



## Effects of School Location on the Problem Solving Abilities in Algebra among Senior Secondary School Students in Rivers State

*Dr Adolphus Telima<sup>1</sup>, Obunge Jessey Ilama<sup>2</sup>*

<sup>1</sup>Department Of Science Education, Faculty Of Education Rivers State University  
Adolphus.Telima@Ust.Edu.Ng

<sup>2</sup>Obunge Jessey Ilama, Department of Science Education, Faculty Of Education Rivers State University  
obungeji@gmail.com

### ABSTRACT

The study investigated the effects of school location on problem-solving abilities in Algebra among senior secondary school students in Rivers State. Ex-post facto design was used in this study. The population is all 145,894 senior secondary school students in Rivers State. Multistage sampling technique was employed in the study. The sample size was all 5,340 senior secondary school III students in Port Harcourt and Akuku-toru Local Government Areas in the 2020/2021 academic session. Source is Rivers State Post Primary Schools Board. The two local government areas were selected by convenience sampling because the researcher is familiar with the environment, and also because of their locations; Port Harcourt representing the urban areas and Akuku-Toru representing the rural areas. Nine schools were selected by cluster sampling method (six in Port Harcourt and three in Akuku-Toru). 390 students which was slightly higher than the minimum number obtained by Taro Yamane formula participated in this study. The instrument used was an Algebraic Problem-Solving Test collated by the researcher. The reliability of the test was determined to be 0.72 using Pearson Product Moment Correlation Formula. Two research questions were answered using simple mean. One hypothesis was raised to guide the study at 0.05 significant level using t-test. The results of the analyses revealed that school location had significant effect on the problem-solving abilities in algebra among senior secondary school students, in favour of students in the rural schools. Based on the findings, it was recommended that problem solving models like Polya's should be part of mathematics curriculum with algebra in focus in our secondary schools and that every student should be encouraged to focus on problem solving irrespective of their school location.

**Keywords:** School location, Problem-Solving Ability, Algebra.

### Introduction

Mathematics is the foundation and bedrock of economic and technological development in any nation (Azuka, 2015). It is a universal branch of science that is highly important to the society. In light of its importance, it is a core subject in both primary and secondary school curriculum all over the world including Nigeria. It is also a prerequisite in the study of many other science related courses at the tertiary level of education. Mathematics is believed over the years to develop logical thinking and enhance reasoning capacity of the human brain and subsequently, development of the society. According to (Alacaci&Dogruel, 2012), problem-solving is an essential aspect of human activity thus the major part of human thinking is consciously aimed towards problem solving. According to (Permendiknas, 2006), algebra in mathematics helps to provide students the ability to work harmoniously and also prepares them to think creatively, analytically, logically and critically. The twentieth centuries and beyond have witnessed increasing difficulties and complexities that require high problem-solving skills at the work place as well as other areas of life in the society and as such, mathematical literacy especially algebra, becomes one of the components required to develop the 21<sup>st</sup> century skills (Julie, Sajaya&Anggoro, 2017). That is why it is important to research into the problem solving abilities of students in algebra in this very essential subject, mathematics.

Despite the importance of algebra in mathematics and the role of mathematics in different areas of human endeavor and national development, many students find algebraic contents especially word problems, difficult and so perceive mathematics as a difficult subject and subsequently score low grades in mathematics in external examinations. Many researchers such as (Zalmon&Wanu, 2017, Jega, Muhammad &Gwandu, 2018) reported that there has been continual low grades of students in mathematics in the senior secondary school certificate examinations.

West African examination council chief examiners' report from 2006 – 2010 stated that modal mark for mathematics in most examination centers was either zero or tending to zero. Their report also revealed that the low grades of students in mathematics is traceable to poor understanding of algebraic contents. West African examination council also reported in 2007, 2008 and 2010 that the continual low grades of students in mathematics is attributed to lack of basic algebraic skills and so they commit errors in solving algebraic problems. What could be the cause of this state of continual low grades of students in mathematics? Could it be school characteristics, or other reasons? That is why this study was carried out to investigate the effect of school location on problem-solving abilities in algebra among senior secondary school students in Rivers State.

---

## Purpose of the study

The purpose of the study was to

1. Assess senior secondary school students' abilities to solve algebraic problems.
2. Investigate the effect of school type based on location on the problem-solving ability in algebra among senior secondary school students.

---

## Research Questions

1. What is the ability of senior secondary school students in solving algebraic problems using polya's model?
2. What is the effect of school type based on location) on the problem-solving ability in algebra among senior secondary school students?

## Hypothesis

1. There is no significant difference in the problem-solving abilities in algebra between senior secondary students in urban and rural schools.

---

## Methodology

The research design of this study was ex-post facto population of the study was all 145,894 senior secondary school students in Rivers State in the 2020/2021 academic session. The study sample was all 5,340 senior secondary school III students in the 2020/2021 academic session. Source is rivers State post Primary Schools Board. 390 senior secondary school III students which is slightly higher than the minimum number obtained by Taro Yamane formula participated in the study out of the 5,340 senior secondary school III students

The instrument used for this study was a researcher-made algebraic questions. There were five word problems, leading to linear, quadratic, simultaneous equations, and graphical problems used to assess the students' problem solving abilities in algebra. Senior secondary school III students were purposively selected for the study because at this level students would have been taught sufficient algebraic contents. The researcher also confirmed with each of the mathematics teachers for the study class in the schools involved that, these topics had been taught according to the senior secondary mathematics curriculum as approved by the ministry of education. Reliability of the instrument was obtained to be 0.72, using Pearson Product Moment Correlation formula. The instrument was administered to the students personally by the researcher using intact class method with the assistance of some teachers in the schools involved. The quantitative data obtained from the students were analyzed by descriptive statistics of mean, these were used to answer research questions 1 and 2 of the study. The null hypothesis was tested at 0.05 level of significance using t-test. The decision rule was to accept the null hypothesis if p-value is greater than the significant level of 0.05 and to reject the null hypothesis if p-value is less than the significant level of 0.05.

---

## Results

### Research Question 1

What is the ability of senior secondary school students in solving algebraic problems using Polya's model?

**Table 1: General Performance of Students in Solving Algebraic Problems.**

Variable	N	%	Mean Score	Mean Difference
High Ability	21	5.40	58.10	52.90
Low Ability	369	94.60	5.20	
<b>Total N=390</b>				

Table 1 shows the general performance of the SS3 students that participated in this study. Out of a total of 390 students that participated, only 21 students scored 50% and above which represents about 5.40% of the total sample with a mean score of 58.10, while 269 students scored below 50% which represents 94.60% of the total sample with a mean score of 5.20. This indicates a general very poor performance of the students in solving algebraic problems.

**Research Question 2**

What is the effect of school type based on location on problem solving ability in algebra among senior secondary school students?

**Table 2: Comparison of Mean scores by school location**

	Urban (N=304)	Rural (N=86)	Mean Difference
Mean	6.60	13.20	6.60
Std. Error Mean	0.70	1.80	

Table 2 shows that 304 students from urban schools and 86 students from rural schools participated in this study with mean scores of 6.60 and 13.20 respectively. The mean difference is 6.60 in favour of students in the rural schools. It is interesting to note that from this study, students in the rural schools have remarkable higher problem solving abilities than those in the urban schools although performances in the two locations are below average.

**Null Hypothesis**

There is no significant difference in the Problem Solving abilities in algebra among senior secondary school students in urban and rural locations.

**Table 3: t-test analysis of Mean Scores by School Location**

Gender	N	$\bar{X}$	Std. Deviation	Std. Error Mean	df	t-cal	p-value	Decision
Rural	86	13.20	16.778	1.80	388	4.008	0.0001	Rejected
Urban	304	6.60	12.259	0.70				

$t(388) = 4.008, P < 0.05$  therefore the null hypothesis is rejected.

Table 3 shows p-value to be 0.0001 which is less than the significant level of 0.05 which means, there is a statistically significant difference between the mean scores of students in the urban schools and rural schools. This difference is in favour of the students in rural schools. Hence, the null hypothesis is rejected.

**Discussion of Findings**

The study was carried out to investigate school location and problem-solving abilities of senior secondary school students in Rivers State, Nigeria. In order to achieve this, two research questions were answered.

Research question one (1) sought to assess the problem-solving abilities of senior secondary school students in algebra. The study shows that only 21 students out of 390 which represents about 5% of the students scored 50% and above with a mean score of 58.10. 369 students out of 390 which represents about 95% of the students scored below 50% with a mean score of 5.20 as shown in table 1. This indicates a very low problem-solving ability of the students. The mean difference between the two categories is 52.90. This is in agreement with the studies of (Zalmon&Wonu, 2017; Jega, Muhammad, &Gwandu, 2018) who did similar studies and found out that the mathematics scores of secondary students in the West African Examinations were very poor for many years. This also confirms reports from the West African Examination Council Chief Examiners, from 2006-2011, which stated that the modal mark for most centers of mathematics was zero or tending to zero. Their reports also showed that students' poor performance in mathematics is due to their poor understanding of algebraic concepts. Chief examiners reports also stated from 2011-2019 that areas of weaknesses of students are traceable to inability to form equations from word problems, to simplify algebraic equations, among others. The findings in this study also conforms with the findings of Gokkusagi (2006) who used the SOLOmodel as a theoretical framework for assessing Form Four (SS1) students' algebraic solving abilities in Malaysia, using linear equation. Results of the study indicated that 62% of the students had less than 50% probability of success at relational level. Generally, most of the students encountered difficulties in generalizing their arithmetic thinking through the use of algebraic symbols. The qualitative dataanalysis found that the highabilitystudents seemed to be more able to seek the recurring linear pattern and identify the linear relationship between variables. They were able to coordinate all the information given in the question to form the algebraic expression and linear equations. While, the low ability students showed abilities more on drawing and counting methods. They lacked understanding of algebraic concepts to express the relationship between the variables.

Ogunsanya (2015) also agrees with the findings of this study. He studied word problems in algebra: Nigerian junior secondary school students' experience, in Lagos state. His findings showed that only about 10% of the whole students involved answered the questions they were given correctly. Based on the poor performance, he suggested more focused approaches in the teaching of algebra with special attention to word problems in Nigerian secondary schools especially in the junior level to lay a strong foundation.

Research question two (2) sought to investigate the effect of school location on problem-solving abilities in algebra of senior secondary school students. Table 2 shows that 304 students from the urban area and 86 students from the rural area were involved in this study. It also shows that, mean of the

urban students is 6.60, mean of the rural students is 13.20 and the mean difference is 6.60 in favour of the rural students. The t-test result showed a significant difference in favour of the rural students which indicates that the rural students had higher problem-solving abilities than the urban students in this study. This finding is in agreement with the finding of (Ajai&Imoko, 2011) who investigated urban and rural students' academic achievement in geometry, using games and simulations method. They found the post-test mean achievement and interest scores of urban and rural students to be different significantly. The findings revealed that students in rural school achieved significantly better in mean achievement score and also in interest scores than their counterparts in the urban schools. However, the findings in this study disagreed with the prior findings of (Owoeye&Yara, 2011, Chianson, 2012) which found that the achievement of students in the urban location in mathematics is higher than that of the students in the rural location.

Awodun and Oyeniyi (2018) also disagreed with the findings of this study. They study influence of school location in Ekiti State, Nigeria. Their findings showed that there is significant difference in academic achievement scores of students in urban and rural located schools. The students in urban schools had higher academic achievement mean score than students in rural schools.

The main findings of the study showed that, senior secondary school students in this study, generally had low problem-solving ability in algebra. Location had significant effect on the problem-solving ability in algebra among senior secondary school students. Interestingly, students in the rural schools had significantly higher problem-solving ability than their peers in the urban schools.

---

## Conclusion

The following conclusions were made based on the findings from the study:

- About 5% of the total students that participated in the study scored 50% and above thus it is clear that about 95% of the students lack the ability to solve problems systematically
- The mean score difference between the students in urban area and those in rural area are statistically significant in favour of the students in the rural area surprisingly. Location therefore has significant effect on the problem solving abilities of students in this study.

---

## Recommendations

The following recommendations were made based on the findings from the study

1. Developing students' ability to solve problems is the integral part of mathematics learning at all levels and strata. Therefore all students both in rural and urban schools, should be encouraged to take problem solving seriously, to improve the abilities of students in solving problems. It is required in all aspect of life.
2. Problem solving models like Polya's should be part of mathematics curriculum in our secondary schools and be adhered to since problem solving is the essence of mathematics.

**REFERENCES**

- Abdullah, A. H., Abidin, N. L. Z., & Ali, M. (2015). Analysis of Students' Errors in Solving Higher- Order Thinking Skills (HOTS). *Asian Journal of Mathematics Science and Technology Education*. 11(21), 133-142
- Abdullah, A.H., Moktar, M., Halim, N.A., Ali, D.F., Tahir, L.M., & Kohar, U.H.A (2016). Mathematics teacher's level of knowledge and practice on the implementation of higher order thinking skills (HOTS), *Eurasia journal of mathematics, science and technology education* 13(1), 3-17
- Ajai, J.T., & Imoko, B. I. (2013). Urban and Rural Students' Academic Achievement and Interest in Geometry. *Taraba State University Journal of Education Research and Production*. 1(2), 56-63
- Akinssani, I. M., & Ahmed, M., (2019). Effects of Gender and School Location on mathematics Achievement of Senior Secondary School Students in Katsina Educational Zone, Katsina State, Nigeria. *Abacus, Journal of Mathematics Association of Nigeria*, 25 (2), 102-113
- Alacaci, C., & Dogruel, M. (2012). Solving a Stability Problem by Polya's four Steps *International Journal of electronics mechanical and mechatronics engineering*, 1 (1), 19-28
- Alhasora, N.S.A., Abu, M. S., & Abdullah, A. H., (2017). Inculcating Higher order Thinking Skills in Mathematics; Why is it So Hard? *MAN in India* 97 (13), 51-62
- Apino, E., & Retnawati, H., (2017). Developing Instructional Design to Improve Mathematical Higher Order Thinking Skills of Students. *Journal of Physics Conference Series*. 812 (1), 1-7
- Ashmore, A. D., Frazer, M. J., & Cassey, R., (1979). Problem Solving and Problem Solving Network in Chemistry. *Journal of Chemistry Education* 56 (6), 377-379
- Awodun, A. O. & Oyeniyi, A. D. (2018). Influence of location on Students' Academic Achievement in Junior Secondary School Basic Science in Ekiti State, Nigeria. *Journal of Emerging Technologies and Innovative Research (JETIR)*. 5(6), 125-129
- Azuka, B. F., (2015). Effects of Emotional Intelligent Skills Acquisition on Students Achievement in Senior Secondary School Geometry in Keffi Education Zone, Nassarawa State, Nigeria. *Asian Journal of Education and Learning*. 3 (4), <http://cvs.gnowledge.oreepisteme.5propfs/09/BassevJoshuaasim.pf>
- Brookhart, S.M., (2010). *How to Access Higher-Order Thinking Skills in Your Classroom*. Alexandria, VA: ASCD
- Budiman, A., & Jailani, J. (2014). Development of Assessment Instrument of Higher Order Thinking Skills (HOTS) in Mathematics Learning on SMP Grade VIII semester 1. *Journal Reset Pendidikan Matematika*, 1(2), 139-151
- Chianson, M. M. (2012). School Location as a Correlate of Mathematics Students' Achievement in a Cooperative Learning Class. *Journal of Education and Leadership Development*. 4(1), 42-46
- Conway, J. H., & Polya, G., (2014). *How To Solve It: Anew Aspect of Mathematical Method*. Princeton University Press, ISBN: 9781400828678.
- Craige, T.S., (2011). Categorization and Analysis of Explanatory Writing in Mathematics. *International Journal of Mathematical Education in Science and Technology*, 42 (7), 867-878
- Doorman, M., Robitzsch, A., Wijiya, A., Heuvel-Panhuizen, M. V.D. (2014). Difficulties in Solving Context-based PISA Mathematics Tasks: An Analysis of Students' Error. *Mathematics Enthusiast* 11 (3), 555-584
- Idris, I. O., (2015). Influence of Gender and School Location in Mathematics Achievement of Junior Secondary School Students in Kogi State Nigeria. *Abacus: Journal of Mathematics Association of Nigeria* 40(1), 249-259.
- Inweregguh, O. C., (2018). Influence of School Categories on the Performance of Senior Secondary School Students in Kogi State. *African Journal of Science, Technology and Mathematics Education (AJSTME)*, 4 (1) 118-125
- Inweregguh, O. C., Osakwe, I. J., Uguanyi, C. C., Agugoesi O. J., (2020). Assessment of Students' Creative Thinking Ability in Mathematical Tasks at Senior Secondary School Level. *International Journal of Curriculum and Instruction* 12 (2) 494-506
- Jailani, J., & Retnawati, H., (2016). The Challenges of Junior High School Mathematics Teachers in Implementing The Problem-based Learning for Improving the Higher Order Thinking Skills. *The Online Journal of Counseling and Education* 5 (3) 1-13
- Jailani, J., Sugiman, S., & Apino, E., (2017). Implementing The Problem-based Learning in Order To Improve The Students' HOTS And Characters. *Journal Reset Pendidikan Matematika*, 4 (2) 247-259.

- Jayanti, R., Rahayuningsih, S., (2019). High Order Thinking Skills (HOTS) of Students in Solving Group Problem Based on Gender. *Al-Jabar Journal Pendidikan Matematika*. 10 (2) 243-250
- Jega, S. H., Muhammad, S., &Gwandu, Z. L. (2018). Causes of Mass Failure in Mathematics at Senior Secondary Schools Certificate Examinations (SCCE) in Some Selected Secondary Schools in Kebbi State in Nigeria. *International Journal of Education and Evaluation*. 4 (4), 12-25
- Julie, H., Sanjaya, F.&Angorro, A. Y., (2017). The Students' Ability in Mathematical Literacy For Uncertainty Problems on PISA Adaptation Test. *AIP Conference Proceedings* 1868 050026 DOI:ID. 1063/1.4995153
- Julius, E., Abdullah, A. H., &Nornazira, S., (2018) Attitude of Students toward Solving Problems in Algebra: A Review of Nigerian Secondary Schools. *Journal of Research and Methods in Education* 8 (1) 26-31.
- Kaya, D., Izgiol, D., Kesan, C., (2014). Investigation of Elementary Mathematics Teacher Candidates' Problem Solving Skills According To Various Variables. *International Journal of Elementary Education*. 6 (2), 295-313
- Kolawole, E. B., &Ajetunmobi, O., (2014). Kolawale's Problem Solving (KPS) Method as a Panacea for Mathematical Problem and an Antidote to Mass Failure in Mathematics Examinations. *Abacus: Journal of Mathematical Association of Nigeria*. 39 (1) 159-176
- Marshall, J. C., Horton, R. M., (2011). The Relationship of Teacher Facilitated Inquiry-based Instruction to Students HOTS. *School Science and Mathematics*. 1(3) 93-101
- Martinez, S., Blanco, V., (2021). Analysis of Problem Posing Using Different Fractions Meanings. *Education, Sciences*. 3(11), 65-70
- Mills, E. D., Mereku, D. K., (2016). Students Performance on the Ghanaian Junior High School. *African Journal of Educational Studies in Mathematics and Sciences*. vol. 12, 2016.
- Ministry of Education and Culture (2016). Regulation of the Minister of Education and Culture of the Republic of Indonesia. *Student Content of Primary and Secondary Education Unit* (21)
- Mullis, I. V. S., Martin, M.O., Foy, P., Hooper, M., (2016). TIMSS 2015 International Results in Mathematics. Chestnut Hill, M. A: IEA.
- Mustaffa, N., (2017). Integrating Algebraic Thinking in Problem-based Learning among Secondary School Students. Unpublished PHD Thesis, University Teknologi Malaysia Faculty of Science.
- Mutai, C. C. (2011). Gender differences In Mathematics Performance among Secondary School Students in Bureti Sub-County, Kericho County, Kenya. Unpublished Master's Thesis.
- Nadirah, M. N., Yusof, H., Haji, A. Z. S. F., Rahimah, J., Ezrinda, M. Z., (2012). Preliminary Study of Students Performance in Algebraic Concepts and Differentiation.
- Napaphun, V., (2012). Relational Thinking: Learning Arithmetic in order To Promote Algebraic Thinking.