was solve $5x +2y =14$ and $3x – 4y = 24$ using any method of choice from the two adopted in the example above. The reason is to determine area of their preference in method. The SPMATQ work solution was collected after thirty (30) minutes and analyzed. The research questions were subjected to descriptive statistics of percentages; while, the hy-potheses were tested using chi-square statistics.

6. RESULTS AND DISCUSSIONS

Research question 1: What proportion of SSS2 students showed preference for one type of method of solving simultaneous equation?

Table 1: Proportion of SSS2 students that showed preference for one type of method

Locations	Gender	Preference proportion of method		Total
		Elimination	Substitution	
Urban	Males = 149	68 (76%)	81 (43%)	149
	Females=131	22 (24%)	109 (57%)	131
		90 (32%)	190 (68%)	280 (100%)
Semi-urban	Males = 77	39 (57%)	38 (53%)	77
	Females =64	30 (43%)	34 (47%)	64
		69 (49%)	72 (51%)	141 (100%)
Rural	Males = 20	08 (50%)	12 (57%)	20
	Females = 17	08 (50%)	09 (43%)	17
		16 (43%)	21 (57%)	37 (100%)
Total	Gender	175 (38%)	283 (62%)	458 (100%)

Table1above, showed that 190(68%) SSS2 students preferred substitution method, while, 90 (32%) preferred elimination method in urban secondary schools in Sapele local government area of Delta state. 69(49%) SSS2 students preferred elimination method, while, 72 (51%) preferred substitution method in semi- urban location. In rural area, 16 (43%) and 21 (57%) SSS2 students preferred elimination and substitution methods respectively. In gender, 283(62%) SSS2 students in proportion preferred substitution method of solving simultaneous equations than elimination method with 175 (38%) in proportion having preference difference of 108 (24%).

Hypothesis 1: SSS 2 students have no preference on any method of solving simultaneous equations

Table2:Chi-square analysis of SSS2 students' preference of method of solving simultaneous equation

Locations	SSS2 Students (observed frequency)	SSS2 Students (expected frequency)
Urban	280	152.67
Semi-urban	141	152.67
Rural	37	152.67
Total	458	458

$$X^2 = \frac{(280-152.67)^2}{152.67} + \frac{(140-152.67)^2}{152.67} + \frac{(37-152.67)^2}{152.67} = 106.20 + 0.8920 + 87.64 = 194.73$$

= 194.73

X^2critical = $X^2_{2,\,0.05}$ = 5.99

Since X^2 critical is less than X^2 calculated, the null hypothesis of no preference in method is not accepted. This implies that SSS2 students have preference on method of solving simultaneous equations.

Research question 2: What proportion of males and females SSS2 students' showed preference for one method of solving simultaneous equations?

Table 3: Proportion of males and females SSS2 students' preference for one method

Locations	**Gender**	**Preference proportion of method**		**Total**
		Elimination	**Substitution**	
Urban	Males =149	68 (76%)	81 (43%)	149 (43%)
	Females =131	22 (24%)	109 (57%)	131 (47%)
Semi-urban	Males =77	39 (57%)	38 (53%)	77 (55%)
	Females =64	30 (43%)	34 (47%)	64 (64%)
Rural	Males =20	08 (50%)	12 (57%)	20 (54%)
	Females = 17	08 (50%)	09 (43%)	17 (46%)

Table 3, revealed that 115 males with average percentage of 61 and 60 females with average percentage of 39 preferred elimination method of solving simultaneous equations. The result also showed those 131 males and 152 females with average percentages of 51 and 49 respectively preferred substitution method of solving simultaneous equations in Sapele Local government area of Delta state. From the above, it implies that males SSS2 students' preferred substitution method of solving simultaneous equations that their females counterparts in Sapele senior secondary schools.

Hypothesis 2: There is no gender barrier on SSS2 students' preference of method of solving simultaneous equations

Table 4: X^2 of gender barrier on SSS2 students' preference to solving simultaneous equations

Locations	Males	Females	Total
Urban	149(150.39)	131(129.61)	280
Semi-urban	77 (75.73)	64 (65.27)	141
Rural	20(19.87)	17(17.13)	37
Total	246	212	458

$$X^2 = \frac{(149-150.39)^2}{150.39} + \frac{(131-129.61)^2}{129.61} + \frac{(77-75.73)^2}{75.73} + \frac{(64-65.27)^2}{65.27} + \frac{(20-19.87)^2}{19.87} + \frac{(17-17.13)^2}{17.13}$$

$$= 0.01285 + 0.01491 + 0.02130 + 0.02471 + 0.00085 + 0.00099 = 0.07561$$

$$X^2_{2,\ 0.05} = - X^2 - \text{critical} = 5.99 > X^2 - \text{cal} = 0.076$$

The calculated value is less than the critical value; hence, the null hypothesis is accepted. This implies that gender have no barrier on SSS2 students preference of method of solving simultaneous equations.

Research question 3: What proportion of urbanized and ruralized SSS2 students showed preference for one method of solving simultaneous equations?

Table 5: Proportion of urbanized and ruralized SSS2 preference method

Locations	Gender	Pref. proportion method Elimination/Substitution	Total
Urbanized urban & semi-urban	Boys=226 Girls=195	107 (62%) 119 (48%) 52 (34) 143 (52%)	226 195
Ruralized	Boys =20 Girls=17	08(50%) 12 (57%) 08(50%) 09 (46%)	20 17

From table 5 above, 159 urbanized and 16 ruralized SSS2 students preferred elimination method, while, 262 urbanized and 21 ruralized SSS2 students preferred substitution method in solving simultaneous equations in Sapele local government area of Delta state.

Hypothesis 3: Schools' locations have no effect on SSS2 students' preference of method of solving simultaneous equations

Table 6: Chi-square analysis of schools' locations effect on SSS2 students' preference method of solving simultaneous equations

Locations	SSS2 students (observed frequency)	SSS2 students (expected frequency)
Urbanized	421	229
Ruralized	37	229

$$X^2 = \frac{(421 - 229)^2}{229} + \frac{(37 - 229)^2}{229}$$

$$= 160.98 + 160.98$$

$$= 321.98$$

$X^2_{1,\ 0.05}$ –critical = 3.84

Since the chi-square critical value is < than calculated value, the null hypothesis is not accepted. This means that schools' locations have effect on SSS2 students' preference of method of solving simultaneous equations in Sapele local government area of Delta state. Finally, the results of tables 1- 6 showed that SSS2 students' preferred substitution method of solving simul-taneous equations both in urban and rural areas of Sapele local government area. The results also revealed that males SSS2 students in Sapele local government senior secondary schools preferred substitution method most than their female students' irrespective of the locations. All these are in agreement with West Africa Examination Council (WAEC) syllabus that "SSS classes' students should be taught simultaneous equations in mathematics using the substitution method as compulsory".

Conclusively, base on the findings, if the mathematics students' preference order (substitution method) is strictly apply in teaching and learning of simultaneous equations, their interest will be motivated, thinking drive high and developmental curiosity towards other mathematical concepts will increase. It is therefore recommended that students' preference order should be follow by the apathy mathematics teachers in the teaching and learning of simultaneous equations in schools. SSS classes' mathematics teachers should acquired the basic knowledge of substitution method of solving simultaneous equations in schools.

Issues to mathematics curriculum developers

One of the challenges facing the mathematics curriculum developers today is to adopt a system of change. One of the significant reasons for embarking on this change in mathematics simultaneous equation curriculum is change in the students' preference order. Students' preference order is the act of students preferring or favoring one way in which things are placed in relation to one another or method (Hornby, 2003). When mathematics students' pref-erence order is considered, it will enhance effective understanding of the teaching and learning of the simultaneous equation solutions in schools. Change in mathematics students simultaneous preference order of solutions further inform changes in some important areas like the objectives of simultaneous equation, system of solving it using appropriate method, content and knowledge of simultaneous equation in mathematics. Revision of simultaneous equation curriculum in mathematics is also necessitated by feedback from researchers of curriculum evaluation which is a crucial part of the curriculum process.

Curriculum embraces the total environment in which education takes place because it is concerned with the child, the teacher, the subject, the method of teaching, evaluation of learning experiences and the physical psy-chological environment (Apologun, 2005). Mathematics curriculum is the total experience which the school mathematics education deals with in educating students (Ugboduma, 2007). Personnel assign with the sole re-sponsibility to plan or develop a suitable curriculum in any mathematical concept are the mathematics curriculum developers (planners). It refers to a process whereby the content, materials, learning activities, etc of mathematical concepts are selected and organized in such a way as to ensure the attainment of the purposes of mathematics education in a society. The main aim of mathematics curriculum planning is to design a suitable program of math-ematics education for the betterment of the society in order to foster its values and ideals for the ultimate attainment of social, economics and developmental goals.

These developers (planners) appropriately planned and imple-mented the mathematics curriculum based on progress and dynamic achievements in mathematics education. De-velopers literarily refer to peoples who are given the authority to develop, organized an unfolding inactiveness bringing into a state of activeness. The reason for constant innovation in mathematics curriculum is to update the existing curriculum to enable it meet the challenges of the global changing society as well as the societal needs and aspirations of learners. Revision of the mathematics curriculum is to add or remove from the existing curriculum with the hope of providing a better programme (Okeke in Alebiosu, 2005). So, the concern of mathematicians and researchers is to probe into the society knowing the phenomena or circumstances which affect meaningful mathe-matical growth and development of the students in the society.

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