

# EFFECTS OF GUIDED INQUIRY INSTRUCTIONAL STRATEGY ON MATHEMATICS ACHIEVEMENT AMONG DYSCALCULIC DISABILITY STUDENTS IN ABIA STATE, NIGERIA

BY

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## Abstract

This study investigated the effects of guided inquiry instructional strategy on mathematics achievement among dyscalculic disability students in Abia state, Nigeria. Quasi-experimental research design was adopted. The study was guided by three research questions and three hypotheses. The population of the study comprised of 110,712 SSII students. Purposive sampling procedure was used to select 120 dyscalculic students. Two schools were selected using simple random sampling technique and an intact class of one arm was purposively selected in each of the schools. Mathematics Achievement Test was designed by the researcher. Data obtained through the instrument were analyzed using inferential statistics of ANCOVA at 0.05 levels of significance. The finding of the study revealed a significant difference in the mean achievement score of students taught using Guided Inquiry and Lecture Method among dyscalculic students. The result of the study further showed that there was a significant main effect of gender (male and female students) on the treatments. The study concluded that guided inquiry instructional strategy is effective in teaching dyscalculic disability students. It is recommended that seminars and workshops should be organized for teachers on the application of guided inquiry method of teaching to assist students with learning disabilities overcome their learning challenges.

**Keywords:** Effects, Guided Inquiry, Instructional Strategy, Mathematics Achievement, Dyscalculia Learning Disability Students

## Introduction

Students' academic performance is one of the top priorities for schools. It is the outcome of education, that is, the extent to which a student, teacher and institution have achieved their educational goals. Research have shown that the behaviour of students, especially in relation to sciences, generally and Mathematics in particular, is greatly influenced by the method of instructional delivery. According to Wordu and Iwok (2018), Mathematics gratifies a wide range of interest and abilities, in making crucial contribution to our understanding and appreciation of the world we live in. Sulaiman and Abdullahi (2015) observed that Mathematics involves activities such as formation of concepts, abstraction, generalization, and problem solving skills. Mathematics is one of the core subjects that is taken very serious in the school system irrespective of country or level of education. Mathematics is an indispensable tool in the study of science, humanities and technology (Edoho et al., 2020).

As stipulated in the National Policy on Education (Federal Republic of Nigeria, 2014), Mathematics is a mandatory subject for all Primary and Secondary School students, and a compulsory entry requirement into all courses in tertiary institutions. Mathematics is considered the gateway subject for academic development related to the fields of Sciences, Technology, Engineering, and Mathematics (STEM) (Roberts, 2014). The National Bureau of Statistics (NBS) (2019) in the 2016-2018 WAECSSCE for private and public candidates revealed the differences in students' performance. The West African Examinations Council Results Statistics 2016-2018 reflected that a total of 1.57 million candidates sat for WAEC in 2018 as public students as against 1.56 million candidates in 2017. 849,069 of the candidates had 5 credits and above including English Language, 1.06 million had 5 credits and above including Mathematics while 756,726 of the candidates had 5 credits and above including Mathematics and English Language. The percentage of candidates with 5 credits and above including Mathematics and English Language is put at 48.15%.

The American Psychiatric Association (2018) submitted that Specific Learning Disability (SLD) means a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, or to do mathematical calculations or any other activity. According to Panicker and Chelliah (2016), SLD is a neurodevelopmental disorder characterized by significant difficulties in learning and using academic skills and typically begins during school-age years. McDowell (2018) also submit that students with SLD may experience difficulty analyzing materials presented during instructional time and organizing information in their minds, leading to poor understanding of the material taught and difficulty remembering instructions. One challenge that is faced by students in numerical ability is known as dyscalculia. Dyscalculia is characterized by difficulties with number sense, memorizing math facts, math calculations, math reasoning and math problem solving. This is also named as specific learning disorder with impairment in mathematics (American Psychiatric Association, 2013). Dyscalculia can range from an inability to order numbers correctly and extend to limited strategies for problem solving.

Students' performances have continues to generate debate on the factors or reason (s) that impedes success in Mathematics. Mathematics disorders may have trouble performing basic Mathematics calculations, or they may have difficulty with concepts like time, measurement or estimation. Dyscalculic learners may have difficulty in understanding simple number concepts, lack an intuitive grasp of numbers, and have problems learning number facts and procedures (Onwukwe, 2021). Raja and Kumar (2012) investigation into the learning difficulties of simple fractions of Indian children in secondary schools shows that one third of all the mistakes in division of fractions were due to the student's negligence to invert the divisor before the process of multiplication.

Effective teaching method is keys towards improved performance in Mathematics. The method used in any teaching and learning situation is very important because the way a teacher presents the subject matter to students may make the students to like or dislike the subject. The application of Guided Inquiry Instructional Teaching Methods in teaching Mathematics has

proven as an effective means of instruction. Amos in Adeuya (2020) submitted that guided Inquiry means careful planning, close supervision, on-going assessment and targeted intervention by an instructional team of teachers through the inquiry process that gradually leads students toward independent learning. Guided inquiry approach is a teaching strategy which attempts to help students ask questions and discover answers to their questions. Inquiry methods permits to observe an event, recognise relevant and irrelevant questions, search out data and take complete responsibility for an entire process of obtaining, organising and interpreting data. Guided inquiry according to Perry et al. in Wokocha (2021) involves students in every stage of learning using a variety of sources under the guidance of the teacher. The teacher provides materials and problems to investigate, students device their own procedure in solving the problems. It is students' centered-activity oriented teaching strategy. The teacher guides the students to discover answers to a problem. The teacher may even explain or give clue or procedure in solving the problem.

Guided inquiry is a student-centered method of teaching whereby students participate actively, question assumptions and provide their viewpoints on any area of subject matter. The view (Kanselaar et al., 2019) is that Guided Inquiry-Based Strategy involves change in the organization of the manner in which the content is taught. It is an approach to teaching and learning that places students' questions, ideas and observation at the center of the learning experience. Guided Inquiry-Based Strategy draws on constructivist ideas of learning in which learners construct new ideas or form concept based upon their experience or prior knowledge. A teacher using the guided inquiry method gives minimal lectures to introduce ideas and to provide overviews but uses more of questioning and interactive class activities to stimulate and to share ideas. The teacher's role in guided inquiry is that of a facilitator, coach, mentor and motivator, rather than dispenser of all the right knowledge (Johnston et al. in Onwuachu & Chukwurah, 2015).

Gender is incorporated in this study as a moderator variable. It is therefore seen as the allocation of roles based on sex in a given society. Gender stereotypism is fixing roles as a result of bias resulting from socio-cultural orientations over the years. These stereotypes affect one's sense of self-worth, behaviour and choices. According to Obih, in Agugum and Okoro (2020) gender is associated with the belief, attitude and societal perception of being a male or female vis-à-vis what each should do, how each should behave, and social functions as well as position they can attain in the society. The release of results from the West African Examination Council (WAEC) and National Examination Council (NECO) is always followed by public outcry as students' performances in both examinations do not match the government and parental expectations. Research has shown that certain teaching methods contribute greatly to students' academic success in sciences and other subjects (Ugwuadu, 2014; Wokocha, 2021; Agugum & Okoro, 2020; & Onwukwe, 2021). It is in light of the foregoing that this study investigated the effects of guided inquiry instructional strategy on Mathematics achievement among dyscalculic students in Abia state, Nigeria.

### Purpose of the Study

The purpose of this study was to determine the effects of guided inquiry instructional strategy on Mathematics achievement among dyscalculic disability students in Abia state, Nigeria. The specific objectives are:

1. To determine the differences in the pre-test and post-test mean scores of treatment on achievement among dyscalculic disability students taught Mathematics using guided inquiry instructional strategy and those taught using lecture method in Abia state.
2. To find out the differences in the mean achievement scores treatment among dyscalculic disability students taught Mathematics using guided inquiry instructional strategy and those taught using lecture method in Abia state.
3. To determine the differences in the mean achievement scores treatment among male and female dyscalculic disability students taught Mathematics using guided inquiry instructional strategy and those taught using lecture method in Abia state.

### Hypotheses

The following null hypotheses were tested at 0.05 levels of significance:

**H0<sub>1</sub>:** There is no significant main effect of treatments (Guided Inquiry and Lecture Method) on dyscalculic students' achievement Mathematics in Abia state.

**H0<sub>2</sub>:** There is no significant main effect of gender on dyscalculic students' achievement in Mathematics in Abia state.

**H0<sub>3</sub>:** There is no significant interaction effect of treatments (Guided Inquiry and Lecture Method) and gender on dyscalculic students' achievement in Mathematics in Abia state.

### Methodology

The study adopted non-equivalent pre-test, post-test quasi-experimental design. This design was adopted because intact classes were used as it was not possible to have complete randomization of the subjects. Two groups were created for the study. The first group (Experimental Group I) received treatment on Guided Inquiry, the second group served as the control group which was exposed to conventional method (Lecture Method). The pre-tests for the students' performance were administered before treatment. Also, the post-tests for the performances were administered after the treatment. The design for the study is presented schematically below:

Experimental Group I:  $O_1$      $X_1$      $O_3$

Control Group:         $O_2$      $X_2$      $O_4$

Where:

$O_1$   $O_2$  = Pre-test for Exp. Group I & Control Group respectively

$O_3$   $O_4$  = Post-test for Exp. Group I & Control Group respectively

$X_1$  = Treatment using Guided Inquiry Strategy

$X_2$  = Control group (taught using Lecture method)

Independent variables include treatments used for the study which are Guided Inquiry strategies. The dependent variable was students' performance. The research design used validated the effectiveness of the variables and helped in the evaluation of Independent variables' effectiveness on academic performance in studying Mathematics.

The target population comprised 12,650 students of Senior Secondary School II in Abia State. The sample for the study consisted of 120 Senior Secondary School II (SSS 2) students of Ukwa-West Local Government Area (LGA) in Abia South Senatorial zone. Purposive sampling procedure was used to select the sample for the study in identifying dyscalculic students. From the three senatorial district of Abia state, one senatorial district was selected using simple random sampling technique. One-Local Government Areas (LGA) was then sampled from the selected senatorial district using simple random sampling technique. Furthermore, two schools were selected using simple random sampling technique to select one (1) school in Ukwa-West LGA and Aba North LGA respectively. An intact SS2 class of one arm was purposively selected in each of the schools. The purpose was because only Science classes are compelled to take Mathematics in secondary schools in Nigeria. The two intact classes were assigned to two groups using simple random sampling technique. Experimental group A comprised of 53 students who were exposed to guided inquiry instructional strategy, while those 67 students in experimental group B were taught using conventional method (Lecture Method). For the purpose of this study, an instrument titled Mathematics Achievement Test (MAT) and two (2) instructional packages was developed by the researcher. These instrument and packages serves as guide for the research.

The Mathematics Achievement Test (MAT) was developed by the researcher and it consists of 30 multiple choice items in Mathematics Achievement. The Mathematics Achievement Test consisted of two sections of A and B. Section A is for the demographic/background information while section B contained 30 objectives items with options A-D. The test items were based on the objectives outlined in the lesson plans prepared. The test items covered three topics namely: Angle of Elevation & Depression, Probability, Surds, Quadratic Equation, Indices & logarithms, Circle Theorem and Statistics. These topics are included in the SS2 syllabus. The Text Blue Print (Table of Specification) used for preparing the achievement test for SSII Mathematics is based on the selected topics in the scheme of work. The test items were constructed using Bloom's Taxonomy of educational objectives for the cognitive domain which are in six areas, namely; Knowledge, Comprehension Application, Analysis, Synthesis and Evaluation.

The pilot test for the achievement test provided data for computing the coefficient of reliability and the Mathematics Achievement Test was subjected to Kuder-Richardson (KR-21) method of reliability to determine the internal consistency of the items. The reliability index of 0.78 was obtained for the Mathematics Achievement Test. Two research assistants, who are Mathematics teachers and the classroom teachers assisted in identifying students with dyscalculia in each school. The duration of the intervention lasted for five weeks. Descriptive statistics of Mean and Standard deviation of the scores obtained from the tests were used to answer the research questions, while Analysis of covariance (ANCOVA) was used to test the hypotheses at 0.05

level of significance using version 25 of the Statistical Package for Social Sciences (SPSS) to analyse the data.

## Results

**Hypothesis One:** There is no significant main effect of treatments (Guided Inquiry and Lecture Method) on dyscalculic students' achievement Mathematics in Abia state.

**Table 1: Gain in Mean Academic Achievement Scores of Students Taught Mathematics using Guided Inquiry Instructional Strategy and those taught using Lecture Method**

Methods	N	Pre-test Mean	Std.D	Post-test Mean	Std. D	Mean Gain
<b>Guided Inquiry Strategy</b>	53	42.66	8.20	63.44	8.57	20.78
<b>Lecture Method</b>	67	33.41	8.48	47.10	8.63	13.69

Table 1 revealed students' mean academic achievement and the pre-test mean score of 42.66 and post-test mean score of 63.44 of students taught Mathematics using guided inquiry instructional strategy. The comparison of the pre-test mean score and the post-test mean score revealed a mean gain of 20.78 after treatment. Tables also revealed pre-test academic achievement means score of 33.41 and post-test mean score of 47.10 of students taught Mathematics using guided inquiry instructional strategy using and those taught using lecture method. The comparison of the pre-test mean score and the post-test mean score revealed gain in mean of 13.69 after treatment. This indicated that lecture method has an effect on the performance of students taught Mathematics.

**Table 2: Gain in Mean Difference of Students taught Mathematics using Guided Inquiry Instructional Strategy and Lecture Method**

Methods	N	Gain in Mean	Difference in Gain in Mean
<b>Guided Inquiry Strategy</b>	53	20.78 (63.44 – 42.66)	7.09 (20.78 – 13.69)
<b>Lecture Method</b>	67	13.69 (47.10 – 33.41)	

Table 2 indicated that students taught Mathematics using guided inquiry instructional strategy had academic achievement gain in mean of 20.78 while the students taught with lecture method had academic achievement gain in mean of 13.69; the gain in mean difference therefore was 7.09. This revealed that students taught Mathematics using guided inquiry instructional strategy performed better than their counterparts taught using the lecture method.

This indicated that guided inquiry instructional strategy has higher positive effect on students' taught Mathematics compared to the lecture method.

**Hypothesis Two:** There is no significant main effect of gender on dyscalculic students' achievement in Mathematics in Abia state.

**Table 3: Gain in Mean Academic Achievement Scores between Male and Female Students' taught Mathematics using Guided Inquiry and Lecture Method**

Treatment	Gender	N	Pre-test Mean	Std.D	Mean Gain	Post-test Mean	Std.D	Mean Gain
<b>Guided Inquiry</b>	Male	28	26.52	8.53		49.82	6.79	
	Female	25	24.43	8.42	2.09	45.53	6.59	4.29
<b>Lecture Method (Control)</b>	Male	37	24.86	7.99		42.67	5.80	
	Female	30	24.20	7.04	.66	45.77	5.34	3.10

Table 3 revealed academic achievements for the pre-test mean gain in Guided Inquiry is 2.09 and .66 for lecture method of Male and Female Students' taught Mathematics using Guided Inquiry and Lecture Method. The result indicated a post-test scores mean gain of 4.29 for Guided Inquiry and 3.10 for Lecture Method. The conclusion is that, there is difference in mean score as far as gender is concerned.

Table 3 showed the main effect of gender on Guided Inquiry Instructional Strategy and Lecture Method on dyscalculic students' achievement Mathematics in Abia state. The result revealed that after adjusting for pre-test scores as the covariate, there is no significant main effect of gender (male and female students) between students taught guided inquiry instructional strategy and lecture method. The result is given as gender:  $F(1, 118) = 30.138$ ,  $P = .264 (>.05)$ , Partial eta ( $\eta^2$ ) = .274 showed that there is no significant difference in the mean achievement scores of male and female students taught guided inquiry instructional strategy and lecture method. The null hypothesis on the mean posttest scores of gender was therefore accepted.

**Hypothesis Three:** There is no significant interaction effect of treatments (Guided Inquiry and Lecture Method) and gender on dyscalculic students' achievement in Mathematics in Abia state.

There is no significant main effect of treatment (Guided Inquiry instructional strategy and Lecture Method) on dyscalculic students' achievement Mathematics in Abia state.

**Table 4: ANCOVA on Tests of Between-Subjects Effects showing the Main Effect, Gender and Treatments on Achievement Scores of Students**

Tests of Between-Subjects Effects						
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1795.782 <sup>a</sup>	3	598.594	22.323	.000	.296
Intercept	82702.480	1	82702.480	3084.128	.000	.951
Pretest_Scores	.007	1	.007	12.365	.987	.000
Treatment	675.277	2	675.277	25.182	.000	.137
Gender	1612.636	1	1612.636	30.138	.000	.274
Treatment * Gender	185.278	1	183.862	28.201	.275	.965
Error	4263.666	116	26.816			
Total	1594330.000	120				
Corrected Total	6059.448	118				

a. R Squared = .296 (Adjusted R Squared = .283)

Table 4 revealed that after adjusting for pre-test scores as the covariate, there is a significant difference in the mean achievement score of students' taught using treatment (Guided Inquiry instructional strategy and Lecture Method) on dyscalculic students' achievement Mathematics in Abia state. The result which is given as  $F(2, 118) = 25.182, P = .000 (< .05)$ , Partial eta ( $\eta^2$ ) = .137 showed that there is a significant difference in the mean achievement scores of students taught using guided Inquiry and Lecture Method on dyscalculic students' achievement in Mathematics in Abia state. The null hypothesis on the mean effect of treatment was therefore rejected.

Table 4 showed the interaction effect of treatment (Guided Inquiry and Lecture Method) and gender on dyscalculic students' achievement in Mathematics. The result which is given as:  $F(1, 118) = 28.201, P = .275 (>.05)$ , Partial eta ( $\eta^2$ ) = .965 showed that there is a significant difference in the mean achievement scores of male and female students taught guided inquiry instructional strategy and lecture method. This revealed that there is no significant interaction effect of treatments and gender on the academic achievement of the dyscalculic students' taught using Guided Inquiry and Lecture Method. The null hypothesis was therefore accepted.

### Discussion of Findings

The findings of the study revealed that there is a significant difference in the mean achievement score of students' taught using treatment (Guided Inquiry instructional strategy and Lecture Method) on dyscalculic students' achievement Mathematics in Abia state. This is supported by Ferguson, in Odupe and Opeisa (2019) who asserts that the inquiry-based teaching approach has a positive effect on the mathematics achievement of students. In inquiry-based learning, the teacher acts as the facilitator of the students learning rather than the supplier of information. These results aligned with that of Ugwuadu (2014) who observed that guided inquiry method of instruction proved more effective than lecture method in



enhancing students' academic achievement. The finding further showed that there is a significant difference in the mean achievement scores of male and female students taught guided inquiry instructional strategy and lecture method. This finding is supported by Mankumari and Ajay (2017) on gender differences in the academic performance of students showed that the female students outperformed their male counterparts. Moreover, the findings of Uwalake (2013) also revealed superiority in the academic achievement of females over males in chemistry. On the other hand, Oribhabor (2019) and Odupe and Opeisa (2019) studied the influence of gender on mathematics achievement of secondary school students and effect of gender on students' academic achievement in public secondary schools respectively. They reported separately that male students performed significantly better than their female counterpart on students' academic achievement in science subjects. On a contrary, Adebayo (2016) found that gender has no significant effect on students' achievement when taught using guided inquiry.

### Conclusions

Based on the findings of the result of the study, it was concluded that a significant difference existed in the effectiveness of guided inquiry in improving academic performance of secondary school students in Mathematics in Abia state, as those exposed to conventional teaching method. The conventional strategy use in teaching mathematics does not encourage creativity and critical thinking in mathematics class. In fact, it brings low conceptual understanding in geometry. The guided inquiry-based learning strategy is a compelling alternative to the more conventional classroom strategy utilized in the past. The learners must inquire directly to gain a deep comprehension of the features in order to grasp the concept.

### Recommendations

Based on the findings discussed above, the following recommendations have been made:

1. There is need for the provision of functional learning centres that could be provided in the curriculum for dyscalculic students and students faced with different learning disabilities. Through the use of guided inquiry method, this would enable students of high and low ability levels to gain confidence in their ability to reliably gather and interpret facts as they learn from their own inquiry.
2. Mathematics teachers should make use of innovative teaching strategy such as guided inquiry methods in order to help male and female dyscalculic students and students with other with varying learning disabilities.
3. It is also recommended that seminars and workshops should be organized for teachers on the application of guided inquiry method of teaching in aiding students with learning disabilities.

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