

Influence of School Categories on The Performance of Senior Secondary School Students in Algebraic Equations in Sokoto State, Nigeria

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ABSTRACT

This study investigated the influence of school categories on the performance of senior secondary school students in algebraic equations in Sokoto State. The descriptive survey research design was used for this study. The population of the study was four thousand and thirty seven (4037) students from 12 schools in 6 educational zones of Sokoto State. Three hundred and fifty one (351) students were selected using Krejcie and Morgan Table for determining sample size. The instrument adopted for the study was an academic performance test in algebraic content. The three hypotheses formulated for the study were tested using statistics measuring difference (T-test). The findings of the results revealed that the performance of students in algebraic equation was not good enough; therefore, it was recommended among others that teachers should make sure that basic concepts, signs, symbols and terms are properly understood by students. The findings of the study have implications for gender in solving mathematics, that No gender should be regarded as the best in solving mathematics. Every student should be treated equally in the class.

Key Words: Influence, School Categories, Students, Performance, Algebraic Equations.

Introduction

Algebra is the language of patterns and relationships through which much of mathematics is communicated. It is a tool which people can and do use to model real situations and answer questions about them. It is also a way of operating with concepts at an abstract level and then applying them, often leading to the development of generalizations and insights beyond the original context (New Jersey Mathematics Curriculum Framework, 1996). An algebraic equation represents a scale, what is done on one side of the scale with a number is also done on the other side of the scale. Algebraic equations are mathematical statements where two expressions are separated by an equal sign. It includes one or more variables. The variables can be on one side or both sides of the equality sign. We use letters to denote variables and these variables are also called literal coefficients or unknown. For instance, $x = 4+2$, the variable x is on one side of the equation, where $2x+3 = x+4$, the variables are on both sides of the equation. Therefore, an algebraic equation contains variables, numbers and an equal sign that can be interpreted into meaningful statements.

Algebra is a significant part of mathematics whose foundation must begin to be built in the very early stage in school. The earlier students are exposed to informal algebraic experiences, the more willing they will be able to use algebra to represent patterns. The concept of representing unknown quantities begins with using symbols such as pictures, boxes, or blanks (i.e., $3 + \sim = 7$). It is vital that students recognize that the symbol that is used to represent an unknown quantity has meaning. The only way this can be accomplished is to consistently relate the use of unknowns to actual situations; otherwise, students lack the ability to judge whether their answers make sense. As students develop their understanding of arithmetic operations, they need to investigate the

patterns which arise. Some of these patterns (which are commonly called properties) should be initially expressed in words. As the students develop more facility with variables, the properties can be expressed in symbolic form. In the latter level in school, problem situations should provide opportunities to generalize patterns and use additional symbols such as names and literal variables (letters). It must be a part of an entire curriculum which involves creating, representing, and using quantitative relationships. In such a curriculum, algebraic concepts should be introduced in conjunction with the study of patterns and developed throughout each student's mathematical education. This development should continue throughout the remainder of the programme, ensuring that the relationship between the variables (unknowns) and the quantities they represent is consistently stressed (New Jersey Mathematics Curriculum Framework, 1996). Therefore, every student needs the knowledge of algebra because it equips them with problem solving skills and much more because of the orderly way in which it enables individuals to think. An understanding of algebra is central to students' ability to do mathematics. It follows from this that, in order to improve students' performance in mathematics in general, the teacher should enhance a profound understanding and acquisition of algebraic concepts and thinking skills (Nickson, 2000).

Unfortunately many factors influence the performance of students in algebra. In the study of Adeneye (2011), one educational variable that appears to be influencing both male and female students in the learning of mathematics is school organization. The effect of single-sex and co-educational schools on performance in mathematics is equivocal and boys and girls behave differently in those schools. At coeducational schools, there was a statistically significant gap favouring females, while at single-sex schools there was a non-significant gap favouring males. These results indicate that single-sex schooling may mitigate male disadvantages in educational achievement.

Other studies have found that the effects of single sex schooling are the same for males and females. In general, boys in the co-educational schools appear to hold more positive attitudes toward mathematics and are confident in their abilities to deal with more advance mathematics. It has been observed that single-sex schools, particularly for girls tend to favour girls' preferred lower levels of social competition and a warmer teaching style. While advocating that single-sex schools, particularly for girls will engender equity in mathematics education, concluded that single-sex schools for girls must be approached with caution. This is against the back drop that co-education has more potential for counter-sexist practices to be effective School location is a variable in achievement that tends to affect male and female students in the learning of mathematics. While rural students tend to manifest more simple social relationships due to greater interpersonal ties in rural settings urban students show complex social relationships.

Thus, one is led to wonder whether gender gaps exist in the mathematics performance of senior secondary school students in Sokoto State based on school location.

Statement of the Problem

Common mistakes, errors and Misconceptions made by students are major identified problems when solving algebraic equation. In Sokoto, research revealed that the performance of secondary school students in problem solving and algebraic problems was poor.

1. Misconceptions with two-step equations and error in collecting like terms. The first class of errors often involves students failing to perform the same operation on both sides of the equation. For example, in the equation $3x + 5 = 20$, students may attempt to isolate x from the coefficient 3 before getting rid of the 5 on the left-hand side of the equation. However, they may fail to recognize that they must divide the entire left-hand side by 3, not just the term $3x$, resulting in the incorrect equation $x + 5 = 20/3$. Or Students were asked to solve the equation for k ,

$9k = 18 - 3k$, they solved it as follows;

$$9k = 18 - 3k$$

$$9k - 3k = 18$$

$$6k = 18$$

$$k = 3$$

The mistake was that $3k$ was subtracted from the left hand side but added to the right hand side; instead, $3k$ should have been added to both sides.

2. Misconception in number sense. Most students would agree that $3 + 3$ is equal to 6. However, many students fail to relate this knowledge to the idea of $x + x$. When presented with this expression, many students will respond that it simplifies to x^2 or $2x^2$. Some students may even claim that $x + y$ is equal to xy . Students must understand the connection between $3 + 3 = 2(3) = 6$ and $x + x = 2x$. A misunderstanding of combining like terms can result in incorrect simplification of rational expressions.

3. Misconception in inequality sign. Students who do not understand why they reverse the inequality sign may over-generalize the rules. For example, students may reverse the inequality symbol when solving $9x < -18$ or $x - 6 > 14$ simply because they see a negative sign even though it is not the coefficient of the variable. Likewise, they may incorrectly reverse the inequality symbol when adding or subtracting a negative constant.

4. Misconception in quadratic formula. When students learn the quadratic formula, they usually memorize the formula without understanding where it comes from. As a result, students think of the quadratic formula as a complicated equation to be memorized without understanding when or how to use it, or why it works. Some students will ignore negative signs associated with a , b , or c , while others will always substitute $a = 1$, even when it has another value. Still others will use an incorrect value of c when an equation takes the form $ax^2 + bx = c$. By detailing how the quadratic formula derives from completing the square to solve quadratic equations, students can better understand the formula and minimize these common errors.

5. Error in clearing fraction. Students were asked to solve the equation for x ,

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

Many students fail to clear the fraction by multiply each term by the L.C.M $(2x+1)(3x+2)(5)$, rather they cross multiply the denominators 5 and $3x+2$ with the numerators 4 and 2. As shown below:

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

These student's misconceptions or errors/mistakes occurs because students did not master the basic concepts of Algebraic equations well and this caused misconceptions to occur in the basic operation of Algebra.

Purpose and Objectives of the Study

The purpose of the study was to investigate the influence of school categories on the performance of senior secondary schools students in algebraic equations in Sokoto State. Specifically the study sought to:

- i. find out if there is any difference in performance in algebraic equations between students in Boarding and Day schools in Sokoto State.

- ii. determine if there is any difference in performance in algebraic equations between students from same Gender and Mixed schools in Sokoto State.
- iii. find out if there is any difference in performance in algebraic equations between male and female students in Sokoto State.

Research Questions

The following research questions guided this study.

- i. Is there any difference in the performance in algebraic equations between students in Boarding and Day schools in Sokoto State?
- ii. Is there any difference in performances in algebraic equations between students from same Gender and Mixed schools in Sokoto State?
- iii. Is there any difference in performances in algebraic equations between male and female students in Sokoto State?

Research Hypotheses

Three null hypotheses were generated and tested at $\alpha = 0.05$ level of significance, they are:

- i. There is no significant difference in the performance in algebraic equations between students in Boarding and Day schools in Sokoto State.
- ii. There is no significant difference in the performance in algebraic equations between students from same Gender and Mixed schools in Sokoto State.
- iii. There is no significant difference in the performance in algebraic equations between male and female students in Sokoto State.

Method

The study employed a descriptive survey research design to find out the opinion of the representative sample from the target population in such a way that will permit inference to be made about entire population. A descriptive study is one in which information is collected without changing the environment (i.e., nothing is manipulated). Accurate information for large population can be obtained with a small sample at relatively low costs (Macmillan & Schumacher 2001: 304-305). Population for the study consisted of all the senior secondary schools students in Sokoto State. The total number of students stands at sixty six thousand and six (66,006). Among this population, the target population was SS2 students with a population of twenty one thousand eight hundred and thirty nine (21,839) of which fifteen thousand nine hundred and forty four (15,944) are boys and five thousand and eight hundred and nine five (5895) are girls.

Three hundred and fifty one (351) students were selected from 4037 students (using Kreycie and Morgan table, 1970) from 12 schools in 6 educational zones in Sokoto State using stratified proportionate random sampling technique. These schools were randomly selected from 6 educational zones in Sokoto state using a hat and draw method of random sampling method. The numbers of all the secondary schools in each zone were written on pieces of paper which were then folded and thoroughly mixed in a hat. Since each school from each zone was only placed on one piece of paper and all the paper were of the same size, each school had the same chance of being picked.

The instrument for data collection was a 30 item questionnaire titled Academic Performance Test in Algebraic Content. The instrument was pilot tested with three (3) secondary schools and seventy five (75) SS2 students drawn from the three schools. The research instrument was examined and made to suit the Sokoto/Nigeria respondent by three expert mathematics educators, from Usmanu Danfodiyo University, Sokoto. To test the reliability of the instrument, the test re-test method was administered to seventy five (75) SS2 students drawn from three

sampled schools that were used in the pilot study. This was done with the help of two research assistants. The reliability index was obtained using the XLSX statistics software. They were then correlated using Cronbach's Alpha and the reliability index was found to be 0.76. Then the instrument will be considered to have satisfactory level of reliability for the study.

Method of Data Analysis

In order to answer the research questions and test the hypotheses, the data collected were subjected to t- test using the Statistical Package for Social Sciences (SPSS).

RESULTS

Table 1: Performance Difference in Algebraic Equations between Students in Boarding and Day Schools in Sokoto State

School	Mean	S.D	N	df	t-Cal	t-Crit	Decision
Boarding	50.79	10.53	82	349	3.45	2.01	H ₀ Rejected
Day	45.40	8.72	269				

Results presented on Table 1, showed that students in the boarding schools performed better as indicated by a mean of 50.79 (SD=10.53) over those in the day schools with a mean of 45.40 (SD=8.72). This implies that there existed significant difference in the performance of students in algebraic equations because the calculated t-value of 3.45 which is higher than the critical t-value of 2.01 at 349 degrees of freedom. Therefore, H₀₃ which states that there is no significant difference in performance in algebraic equations between students in Boarding and those in Day schools in Sokoto state was rejected.

Table 2: Performance Difference in Algebraic Equations between Students in Same Gender and Mixed Schools in Sokoto State

School	Mean	S.D	N	Df	t-Cal	t-Crit	Decision
Same Gender	44.94	8.21	147	349	2.30	1.96	H ₀ Rejected
Mixed	47.42	10.18	204				

Results presented on table 2 showed that students in the mixed schools performed better as indicated by a mean of 47.42 (SD=10.18) over those in the same gender schools with a mean of 44.94 (SD=8.21). This showed that there existed significant difference in the performance of students in algebraic equations because the calculated t-value of 2.30 which is higher than the critical t-value of 1.96 at 349 degrees of freedom. Therefore, H₀₂ which states that there is no significant difference in performance in algebraic equations between students from same gender and those from mixed schools in Sokoto state was rejected.

Table 3: Performance Difference in Algebraic Equations between Male and Female Students in Sokoto State

School	Mean	S.D	N	Df	t-Cal	t-Crit	Decision
Male	47.80	9.82	254	349	0.393	2.01	H ₀ Retained
Female	47.29	9.99	97				

Table 3 showed that there is no marked difference as indicated by a mean of 47.80 (SD=9.82) for the male and a mean of 47.29 (SD=9.99) for the female. This showed that there exists no significant difference in the performance of male and female students in algebraic equations because of the calculated t-value of 0.393 which is lower than the critical t-value of 2.01 at 349 degrees of freedom. Therefore, H₀ which states that there is no significant difference in performances in algebraic equations between male and female students in Sokoto State was retained.

Discussion

Study was to investigate the influence of school categories on the performance of senior secondary schools students in algebraic equations in Sokoto State. The results emerged from the study revealed that students from Boarding schools performed significantly better than their counterpart in Day schools, students from the mixed schools performed significantly better than their counterpart from same gender schools and there is no marked difference in performance of males and their females’ counterpart.

The findings from this study aligned with the study of Bashir (1999) which revealed that students in the Boarding schools performed significantly better than their counterpart in Day schools. This may be because of more conducive learning environment, thorough supervision and more academic help and support.

This finding also disagrees with the findings of Galadima (1988) but aligned with Bashir (1999), Musibau and Johnson (2010) and Adeneye (2011) which revealed that students from mixed schools performed significantly better than their counterpart from same gender schools. Finally, the findings of this study contradicts the findings of Mercy (2007), Aminu (2008), Basse, Joshua and Esim (2003), Jahun and Momoh (2001) and Bashir (2006), but is in line with the findings of Kolawole and Ajetunmobi (2014) which indicated that there is no marked difference in performance of male and their female counterpart. Also Adeneye (2011) which revealed there was no statistically significant difference i.e. the performance of male and female students did not differ in either co-educational schools or urban schools.

Conclusion

This study investigated the influence of school categories on the performance of senior secondary school students in algebraic equations in Sokoto State. The results obtained from the analysis of the data obtained in this study led to the rejection of two null hypotheses while one of the hypotheses rose in the study was retained. From the findings, the following conclusions are made for the study:

The performance of students in boarding schools in algebraic equations was better than that of their counterpart in day schools, students from mixed schools performed better in algebraic equations than that of their counterpart from same gender schools and there is no significant difference in performance of male and female students in algebraic equations. That is, gender has no significant influence in learning of algebraic equations.

Implications

No gender should be regarded as the best in solving mathematics. Every student should treat equally in the class.

Recommendations

The following recommendations were made based on the findings of the study:

- i. Teachers should emphasis more on how to solve fractional algebraic equations by multiply both sides with the lowest common multiple. (LCM) of the denominators, instead of cross multiply. Especially, fractions with binomials.
- ii. Teachers should put more emphasis on the identified areas of students' difficulties while teaching and also make sure that concepts, signs, symbols and terms are properly understood by students. This will ensure a proper foundation in algebraic content.
- iii. Training of teachers through special workshop by Mathematical Association of Nigeria (MAN) on strategies to teach algebra in schools.
- iv. Gender discrimination should not arise during teaching and learning of mathematics by the teachers. Every student should be treated equally in the class. No gender should be regard as the best in solving mathematics. This will encourage and boost the morale of every student to learn mathematics

References

- Adeneye, O. A. A., (2011). Is Gender a Factor in Mathematics Performance among Nigerian Senior Secondary Students with Varying School Organization and Location? *International Journal of Mathematics Trends and Technology*, 2(3).
- Aminu, A., (2008). The Effect of Gender on Students Performance in Mathematics. *Kano Journal of Science Education (KAJOSE)* 3(2), 11-15.
- Bashir, S., (1999). Students performance in mathematical problem solving in Sokoto State.M.ed Thesis, UDUS.
- Bashir, Y., (2006). The Effect of Gender on Students Performance in Mathematics. *Kano Journal of Science Education KAJOSE*, 3(1), 136-146.
- Bassey, S., Joshua, M. T. & Esim, E., (2003). *Gender Difference and Mathematics Achievement of Rural Secondary School in Crossriver State*. Retrieved on 17 March, 2011 from <http://cvs:gnnowledge.Ore episteme.5 pro pfs/09BasseyJoshuaasim.pf>.
- Galadima, I., (1988). Comparative performance by Gender in subtopics of Junior Secondary School Algebra in Sokoto State.M.Ed Thesis. A.B.U. Zaria.
- Jahun, U.I. & Momoh, J.S., (2001). The Effect of Environment and Sex on the Mathematics Achievement of J.S.S. Students in Kwara State. *ABACUS; Journal ofMAN*, 26(2), 55-58.
- Kolawole, E. B. & Ajetumobi, O., (2014). Kolawoe's Problem Solving (KPS) Method Panacea for Mathematical Problems and an Antidote to mass Failure in mathematics Examinations. *Journal ofMAN*, 39(1),159-176.
- Krejcie, R.V. & Morgan, D.W., (1970). Table for Determining Sample Size from a given population.
- Macmillan, J.H. & Schumacher, S., (2001). *Research in Education: A Conceptual Introduction* .New York: Longman 4th Ed.
- Mercy, K. V., (2007). Sex Difference and Scientific Performance. *Women Journal of Science and Technology*. 9(2), 74-82.

- Musibau & Johnson (2010).The Influence of School Sex, Location and Type on Students' Academic Performance. *International Journal Education Science*, 2(2), 81-85.
- New Jersey Mathematics Curriculum Framework (1996).About Algebra.
- Nickson, M., (2000).*Teaching and Learning Mathematics: A Teacher's Guide to Recent Research and its Application*. London: Cassell.