

THE EFFECT OF HEURISTIC STRATEGY IN THE ACADEMIC PERFORMANCE OF SECONDARY SCHOOL STUDENTS IN MATHEMATICS; A STRATEGY FOR EDUCATION DEVELOPMENT AND SOCIAL PEDAGOGY

Daramola, Kayode Rapheal Ph.D.

Department of Science Education, Faculty of Education,
Adeyemi Federal University of Education, Ondo, Nigeria

daramolakayode25@yahoo.com,

daramolakr@afued.edu.ng

ORCID: [0000-0002-1580-5210](https://orcid.org/0000-0002-1580-5210)

&

Ayegbusi, Olubu Ojo

Department of Science Education, Faculty of Education,
Adeyemi Federal University of Education, Ondo, Nigeria

ayegbusioo@afued.edu.ng

Abstract

This study investigated the Effect of Heuristic strategy in the academic performance of secondary school students in Mathematics: A Panacea for Education Development and Social Pedagogy in Ondo State, Nigeria. The study adopted quasi-experimental of pre-test, post-test, control group design. The population comprised all Senior Secondary Schools two (SSS II) students in public Senior Secondary Schools in Ondo State. The sample was made up of 108 Mathematics students in their intact classes in four selected secondary schools in two local governments' area. Simple random sampling was used to select the two schools; the students were selected using random sampling technique. Mathematics Achievement Test (MAT) was used to generate data for the study. The face and content validity of the instrument was ensured by experienced secondary school Mathematics teachers, experts in the Department of Test and Measurement. The reliability of the instrument was determined through a test- retest method which yielded reliability co-efficient of 0.86. Data were analyzed using mean, standard deviation and t-test analysis. The findings indicated that Heuristic teaching strategy was more effective than the one without Heuristic in enhancing student's performance in Mathematics. The finding equally indicated that there was significant interaction effect of gender and strategies on students' performance in Mathematics. Therefore the study recommends among others, that Mathematics teachers should employ the use of Heuristic teaching strategy in the teaching Mathematics in secondary schools.

Keywords: Academic Performance, Gender, Heuristic Strategy, Mathematics, Social Pedagogy

Introduction

Mathematics occupies a central position in contemporary society. It provides the fundamental foundation for economic knowledge and plays a crucial role in the physical sciences, technology, business, finance, and many other fields. Indeed, mathematics underpins most scientific and industrial advancements.

However, many students who are expected to excel and eventually lead in these areas encounter numerous challenges and harsh realities. These difficulties include paying attention to teachers, following appropriate procedures in solving mathematical problems, adhering to rules, avoiding classroom distractions, maintaining positive relationships with peers, and managing their emotions effectively. Such issues pose significant challenges to individual development, particularly in many developing nations.

Many factors have been identified by researchers as the causes of the low mathematics performance among secondary school students. These include inadequate facilities in the school, inadequate qualified teachers, poor attitude towards the subject by the students and the teachers, anxiety and many more. Mathematics as a subject virtually affects all aspects of life and it is a basic requirement for admission for nearly all the courses of study in tertiary and useful in social pedagogy. The utilization of letter, characters and images (either blended or in an unexpected way) in depicting and marking charts likewise will in general get trouble the comprehension of the subject. All these appear to have added to student's powerlessness to get Mathematics and subsequently lead to lackluster showing in the subject. The control of images using learned expressions like; taking out sections, appears to make problems for students in learning Mathematics. Mathematics problems with or without teachers management seems to have brought about problem of low scholastic performance in Mathematics among students, the investigation look to decide if the utilization of Heuristic and social pedagogy.

The main purpose of this study is to investigate the effect of the heuristic teaching strategy on the academic performance of secondary school students in Mathematics as a means of promoting educational development and social pedagogy.

Specifically, the study seeks to:

- determine the effect of heuristic teaching strategy on students' academic performance in Mathematics.
- determine the influence of gender on students' academic performance when taught using heuristic strategy.

The following research questions were raised to guide the study:

1. What is the effect of heuristic teaching strategy on secondary school students' academic performance in Mathematics?
2. Does gender influence the academic performance of students taught using heuristic strategy?

The hypotheses are;

1. There is no significant difference in the academic performance of students taught Mathematics using heuristic strategy and those taught using conventional teaching methods.
2. There is no significant gender difference in the academic performance of students taught using heuristic strategy.

Literature Review

Social pedagogy has been described as education in its broadest sense, emphasizing holistic approaches to learners' experiential development. It focuses on the continuous creation of opportunities for learning through meaningful interaction with students, where activities are relationship-centered and interconnected. The concept is often associated with Jean-Jacques Rousseau in 1762, while the term "social pedagogy" was first used by the German educationist Karl Mager in 1844.

For any nation to develop socially, politically, economically and technologically, such nation should develop more successful youth in technology, if a sound basic technology will be achieved Mathematics must be basis. Also, any student who did not take Mathematics as important subject, such students will not be able to go far in any Mathematics related courses. Daramola (2016). Mathematics Education is needed to expedite technological advancement. (Kolawole and Olofin 2017) submitted that, Mathematics is the heart of a nation and as a device that facilitate the learning of all subjects in social pedagogy. There is absolute confidence that Mathematics performs effective function in the efficient improvement in students learning. In the school curriculum, Mathematics is normally identified as the foundation of many topics. Mathematics is the gate and the key to developing social pedagogy as everybody needs it. Few studies as Uka (2015) have shown that a positive relationship exists between problem solving and educational development and social pedagogy. Mathematics is a part to everything about life (Eze, 2009). Mathematics has been a compulsory core subject due to its indispensability in all facet of life. The emphasis of the mathematics curricula is on the value in social skills. Hence, it is clear that the general objectives of education coincide with the objectives of Mathematics education. Hence, the stated objectives cannot be achieved.

Heuristic strategy is a pure discovery method of learning Mathematics experimentally, which is independent of the teacher. It is a hand-on interactive approach to learning. Also it is an individualized type of students' centered teaching-learning method that incorporates inquiry method.

A way to deal with problem solving that utilizes a viable technique or different easy routes to create arrangements that may not be ideal yet are adequate given a restricted time period or cutoff time. The strategy expects students to tackle various problems tentatively. A few investigations have utilized heuristic cycles. Owolabi, and Oginni (2013) helped his auxiliary

school students take care of math problem solving questions utilizing heuristic guidance. Wilson (2010) examined the variety among general and assignment explicit heuristics.

In this heuristic methodology in creating psychological deduction towards the advancement of numerical reasoning, problem solving as a device was utilized to evoke the reasoning cycle where students took part in an assortment of activities, problems, and examinations as they investigated mathematics ideas from a problem-solving viewpoint in an intuitive way through different heuristics. The accentuation was on investigation of different mathematics settings to learn mathematics, to tackle problems, problem expansions, and to convey numerical showings. Kantowski's (2012) guarantee that his auxiliary school students take care of numerical problems utilizing heuristic guidelines in an entrancing manner. He proceeded to say that utilizing a heuristic way to deal with solving Mathematics questions expanded students' performance significantly and assisted them with developing problem-solving abilities. Gender equity problem is where new attentions are focusing upon. It is the contention of many Mathematics educators that education generally is skewed in favour of male as against female. Allen (2007); and Chung and Park (2015), who reported that gender is not significant influencing factor in students' performance. According to Kolawole (2012), gender issues and achievements were examined by Nigerian high school students in the field of mathematical computation, males in schools for boys did not score much better than females in schools of females. Also, Kolawole found no substantial association impact of care and gender on student success when looking at particular effects of gender. Gender has effects on students' performance in Mathematics. This is in accordance with the discoveries of Kolawole (2013), who found that KPS is not gender biased.

This may indicate that one gender is not more intelligent than the other, and that if given the same opportunity, each would demonstrate their abilities. Male students are more likely perform better than female students,

Methodology

The research employed a quasi-experimental design with pre-test, post-test, and two classes. One experimental and one control groups were included in the research. Participants in the experimental groups were taught the Heuristic teaching strategy, while those in the control group were taught the traditional approach. The design's schematic pattern is shown below:

$E_1: 0_1 \quad X \quad 0_2$ - Experimental group

$C: \quad 0_3 \quad X_C \quad 0_4$ - Control group

Where

$0_1, \quad 0_3, =$ Observations before treatment

$0_2, \quad 0_4, =$ Observations after treatment

X - Treatment using Heuristic

C - Conventional Method

The targeted population for this study consisted of all the Senior Secondary Schools two (S.S.S.II) students in public schools in Ondo State. There are 1,021 SSS 2 Students in the target local government area in the state, as obtained from the Ministry of Education, Examination unit, 2024/2025 session.

The sample for the study consisted of 108 students in their intact classes in four selected secondary schools in Ondo East Local Government area of Ondo State which take 10.6 % of the population. Simple random sampling was used in the selection of one local government areas from central senatorial district in Ondo state. The second stage entailed the use of stratified random sampling technique to select four schools from the local government selected. While the third stage involved students in their intact classes in four selected secondary schools in Ondo East local government area of Ondo State. Research instrument used for this study was Mathematics Performance Test (MPT). The face and content validity of the instruments was done by the experts in Mathematics departments and it was also presented to Test Measurement and Evaluation experts. While the reliability was determined by using test re-test method and analyzed by using Pearson's Product Moment Correlation Analysis, which yielded 0.86 reliability coefficients. The research assistants were employed to administer the instrument. The data collected was analyzed inferentially using analysis of covariance (ANCOVA) all at 0.05 level of significance.

Results and Discussion

The result of the data collected through pre-test and post-test were subjected descriptive statistics and inferential statistics of t-test analysis.

Research Question One: What is the effect of heuristic teaching strategy on secondary school students' academic performance in Mathematics?

Table 1: Summary of Mean and Standard Deviation on Performance of Experimental and Control groups

Groups	N	Mean	Std. Dev	Std, Error	Mean diff
Heuristic	52	53.85	7.053	0.978	12.98
Conventional	56	40.84	6.859	0.917	

From table 1, the mean performance and standard deviation of experimental and controls groups were 53.85, 7.053 and 40.84, 6.859 respectively, with mean difference of 12.98 in favour of experimental group which is Heuristic teaching strategy. Hence, it can therefore be assumed that students from experimental group performed better than students from control group.

Research Question Two: Does gender influence the academic performance of students taught using heuristic strategy?

Table 2: Summary of descriptive statistics on Performance of Male and Female in experimental group

Gender	N	Mean	Std. Dev	Std. Error	Mean diff.
Male	29	55.14	7.772	1.443	2.97
Female	23	52.17	5.773	1.204	

Table 2 revealed that the male had a mean score of 55.14 with standard deviation of 7.772 while female students had a mean of 52.17 and standard deviation of 5.773. This result shows that the male students mean performance score was slightly better than of their female counterparts.

Hypotheses one: There is no significant difference in the academic performance of students taught Mathematics using heuristic strategy and those taught using conventional teaching methods.

Table 3: t-test analysis on performance of students in experimental and control groups

Groups	N	Mean	Std. Dev	Std. error	Df	t _{cal}	t _{crit}	P-value
Heuristic	52	53.82	7.053	0.978	106	9.699	1.96	0.001
Conventional	56	40.84	6.859	0.917				

In table 3 above, since the calculated t-value (9.699) is greater than the critical value (1.96) and the p-value (0.001) is less than 0.05, the null hypothesis is rejected.

There is a statistically significant difference in the academic performance of students taught using the Heuristic method and those taught using the Conventional method. Students taught using the Heuristic method performed significantly better than those taught using the Conventional method. The Heuristic teaching method is more effective in improving students' academic performance compared to the Conventional teaching method.

This implies that the students taught Mathematics using Heuristic teaching strategy performed significantly better than the students taught Mathematics using Conventional teaching strategy.

Hypothesis Two: There is no significant gender difference in the academic performance of students taught using heuristic strategy.

Table 4: t-test analysis on Performance of Male and Female students in experimental groups

Gender	N	Man	Std. Dev	Std. Error	Df	t _{cal}	t _{crit}	p-value
Male	29	45.00	8.485	1.443	50	1.52	1.96	0.134
Female	23	45.91	7.904	1.204				

From the table 4, since the calculated t-value (1.52) is less than the critical value (1.96) and the p-value (0.134) is greater than 0.05, the null hypothesis is not rejected.

There is no statistically significant difference in the academic performance of male and female students in the experimental group. Although female students had a slightly higher mean score (45.91) than male students (45.00), the difference is not statistically significant.

The experimental teaching method appears to be gender-friendly, as it benefits male and female students equally.

Discussion

Findings from the study as a Panacea for Education Development and Social Pedagogy revealed that there is significant effect on the students' performance in the Mathematics when exposed to Heuristic teaching strategy. The experimental group obtained higher scores in Mathematics compared to those who were taught using conventional method. The significant difference in favour of the Heuristic teaching strategy suggests effectiveness of the method when taught with Mathematics. This backs up Daramola (2016) guarantee that his auxiliary school students take care of numerical problems utilizing heuristic guidelines in an entrancing manner. He proceeded to say that utilizing a heuristic way to deal with solving Mathematics questions expanded students' performance significantly and assisted them with developing problem-solving abilities.

The finding of this study also shed some light on the effect of Heuristic teaching strategy on gender; the findings revealed that the interaction effect between Heuristic teaching strategy and gender was not significant on students' performance. This finding agrees with earlier studies of Allen (2007); and Chung and Park (2015), who reported that gender is not significant influencing factor in students' performance. Gender has effects on students' performance in Mathematics. This is in accordance with the discoveries of Kolawole (2013), who found that KPS is not gender biased.

Conclusion

Based on the finding it could be concluded that, the used of Heuristic teaching strategy as a Panacea for Education Development and Social Pedagogy improves students' performance than the conventional method when taught Mathematics. Also, it was concluded than gender is

not significant influencing factor in the students' performance in Mathematics when exposed to Heuristic teaching learning strategy.

Recommendations

Based on the findings of this study the following recommendations were made as a Panacea for Education Development and Social Pedagogy.

- Mathematics teachers should adopt the Heuristic teaching method in classroom instruction, as it has been proven to significantly improve students' academic performance compared to the conventional method.
- Ministries of Education and school administrators should organize workshops, seminars, and in-service training programmes to equip teachers with the skills required to effectively implement the Heuristic teaching method.
- Curriculum planners should incorporate activity-based and problem-solving strategies such as the Heuristic method into the mathematics curriculum to enhance students' understanding and performance.
- Since the method was found to be gender-friendly, teachers should confidently apply the Heuristic method to both male and female students without bias.
- Schools should provide adequate instructional materials and learning resources that support heuristic and student-centered learning approaches.
- Teachers should encourage active student participation, critical thinking, and guided discovery in mathematics lessons to improve retention and understanding.

References

- Allen, C. (2007). An action based research study on how using manipulative will increase students achievement in Mathematics. Retrieved from <http://www.org/>
- Chung, K. H. & Park, S. G. (2015). The effect of action learning based teaching and learning strategies on competency development of nursing students". Proceeding of 7th of international workshop of ASTL and health care and nursing V, Jeju University, Korea
- Daramola K.R (2016). Effect of using Instructional Technology Resources in the teaching of Mathematics among Senior Secondary school students in Akoko North West Local Government Area of Ondo State. *Journal of Education and Human Development*, 6(1), 15-25 Insuderc Academic Publishers ISSN: 2465-7468
- Eze, J. E (2009). Mathematics education and millennium development goals (MDGS). Proceeding of 50th annual conference of Mathematics association of Nigeria (MAN). Federal republic of Nigeria (2014). National policy on education, Lagos; NERDC.

- Kolawole, E.B. (2012). Gender issues and academic performance of senior secondary school students in Mathematics Computation tasks in Ekiti State Nigeria. *Pakistan Journal of social sciences*, 15 (1), 102 -111
- Kolawole, E .B. (2013). Kolawole’s Problem Solving (KPS) A panacea to Mathematical and life’s problems. *Standard Journal of Education and Essay* 1(8), 131-141
- Kolawole, E. B. & Olofin S. O. (2017). Effects of goal setting skill and peer modeling strategies on academic performance of Ekiti State students in Mathematics. Book of reading of Prof. Onwuamanam, *Journal of Counseling and Applied Psychology*.
- Owolabi, O. T. & Oginni O. I. (2013). Assessing the relative effectiveness of three teaching methods in the measurement of students’ performance in Physics. *International Journals of Material, Methods and Technologies*, 1 (8), 116-125.
- Uka, N. K. (2015). Developing entrepreneurial skills in secondary school students through effective mathematics education in Aba, Nigeria. *International Journal of education learning and development*, 3(7), 1-11
- Wilson, C. H. (2006). Small business versus entrepreneurship revisited. In Brochans R. H. (ed). *Entrepreneurship education: A Global View: Burlington: Ashgate*