

**LATERAL THINKING PROBLEM-SOLVING ABILITY AS DETERMINANTS OF
SECONDARY SCHOOL STUDENTS' ACHIEVEMENT AND RETENTION IN
ALGEBRA IN ENUGU STATE**

Nneji, Samuel Onyinyechi, Ph.D
onyinyechi.nneji@esut.edu.ng

**Department of Mathematics and Computer Education
Enugu State University of Science and Technology (ESUT), Enugu, Enugu state**

Abstract

The main purpose of this study was to ascertain whether or not lateral thinking problem-solving ability can determine secondary school students' achievement and retention in algebra in Enugu state. Design adopted for the study was descriptive survey design. Two research questions and two hypotheses guided the study. Area of the study was Enugu state of Nigeria. The population for the study consisted of 60,457 Senior Secondary School II (SSSII) students in Enugu state as at the time of the study. Sample for the study consisted of 2,967 Senior Secondary School II (SSSII) students in Enugu State. This sample was made up of 1,195 students from urban schools and 1,772 students from rural schools. Instruments for data collection were Lateral Thinking Problem-Solving Abilities Scale (PROSAS) and Algebra Retention Test (ART). A stability coefficient of .69 was obtained for ART. On the other hand, PROSA yielded a reliability coefficient of .73 using Cronbach's Alpha's method since the items were not dichotomously scored. Mean with standard deviation were used to answer the research questions while z-test statistic was used to test the hypotheses at 0.05 significant level. Based on the findings of this study, it was concluded that lateral thinking problem solving ability can enhance secondary school students' achievement and retention in algebra. Consequent upon the findings of this study, it was recommended that secondary school mathematics teachers should aim at inculcating lateral thinking problem solving ability in to their learners to help them achieve high and retain more in algebra.

Introduction

Problem-solving is a process or means by which an individual uses previously acquired knowledge, skills, and understanding to satisfy the demands of an unfamiliar situation (Inusa, 2018). Marua (2015) asserted that problem-solving consists of using generic or ad-hoc methods in an orderly manner to find solutions to problems. Problem solving ability refers to the skill to understand what the end goal of the problem is, and what rules could be applied in solving it.

Problem-solving abilities are competences that one would use to find the problems that are in the way to getting to one's own goal.

Marua further hinted that one of the veritable problem solving abilities that will benefit secondary school students is Lateral thinking problem solving ability. Lateral thinking problem solving ability involves approaching solutions to a given problem indirectly and creatively. Lateral thinking will often produce solutions whereby the problem appears as "obvious" in hindsight. That lateral thinking will often lead to problems that you never knew you had, or it will solve simple problems that have a huge potential. For example, if a production line produced 1000 books per hour, lateral thinking may suggest that a drop in output to 800 would lead to higher quality, and more motivated workers. Lateral thinking "puzzles" * Lateral thinking puzzles are supposed to demonstrate what lateral thinking is about. However, any puzzle that has only one solution been "not" lateral. While lateral thinking may help you construct such puzzles, the lateral thinking tools will seldom help you solve puzzles.

As good and effective as Lateral thinking problem solving abilities may sound, researchers have reported conflicting findings on the extent to which they (problem-solving abilities) can determine students' achievement and retention in algebra. A few examples include Inusa (2018) and Hilton (2020) who found in their separate studies that students with higher problem-solving abilities achieved higher and retained more algebra than their counterparts with lower problem-solving abilities. Whereas, King (2015) and Ebinibe (2017) in their separate studies found no significant difference in the mean algebra achievement and retention scores of students with different problem-solving abilities. These conflicting findings suggest the need for more enquires. Thus, the main challenge of this study is to bridge the gap by investigating

whether or not problem-solving abilities can determine secondary school students' achievement and retention in algebra in Enugu state.

Educators and researchers vary in their findings and opinions as to whether school location affects students' achievement and retention in secondary school mathematics or not, especially when they have different problem-solving abilities. Marua (2015) reported that urban school's students with high problem-solving abilities achieved higher and retained more in algebra than their rural schools' counterparts. On the other hand, Jumoh (2017) found that rural school's students with high problem-solving abilities achieved higher and retained more in algebra than their urban schools' counterparts. While Ahmadi (2019) found no significant difference in the mean algebra achievement and retention scores of students with high problem-solving abilities in both urban and rural schools.

Location in the context of this work is categorized into two viz; urban and rural. Undoubtedly, urbanization and rural development still pose great challenges to the government of the third world countries such as Nigeria. In the urban areas, barely all the basic infrastructures are inadequate in supply, hence, the struggle for and consequent over stretching of the available few. Therefore, in the school system, the story has remained that of over-crowded classrooms, insufficient and obsolete equipment, absenteeism occasioned by the use of school children for street trading even during the school hours, truancy on the part of the teachers as they hassle to survive the high cost of living, etc.

The emergence of urban congestion has worsened things and created more unmanageable social problems. The problems of urbanization are many and they constitute a big threat to teaching and learning in secondary schools this is because learning must take place in a

conducive environment. Unconducive teaching and learning environment occasioned by urbanization will definitely affect the secondary school learners (students). However, there is no definitive conclusion on whether these will affect the students' problem-solving abilities or not.

On the other hand, the situation in the rural areas is not in any way better. Although the rural locations may never be known for over-population, they have definitely suffered neglect and abandonment. Hence, schools in the rural areas are marked by dilapidated buildings, where they even exist at all. There is also lack of necessary equipments to enhance teaching and learning. Many rural schools have been deserted by teachers who usually seek transfers to urban areas. All these largely tell on the learners who are the most vulnerable. Once again, the extent to which this may affect the learners' problem-solving abilities is still contentious as many researchers have reported conflicting findings. Hence, a study of this nature is most timely as it also seeks to investigate whether school location can influence secondary school students' problem-solving abilities and their consequent achievement and retention in algebra.

Purpose of the study

The main purpose of this study was to ascertain whether or not Problem-Solving Abilities can determine secondary school students' achievement and retention in algebra in Enugu state. In specific terms, the study sought to determine

- i. Mean algebra achievement and retention scores of students with lateral thinking problem-solving ability in urban and rural secondary schools in Enugu state

Research Questions

The following research questions were raised and served as a guide for the study;

1. What are the mean algebra achievement scores of students with lateral thinking problem-solving ability in urban and rural secondary schools in Enugu state?

2. What are the mean algebra retention scores of students with lateral thinking problem-solving ability in urban and rural secondary schools in Enugu state?

Hypotheses

The following hypotheses are formulated for the study and tested at .05 level of significance:

1. The Mean algebra achievement scores of urban and rural secondary schools' students with lateral thinking problem-solving ability in Enugu state do not differ significantly
2. There is no significant difference between the Mean algebra retention scores of urban and rural secondary schools' students with lateral thinking problem-solving ability in Enugu state

Methodology

Design adopted for the study was descriptive survey design. Two research questions and two hypotheses guided the study. Area of the study was Enugu state of Nigeria. The population for the study consisted of 60,457 Senior Secondary School II (SSSII) students in Enugu state as at the time of the study. Sample for the study consisted of 2,967 Senior Secondary School II (SSSII) students in Enugu State. This sample was made up of 1,195 students from urban schools and 1,772 students from rural schools. Instruments for data collection were Lateral Thinking Problem-Solving Abilities Scale (PROSAS) and Algebra Retention Test (ART). A stability coefficient of .69 was obtained for ART. On the other hand, PROSA yielded a reliability coefficient of .73 using Cronbach's Alpha's method since the items were not dichotomously scored. Mean with standard deviation were used to answer the research questions while z-test statistic was used to test the hypotheses at 0.05 significant level.

Results

Research Question 1

What are the mean algebra achievement scores of students with lateral thinking problem-solving ability in urban and rural secondary schools in Enugu state?

Table 1: mean algebra achievement standard deviation scores of students with lateral thinking problem-solving ability in urban and rural secondary schools

Group	n	Achievement	
		Mean	SD
Urban	255	81.32	0.011
Rural	396	80.69	0.011

From table 1, the mean algebra achievement and standard deviation scores for urban school's students with lateral thinking problem-solving ability were 81.32 and 0.011 respectively. For rural school's students with lateral thinking problem-solving ability, their mean algebra achievement and standard deviation scores were 80.69 and 0.011 respectively.

From the results, urban and rural schools' students with lateral thinking problem-solving ability achieved very high in algebra. Also, their standard deviation scores were very low, indicating little or extreme values in their scores. Hence, the scores obtained clustered around the mean, indicating that they represent the real achievement of the students in algebra.

Research Question 2

What are the mean algebra retention scores of students with lateral thinking problem-solving ability in urban and rural secondary schools in Enugu state?

Table 2: mean algebra retention and standard deviation scores of students with lateral thinking problem-solving ability in urban and rural secondary schools

Group	n	Retention	
		Mean	SD
Urban	255	76.52	0.015
Rural	396	75.71	0.020

From table 2, the mean algebra retention and standard deviation scores were 76.52 and 0.015 respectively. For rural school's students with lateral thinking problem-solving ability, their mean algebra retention and standard deviation scores were 75.71 and 0.020 respectively.

From the results, urban and rural schools' students with lateral thinking problem-solving ability retained very high in algebra. Also, their standard deviation scores were very low, indicating little or extreme values in their scores. Hence, the scores obtained clustered around the mean, indicating that they represent the real retention of the students in algebra.

Hypotheses 5

The Mean algebra achievement scores of urban and rural secondary schools' students with lateral thinking problem-solving ability in Enugu state do not differ significantly

Table 10: z-test analyses for hypothesis 5

Group	n	\bar{x}	SD	Df	z-calculated	z-critical	Decision
Urban	1195	81.32	0.011	3021	0.76	1.96	Not significant (Do not reject null hypothesis)
Rural	1772	80.69	0.011				

From table 10, z-calculated of 0.76 is less than z-critical value of 1.96, therefore, hypothesis 5 is not rejected as stated. This shows that the mean algebra achievement scores of urban and rural secondary schools' students with lateral thinking problem-solving ability in Enugu state do not differ significantly

Hypotheses 6

There is no significant deference between the Mean algebra retention scores of urban and rural secondary schools' students with lateral thinking problem-solving ability in Enugu state

Table 11: z-test analyses for hypothesis 6

Group	n	\bar{x}	SD	Df	z-calculated	z-critical	Decision
Urban	1195	76.52	0.015	3021	0.73	1.96	Not significant (Do not reject null hypothesis)
Rural	1772	75.71	0.020				

From table 11, z-calculated of 0.73 is less than z-critical value of 1.96, therefore, hypothesis 6 is not rejected as stated. This indicates that there is no significant deference between the Mean algebra retention scores of urban and rural secondary schools' students with lateral thinking problem-solving ability in Enugu state

Summary of findings

Findings made in this study can be summarized thus;

1. Urban and rural schools' students with lateral thinking problem-solving ability achieved and retained very high in algebra.

Discussion of Findings

The major findings of this study were discussed and are hereby presented based on the major variables investigated in the work. To establish whether lateral thinking problem-solving ability could determine secondary school students' achievement and retention in algebra in Enugu state, research question three sort to ascertain the mean algebra achievement and retention scores of students with lateral thinking problem-solving ability in urban and rural schools. It was found in this study that urban and rural schools' student with lateral thinking problem-solving ability achieved and retained very high in algebra. This finding agrees with those of Samuelson (2015) Alaje (2017) and Irem (2018) who found in their separate studies that lateral thinking problem-solving ability determined students' achievement, interest and retention in mathematics. On the other hand, Gugi (2019) found the contrary and reported that lateral thinking problem-solving ability could not determine students' achievement, interest and retention in mathematics. Other studies based on problem-solving abilities generally, such as Marua (2015) and Harry (2019) also supported the findings made in this study while those of King (2015) and Ebinibe (2017) joined the group that found no significant influence of problem-solving abilities on students' achievement, interest and retention in mathematics.

This result is very apt because the process of thinking is synonymous with solving mathematics. Udabah and Nneji (2019) stated that solving mathematics is all about thinking, this is because every mathematics problems has something hidden which critical and reflective thinking can unveil. Lateral thinking specifically is a veritable tool in the hands of any mathematics student, especially those in secondary schools. This is so as at least a credit pass in secondary mathematics is required for progress in any field of the tertiary education sector. Lateral thinking application at secondary school level entails; trying to solve a problem, seeing a switch over from a familiar pattern to a new unexpected one, being more concerned with the true

value of ideas, thinking about a problem, having a major aim that there is a solution, formulating idea-generating tools, trying to break current thinking patterns, ensuring more values is received from idea generating output, generating treatment tools that promote consideration of real-world support and choosing an object at random associating it with the area you are thinking about. The finding of this study regarding lateral thinking problem solving ability is therefore encouraging.

Conclusions

Based on the findings of this study, it was concluded that lateral thinking problem solving ability can enhance secondary school students' achievement and retention in algebra irrespective of the location of their schools.

Recommendations

Consequent upon the findings of this study, the following recommendations were proffered;

1. Secondary school mathematics teachers should aim at inculcating lateral thinking problem solving ability in to their learners to help them achieve high and retain more in algebra.
2. Mathematics teachers in urban and rural schools should be encouraged to see the importance of lateral thinking problem-solving ability to their students.
3. Mathematics teachers in urban secondary schools should improve in their efforts to inculcate lateral thinking problem solving ability in their students so as to help the students meet up with their rural schools' counterparts.
4. School owners may wish to institute awards for mathematics teachers whose students exhibit satisfactory lateral thinking problem-solving abilities to encourage them.

References

- Abel, H. (2017). *The Psychologist*. Ikeja: Ibukm-oluwa press ltd.
- Ajom, G. & Agbenyi, O.N. (2019) Effect of lateral thinking ability on secondary school students' achievement and interest in mathematics. <http://www.interscience.com/abstract/608288/ABSTRACT>
- Amadi, N. (2019) Effect of brainstorming problem-solving ability on junior secondary school students' interest in mathematics in Okigwe Education zone of Imo state. <http://www.interscience.com/abstract/608288/ABSTRACT>
- Alaje, C.P. (2017) Relationship between secondary school students' lateral thinking ability and their achievement, interest and retention in algebra in Oyo state. www.mathscorner/tcl.com.
- Bell, U. & Thompson, K.L. (2018) Efficacy of reduction ability in promoting students' Achievement and Retention in Mathematics. <http://www.maths.prg.com./journal> 7(2). 715-728
- Bill, M.U (2017), Effect of problem-solving abilities affecting the interest and achievement of High School students in Trigonometry. www.mathscorner/tcl.com.
- Ditu, M. (2019) Relationship between secondary school students' divide and conquer problem-solving ability and their achievement, interest and retention in mathematics in Central District of Zambia. <http://www.interscience.com/abstract/608288/ABSTRACT>
- Ebinibe, S. (2017) Gender difference in achievement and retention among secondary school students with different problem-solving abilities in Uyo, Akwa-Ibom state. www.mathscorner/tcl.com.
- El-Amin, W. & Husseni, J (2018). Influence of problem-solving abilities on students' school location in Delta state. *Journal of early adolescence* 11(1) 56-95
- Federal Republic of Nigeria. (2014) *National Policy on Education*. Abuja: NERDC Press.
- Hanks, Q. (2017). Factors inhibiting Students' Self-Esteem. *Journal of Psychology*, 5(2), 290-315. <http://www.edu.org.com>.
- Harry, G. (2019) Problem-solving abilities as correlates of secondary school students' interest, achievement and retention in mathematics in Copenhagen. <http://www.interscience.com/abstract/608288/ABSTRACT>
- Hilton, H. (2020) Effect of reduction problem-solving ability on high school students' achievement in mathematics in Kentucky Educational District, USA. *Association for Promotion of Creative Education Journal*, 3(1). 35-42

- Inusa, U. (2018) Divide and conquer problem-solving ability as correlate of secondary school students' interest, achievement and retention in algebra in Zaria, Kaduna state. [http://www.maths.prg.com./journal 7\(2\). 35-50](http://www.maths.prg.com./journal 7(2). 35-50)
- Irem, E. (2018) Lateral thinking problem-solving ability as correlate of secondary school students' achievement, interest and retention in algebra in Afikpo Ebonyi state. [http://www.maths.prg.com./journal 7\(2\). 71-89](http://www.maths.prg.com./journal 7(2). 71-89)
- Iyang, C. (2016) *Fundamental of Research in Social Sciences*. Cape Town: Jeff Publications.
- Jacobs, R. (2018). *Educational Treaties*. www.amazonbooks.com
- Jumoh, S. (2017) Relationship between secondary school students' brainstorming ability and their achievement, interest and retention in mathematics in Delta state. www.mathscorner/tcl.com.
- King, O. (2015) Gender difference in achievement and retention among high school students with different problem-solving abilities in Dundee, Scotland. [http://www.Africanquarters.org/journal 2\(1\). 211-224](http://www.Africanquarters.org/journal 2(1). 211-224)
- Kofi, P.E. (2018) *Teaching College Algebra with reduction problem-solving abilities*. www.amazonbooks.com
- Kreks, M. (2016) *Research Methodology*. Benin City: Iguma Press Ltd.
- Kuntu, M & Pedro, C.N. (2019) Promoting Higher order mathematical thinking in secondary schools through Problem-solving ability.
- Kwame, H.Y and Damte, J. (2018) Furthering Application of Mathematical Principles among students of Public and private Secondary schools through use of divide and conquer ability. [http://www.maths.prg.com./journal 7\(2\). 355-370](http://www.maths.prg.com./journal 7(2). 355-370)
- Marshal, D. (2020) Relationship between high school students' divide and conquer ability and their achievement, interest and retention in mathematics in East London, UK. *Association for Promotion of Creative Education Journal*, 3(1). 155-167
- Marua, B. (2015) Problem-solving abilities as determinants of secondary school students' attitude, achievement and retention in mathematics in Gombe state. [http://www.Africanquarters.org/journal 2\(1\). 20-34](http://www.Africanquarters.org/journal 2(1). 20-34)
- Mayo, P. (2017). Attachment theory. <http://www.psychologicaltheories.com>
- Michelle, N. (2018). *The Caregivers Guide*. Jos: Pwajock press limited.
- Ojim, D.K & Nyim, S.P. (2018) A comparative study of the mean interest, achievement and retention scores of public and private schools' student taught algebra. [http://www.maths.prg.com./journal 7\(2\). 409-420](http://www.maths.prg.com./journal 7(2). 409-420)
- Okafor, H.J (2019) Improving Students' Achievement Interest and Retention in Algebra. <http://www.interscience.com/abstract/608288/ABSTRACT>

Peters, F. (2016) *Advanced Research Design*. Manchester: Fixing Press Inc.

Preesha, A. (2018) Relationship between secondary school students' reduction ability and their achievement, interest and retention in algebra in South West India. <http://www.maths.prg.com./journal> 7(2). 118-129

Samuelson, O. (2015) Relationship between high school students' lateral thinking problem-solving ability and their achievement, interest and retention in mathematics in Geneva Switzerland. <http://www.Africanquarters.org/journal> 2(1). 101-124

Tinks, I. (2017). *Raising the Ideal Kids*. New Delhi: Bandura publishing company Inc.

Tsui, P.F. (2016) School type: A correlate of students' interest, achievement and retention in Mathematics.

Tiz, U. (2019) Pedagogy in Secondary School Mathematic. <http://www.mathsedu.org.com>.

Viano, R. (2019) Effect of reduction problem-solving ability on secondary school students' interest in mathematics in Kenya. <http://www.interscience,.com/abstract/608288/ABSTRACT>

Yandev, M. (2019) Brainstorming problem-solving ability as correlate of secondary school students' interest, achievement and retention in algebra in Gboko Benue state [.http://www.interscience.com/abstract/608288/ABSTRACT](http://www.interscience.com/abstract/608288/ABSTRACT)

Zacky, O. & Young, N.C. (2018) Effect of geometry on students' achievement, interest and retention in mathematics.