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Effect Of Probem-Solving Method On Pupils' Academic Achievement In Mathematics

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ABSTRAK. This study investigated the effect of problem-solving method on pupils' academic achievement in mathematics in Ilorin South local government area of Kwara State. The study adopted a quasi-experimental design. The sample of the study consisted of 75 basic five (5) pupils. There were two experimental groups and two control groups; a stratified random sampling technique was used to select four schools (two public and two private) in Ilorin South local government area of Kwara state. The instrument used for the data collection was the Mathematics Achievement Test (MAT) which consists of 20 multiple choice items. Four research purposes and seven research hypotheses were formulated to guide the study. These hypotheses were tested at a 0.05 level of significance. Data collected for the study were statistically analyzed using mean and ANCOVA statistical tool. The results of the study revealed that problem-solving method had significant effects on the academic pupils in mathematics. Those taught using the problem-solving method (the experimental group) outscored those in the control group. Age and school type were not significant factors. The interaction effect between the treatment (problem-solving method) and the two variables (age and school type) was not statistically significant. Based on these findings, it was recommended that basic school mathematics teachers should adopt the use of problem-solving method to teach mathematics, especially at the middle and upper basic levels. This will enhance the academic achievement of pupils and enable them to mathematize some of their daily problems.

Kata kunci: Mathematics, Problem-solving, Mathematics, Primary School

PENDAHULUAN

The importance of education in the development of any country cannot be overemphasized. It goes beyond just teaching and increasing cognitive abilities. Education has diverse definitions, as different people define it based on their perspectives. According to Kumar

& Ahmad (2007), three concepts describe education in general: knowledge, subject, and process. Education can be defined as a purposeful or unconscious psychological and sociological phenomenon which helps develop each individual to the fullest extent and maximizes the development of society in a way that both individuals and society enjoy maximum happiness and prosperity (Kumar & Ahmad, 2007). In the words of Idris et al.(2012), a country's educational system is integral to the development of its economy and society. It provides knowledge and skills to the general population, shaping the younger generation's personality.

Consequently, providing everyone with quality education is a national priority for many countries. According to the National Policy on Education (FRN, 2013), one of the goals of education in Nigeria is the development of appropriate skills, mental, physical, and social abilities and competencies to empower the individual to live and contribute positively to society. The researcher further stated that all the processes that focus on the child's overall development are regarded as education. Education is not restricted to the school only. However, formal education starts at school, where learners are taught at various levels: basic, post-basic, and tertiary.

Education given to children between 0-15 years is regarded as basic education. It encompasses Early Child Care and Development Education (0—4 years) and 10 years of formal schooling. Post-Basic Education is given after the successful completion of 10 years of formal basic education, while tertiary education is given after post-basic education in a university, polytechnic, mono-technic, college of education, and other specialized institutions established for tertiary education (National Policy on Education, FRN, 2013). Primary education, a subset of basic education, is a compulsory, free, and universal education given to children aged 6 to 12. Its first two objectives involve inculcating numeracy and literacy skills and laying a basis for sound and reflective thinking. The primary education curriculum includes English Studies, One Nigerian Language, Mathematics, Basic Science and Technology, Religion and National Values, Cultural and Creative Arts, Arabic (optional), Pre-vocational Studies, and French Language (National Policy on Education, FRN, 2013).

As observed in the National Policy on Education (FRN, 2013), mathematics is a core and compulsory subject at the basic education level, which is attributed to its relevance to our daily activities. Mathematics has no generally accepted definition. Mathematics concerns numbers, shapes, change, and comparison (Ebrahim, 2009). Khait (2005) viewed Mathematics as a language activity characterized by pairing words with precise meanings. Yadav (2017) concluded in his research that studying assumptions, their characteristics, and applications is central to mathematics. Mann (2006) opined that the essence of Mathematics as a school subject is creativity and talent development, which requires creative applications in the exploration of mathematics problems. In the same vein, Peter (2012) proposed that mathematics educators are responsible for promoting critical thinking skills in their students. They should teach them to understand concepts and not simply memorize information. Mathematics literacy is important in both schools and daily life. It is as necessary as reading or writing proficiency to cope with a changing world. It helps one to interpret data, solve day-to-day problems, solve numerical and graphical situations, and communicate using mathematics (Ojose, 2011). Given the importance of mathematics, especially in solving day-to-day problems, mathematics teachers must use effective methodologies in teaching mathematics to pupils.

Educators and researchers are looking for new methods in teaching mathematics education to help students develop their problem-solving abilities. If a person is to succeed tomorrow, he needs the right training today. Specifically, all curriculums on teaching and learning mathematics agree that teaching mathematics aims to open students up to different types of mathematical thinking and expand their problem-solving abilities (Guvercin & Verbovskiy, 2014). Therefore, teachers need to change from the conventional method to a more student-centred method which the problem-solving method is one of.

Problem-solving is an instructional method that makes pupils active rather than passive in their learning process. To Kuzle (2015), Problem-solving as an instructional method can help build mathematical knowledge, solve problems that arise in mathematics, and to apply and adapt different problem-solving strategies. In addition, it can be used for monitoring and reflecting on one's mathematical problem-solving processes. Teaching mathematical problem-solving is a great way to provide students with opportunities to develop their 21st-century skills and gain unprecedented contextual knowledge (Szabo et al., 2020.). Problem-solving tops the Process Standards for School Mathematics list, and it is considered the heart of mathematics education NCTM (2000). According to Samuel (2018), in the problem-solving method, a problem is thrown open to the students to find solution-new values within a specific period. It, therefore, grants them the opportunity to find out. They consult textbooks, notebooks, resource persons, or the internet to get solutions.

Academic achievement is the current level of a student's learning. Measuring academic achievement provides key information about pupils' mastery of standards. Finding schools that most benefit from support can be started by identifying those where many students are having difficulty passing state exams (Minnesota Department of Education, 2017). Academic achievement is important for the successful development of young people in society. By doing well in school, students are better prepared to transition into adulthood and achieve greater success in their future careers. Academic success is important for the many positive outcomes it leads to (Regier, 2011).

Several studies have been carried out to determine the effect of problem-solving on academic achievement in mathematics at various levels of education. Naz & Mumtaz (2020) examined the relationship between the problem-solving approach and eighth-grade students' academic performance. They found that the new style of teaching (problem-solving approach) is more effective than the old one (conventional techniques), improving student achievements. Ali et al. (2010) conducted a study on the effects of using problem-solving methods in teaching mathematics to students. They concluded that when students were taught through these methods, their academic achievement outpaced those taught through more traditional methods. Perveen (2010) explored a study on the effect of a problem-solving approach on the academic achievement of students in Mathematics at the secondary level. The study results suggest that when secondary-level students learn mathematical concepts through problem-solving, they retain them better than if presented in an expository sequence. Khatimah & Sugiman (2019) also examined the effect of a problem-solving approach on mathematics problem-solving ability in fifth grade. It was concluded that the effect of the problem-solving approach on mathematics problem-solving ability in class V was significant and positive.

Various research has been carried out to show how age and school type influence academic achievement. The study of Ebenuwa-Okoh (2010) revealed, among others, that age is not a significant predictor of academic performance. The result of the study by Voyles (2011) found a significant relationship between the age of students and their academic success in mathematics. Yusuf & Adigun (2010) revealed in their study that school type had no significant influence on students' academic performance. Lubienski &

Lubienski (2006) examined the effects of school type across private, public, and charter schools. They found a reversal of the private school effect. Public schools outperformed charter and private schools.

Based on the controversial findings on the influence of age and school type on pupils' academic achievement, this research will include age and school type as possible moderators in the academic achievement of pupils in mathematics using the problem-solving method. This will be done by investigating the effect of problem-solving methods on pupils' academic achievement in mathematics in Ilorin South Local Government Area of Kwara State.

Observations from several works of literature have proven problem-solving methods to enhance academic performance across various subjects effectively. Its effect on mathematics achievement is yet to be duly established. Also, various researchers have worked on the effect of problem-solving across different locales. To the best of the researcher's knowledge, there has been no study on the effect of problem-solving methods on the academic achievement of pupils in mathematics in Ilorin South Local Government Area of Kwara State. Therefore, the researcher intends to fill these gaps by establishing the effect of problem-solving methods on pupils' academic achievement in mathematics in Ilorin South Local Government Area of Kwara State.

METODOLOGI

The research design employed in this study is quasi-experimental. There was no randomization of the pupils because they were in their intact classes. The design is found suitable and appropriate for establishing a possible cause-and-effect relationship. It is a non-equivalent control group design. The population for this research were all primary school pupils in Ilorin South Local Government Area of Kwara State. The target population were all the Primary 5 (Basic 5) pupils. A stratified random sampling technique was adopted. First, all the schools were classified into two strata (Public and Private). One private school, as well as one public school, were selected randomly as the experimental groups. Two schools were also randomly selected after the stratification as the control group (i.e. one private and one public).

This study employed two research instruments titled Problem-Solving Instructional Package for Mathematics (PIPM) and Mathematics Achievement Test (MAT). Problem-Solving Instructional Package for Mathematics (PIPM) consist of lesson plans in which the roles of the teacher and pupils participating in the lessons are clearly stated; it is also made up of four lesson plans based on the problem-solving method for the experimental groups. At the same time, Mathematics Achievement Test (MAT) (pre-test and post-test) consisted of twenty multiple-choice test items on the instructional content (mathematics). The face and content validity of the instrument was carried out by three lecturers from the Department of Adult and Primary Education, University of Ilorin and Primary School mathematics teachers.

MAT was further subjected to a reliability test by administering the instruments twice on thirty primary five pupils who were not part of the study; Cronbach Alpha was used to calculate the reliability coefficient, and a reliability coefficient of 0.716 was achieved.

TEMUAN DAN DISKUSI

Hypothesis One: There is no significant main effect of treatment on pupils' academic achievement in mathematics.

Table 1: *Analysis of Covariance (ANCOVA) of the significant main effect of treatment on pupils' academic achievement in mathematics*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Decision
Corrected Model	830.572[a]	2	415.286	56.186	.000	
Intercept	472.247	1	472.247	63.892	.000	
Pretest	78.398	1	78.398	10.607	.002	
Treatment	487.063	1	487.063	65.897	.000	Rejected
Error	532.174	72	7.391			
Total	8122.000	75				
Corrected Total	1362.747	74				

a. R Squared = .609 (Adjusted R Squared = .599)

The ANCOVA test output in Table 3 reveals that there was a significant effect of the main treatment (problem-solving method) on pupils' academic achievement in mathematics. ($F_{(1, 65)}$=65.897; p<.000). Hence, hypothesis one was rejected as the p-value of .000 was less than the significant level of 0.05.

Hypothesis Two: There is no significant interaction effect of treatment and age on pupils' academic achievement in mathematics.

Table 2: *Analysis of Covariance (ANCOVA) of the significant interaction effect of treatment and age on pupils' academic achievement in mathematics.*

Source	Type iii sum of squares	Df	Mean square	F	Sig.	Decision
Corrected model	841.652[a]	4	210.413	28.265	.000	
Intercept	455.174	1	455.174	61.145	.000	
Pretest	75.322	1	75.322	10.118	.002	
Treatment	467.158	1	467.158	62.755	.000	Not Rejected
Age	.053	1	.053	.007	.933	
Treatment * Age	11.060	1	11.060	1.486	.227	
Error	521.094	70	7.444			
Total	8122.000	75				
Corrected total	1362.747	74				

A. R squared = .618 (adjusted r squared = .596)

The ANCOVA output in Table 2 indicates that there was no significant interaction effect of treatment and age on pupils' academic achievement in mathematics. ($F_{(1,34)}$=1.486; p=0.227), thus, hypothesis four is not rejected. This is because the p-value 0.227 was greater than 0.05 alpha level. It, therefore, implies that the treatment (problem-solving method) has a direct effect on the academic achievement of pupils in mathematics.

Hypothesis Three: There is no significant interaction effect of treatment and school type on pupils' academic achievement in mathematics.

Table 3: *Analysis of Covariance (ANCOVA) of the significant interaction effect of treatment and school type on pupils' academic achievement in mathematics.*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Decision
Corrected Model	894.074[a]	4	223.519	33.384	.000	
Intercept	459.639	1	459.639	68.651	.000	
Pretest	79.061	1	79.061	11.808	.001	
Treatment	230.088	1	230.088	34.365	.000	
School Type	63.488	1	63.488	9.482	.003	
Treatment*school Type	.480	1	.480	.072	.790	Not Rejected
Error	468.672	70	6.695			
Total	8122.000	75				
Corrected Total	1362.747	74				

a. R Squared = .656 (Adjusted R Squared = .636)

ANCOVA output in Table 3 indicates that there was no significant interaction effect of treatment and school type on pupils' academic achievement in mathematics ($F_{(1,34)}$=0.072; p=0.790), thus, hypothesis five is not rejected. This is because the p-value 0.790 was greater than 0.05 alpha level. This implies that the treatment (problem-solving method) has a direct effect on the achievement of pupils in mathematics.

Hypothesis Four: There is no significant interaction effect of treatment, age, and school type on

Table 4: *Analysis of Covariance (ANCOVA) of the significant interaction effect of treatment, age, and school type on pupils' academic achievement in mathematics.*

Source	Type III sum of squares	Df	Mean square	F	Sig.	Decision
Corrected model	914.071[a]	7	130.582	19.500	.000	
Intercept	407.404	1	407.404	60.837	.000	
Pretest	75.159	1	75.159	11.223	.001	
School Type*Age*Treatment	.000	0	23.19	41.110	0.380	Not Rejected
Error	448.676	67	6.697			
Total	8122.000	75				
Corrected total	1362.747	74				

A. R squared = .671 (adjusted r squared = .636)
pupils' academic achievement in mathematics.

The ANCOVA output in Table 4 shows that there was no significant interaction effect of treatment, age, and school type on pupils' academic achievement in mathematics ($F_{(1,34)}$=41.110; p=0.380), hence, hypothesis seven is not rejected. This is because the p-value 0.380 was greater than 0.05 alpha level. This means that the pupils' age and school type had no or minimal effect on the treatment (problem-solving method).

Discussion of Findings

This research is carried out to determine the effect of problem-solving methods on pupils' academic achievement in mathematics in Ilorin South local government area of Kwara state. To achieve this, seven research purposes and hypotheses were formulated.

The finding in Table 1 revealed a significant main effect of treatment on pupils' academic achievement in mathematics. The experimental groups (problem-solving) achieved significantly higher than the control groups. Therefore, null hypothesis 1 was rejected. This finding relates to that of Perveen (2010), who researched the effect of a problem-solving approach on the

academic achievement of students in Mathematics at the secondary school level. The result of the research showed that the experimental group outscored the control group significantly on the post-test. Also, Khatimah and Sugiman (2019), Guvercin & Verbovskiy (2014), and Naz and Akhter (2020) found that problem-solving has a positive impact on the learners' academic achievement in mathematics. Their finding is related to that of Nwoke (2015), who recommended that mathematics teachers apply an appropriate problem-solving approach to enhance students' achievement in the subject. These findings also agree with that of Abdu-Raheem (2011) and Ishaku (2015), who experimented with the problem-solving method in their studies using various subjects and discovered that the problem-solving method positively impacts pupils' academic achievement.

Following the statistical analysis in Table 2, it was found that there was no significant interaction effect of treatment and age on pupils' academic achievement in mathematics. It, therefore, implies that the treatment (problem-solving method) directly affects the academic achievement of pupils in mathematics. Hence, the null hypothesis 4 was not rejected. This finding supports the finding of Ali et al. (2010), whose finding also showed that the problem-solving method directly affects the academic achievement of learners in mathematics. On the other hand, it negates the findings of Khaimah and Sugiman (2019), which showed a significant interaction effect of age on pupils' academic achievement in mathematics.

The result in Table 3 revealed no significant interaction effect of treatment and school type on pupils' academic achievement in mathematics. This, therefore, implies that the treatment (problem-solving method) directly affects the academic achievement of pupils in mathematics. Hence, the null hypothesis 5 was not rejected. This agrees with the findings of Osuafor and Orji (2017), who found no significant interaction effect of problem-solving and their moderating variable.

Table 4 revealed no significant interaction effect of treatment, age, and school type on pupils' academic achievement in mathematics. This means that the pupils' age and school type had no or minimal effect on the treatment (problem-solving method). Hence, the null hypothesis 4 was not rejected. This finding partially supports the findings of Sungur and Bal (2016), which revealed no significant effect of age on problem-solving. However, there was a significant effect of school type and problem-solving skills on the performance of the pupils.

KESIMPULAN

A. Kesimpulan

Based on the data analysis and results of this study, it was concluded that the problem-solving method could potentially improve pupils' academic achievement in mathematics in the Ilorin South local government area of Kwara state. This could be because the problem-solving method makes the pupil an active rather than passive participant in learning. Thereby encouraging collaboration and brainstorming between the teacher and the pupils. Those in private schools do not perform significantly better than those in public schools. Likewise, there was no significant discrepancy in the score of the pupils based on age. This implies that school type and age are not significant variables that influence pupils' academic achievement in mathematics. Lastly, there was no significant interaction effect between the treatment (problem-solving method) and the two variables (age and school type).

B. Saran

Based on the findings and conclusions of this study the following recommendations are made by the researcher:

1. School administrators and education agencies should encourage basic school mathematics teachers to use problem-solving method to teach mathematics, especially at the middle and upper basic levels. This will enhance the academic achievement of pupils and enable them to mathematize some of their daily problems.
2. Seminars and in-service programs should be organized for mathematics teachers to equip them with more knowledge on the use of problem-solving method.
3. Stakeholders in education should provide relevant instructional materials for efficient and effective utilization of problem-solving method..

REFERENSI

Abdu-Raheem, B. O. (2011). Effects Of Problem-Solving Method On Secondary School Students Achievement And Retention In Social Studies, In Ekiti State, Nigeria. *Journal of International Education Research (JIER), 8*(1), 19–26. https://doi.org/10.19030/jier.v8i1.6692

Ali, R., Hukamdad, D., Akhter, A., & Khan, A. (2010). Effect of Using Problem Solving Method in Teaching Mathematics on the Achievement of Mathematics Students. *Asian Social Science*, *6*(2), 67–72. https://doi.org/10.5539/ass.v6n2p67

Ebenuwa-Okoh, E. E. (2010). Influence of Age, Financial Status, and Gender on Academic Performance among Undergraduates. *Journal of Psychology*, *1*(2), 99–103. https://doi.org/10.1080/09764224.2010.11885451

Ebrahim, A. (2009). What Is Mathematics ? *Retrieved February 17, 2022 from Http://Www.Mathscitech.Org/Articles*.

Federal Republic of Nigeria National Policy on Education 2013 (p. 56).

Idris, F., Hassan, Z., Ya'acob, A., Gill, S. K., & Awal, N. A. M. (2012). The Role of Education in Shaping Youth's National Identity. *Procedia - Social and Behavioral Sciences*, *59*, 443–450. https://doi.org/10.1016/j.sbspro.2012.09.299

Ishaku, C. (2015). Effects Of Problem-Solving And Discussion Teaching Methods On Students ' Achievement In Genetics. *Unpublished Masters Thesis, University of Nigeria*.

Khait, A. (2005). The definition of mathematics: Philosophical and pedagogical aspects. *Science and Education*, *14*(2), 137–159. https://doi.org/10.1007/s11191-005-0029-9

Khatimah, H., & Sugiman, S. (2019). The effect of problem solving approach to mathematics problem solving ability in fifth grade. *Journal of Physics: Conference Series*, *1157*(4). https://doi.org/10.1088/1742-6596/1157/4/042104

Kumar, S., & Ahmad, -Sajjad. (2007). Meaning, Aims and Process of Education. *Discipline Course Education in Contemporary Social Context*, 1–16.

Kuzle, A. (2015). Problem solving as an instructional method: The use of open problems in technology problem solving instruction. *LUMAT: International Journal on Math, Science and Technology Education*, *3*(1), 69-86.

Lubienski, C., & Lubienski, S. (2006). Charter, Private, Public Schools and Academic Achievement: New evidence from NAEP Mathematics Data 1. *Public Choice*, *September 2010*, 1–48. http://datacenter.spps.org/sites/2259653e-ffb3-45ba-8fd6-

Mann, E. L. (2006). Creativity: The essence of mathematics. *Journal for the Education of the Gifted*, *30*(2), 236–260. https://doi.org/10.4219/jeg-2006-264

Minnesota Department of Education. (2017). What is Academic Achievement? *Department of Education*, 1–2.

National Council of Teachers of Mathematics, (NCTM). (2000). *Principles and Standards for School Mathematics* (Vol. 29, Issue 5). https://doi.org/10.5951/at.29.5.0059

Naz, B., & Akhter, M. (2020). Effect of Problem Solving Approach on Achievement of Eighth Grade Students in Mathematics. *Orient Research Journal of Social Sciences*,

5(2), 68–77.

Nigerian Educational Reseach and Development Council (NERDC). (2013).

Nwoke, B. I. (2015). Impact of Problem Solving Approach on Senior Secondary School Students' Achievement in Mathematics Nwoke. *Journal of Research in Education and Society*, *6*(1), 27–33.

Ojose, B. (2011). Mathematics Literacy : Are We Able To Put The Mathematics We Learn Into Everyday Use ? *Journal of Mathematics Education*, *4*(1), 89–100.

Osuafor, A. M., & Orji, C. J. (2017). Effect of students' background knowledge of mathematics on senior secondary school students' achievement in physics. *Elixir International Journal*, *107*(6), 47250–47253. http://www.ijsre.com/assets/vol.%2C-10(1)-adegoke.pdf

Perveen, K. (2010). Effect Of The Problem-Solving Approach On Academic Achievement Of Students In Mathematics At The Secondary Level. *Contemporary Issues in Education Research (CIER)*, *3*(3), 9. https://doi.org/10.19030/cier.v3i3.181

Regier, J. (2011). *Why is Academic Success Important ? By Janelle Regier*.

Samuel, A. W. (2018). *Essential Teaching Methods For Education And Behavioural Sciences* (Issue January). Sabcos Printers & Publishers, Rivers State.

Sungur, G., & Bal, N. (2016). Analysis of 4th grade students' problem solving skills in terms of several variables. *Journal of Education and Practice*, *7*(14), 1–9. www.iiste.org

Szabo, Z. K., Körtesi, P., Guncaga, J., Szabo, D., & Neag, R. (2020). Examples of problem-solving strategies in mathematics education supporting the sustainability of 21st-century skills. *Sustainability (Switzerland)*, *12*(23), 1–28. https://doi.org/10.3390/su122310113

Voyles, M. . (2011). Student academic success as related to student age and gender. *Unpublished Masters Thesis*, *2*(1), 111.

Yadav, D. K. (2017). © Associated Asia Research Foundation (AARF) Publication. *International Research Journal of Mathemathics, Engineering and IT*, *4*(1), 34–42.

Yusuf, M. A., & Adigun, J. T. (2010). The Influence of School Sex, Location and Type on Students' Academic Performance. *International Journal of Educational Sciences*, *2*(2), 81–85. https://doi.org/10.1080/09751122.2010.11889992