



Effect of Guided Inquiry and Explicit-Instructional Strategies on Lower Basic Students' Academic Performance in Mathematics

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ABSTRACT

This study investigated the effect of guided inquiry and explicit-instructional strategies on lower basic students' academic performance in mathematics. We employed a non-randomized pretest-posttest control group quasi-experimental design. The population comprised all primary school students in Oyo East Local Government Area, Nigeria while 132 students all in lower basic schools were sampled from six intact classes. The mathematics Performance Test (MPT) was used as a research instrument. The content validity was established with the use of experts' judgment from two experts in mathematics education while the test-retest reliability estimates of the instrument yielded 0.78. Four research hypotheses were tested. The findings of the study revealed that there is a significant main effect in using a guided-inquiry instructional strategy on mathematics. There is the significant main effect of explicit instructional strategy on students' mathematics academic performance. There is a significant interaction effect of guided inquiry and explicit instructional strategies, gender, and school type on lower basic students' academic performance. Guided inquiry and explicit instructional strategies are good teaching strategies to reduce mathophobia among primary school students in mathematics.

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1. INTRODUCTION

Education is a medium through which the potential of individuals with a uniquely powerful set of tools is developed. These tools include logical reasoning, problem-solving skills, and the ability to think in abstract ways. Therefore, mathematics is the creation of the human mind, concerned primarily with ideas, processes, and reasoning. It has been regarded as the cornerstone of all scientific thinking. Nwagbo (2006) defines mathematics as the science of intellectual activity which is carried out by a human and designed to discover information about the natural world in which he lives as well as to discover how the information can be organized to benefit the human race. Mathematics is a tool used in science, technology, and industries. The definition connotes that all sciences draw their aspirations from mathematics and implies that mathematics is a language of sciences. Ezeugo and Agwagah (2000), their study looked at mathematics as a scientific tool for realizing the nation's scientific and technological aspirations.

Students, therefore, develop numeracy, reasoning, thinking skills, and problem-solving skills through the learning and application of mathematics (Husnah *et al.*, 2021). These are valued not only in science and technology but also in everyday living and the workplace. Mathematics is a subject that intrudes into all aspects of human endeavor and further describes mathematics as the life wire in the studies of various disciplines (Bolaji & Adeoye, 2022). He further stressed that mathematics is also a subject of enjoyment and excitement, which offers students opportunities for creative work and moments of enlightenment and joy. When ideas are discovered, and insights gained, students, are encouraged to pursue mathematics beyond the classroom walls. One may ask the question of why mathematics should be taught in schools. Mathematics as a discipline has many advantages for human beings some of which are utilitarian, social activities, cultural activities, and aesthetics. In utilitarianism, mathematics is an effective tool for realizing results. This made the subject be taught from the lowest to the highest levels of knowledge that the child's ability can allow. Although, mathematics occupies a critical position in the school curriculum which is why the researchers observed that most students find it difficult to pass the subject.

Many reasons have been attributed to the causes of poor academic performance in Mathematics. Amongst the causes of poor academic performance in Mathematics which the researchers have noted are attitudes of the learners towards the subject, lack of teaching experiences, economic conditions, lack of appropriate teaching methods/strategies, and low motivation of teachers and attitudes (Makondo & Makondo, 2020). Student's attitudes towards mathematics found that teachers, methods of teaching mathematics, and personality accounted for students' negative attitudes toward mathematics performance. Adeyemi (2008) revealed that teachers' teaching experience was significant to student's learning outcomes as measured by their performance.

The fear of Mathematics (mathophobia) led various scholars to conclude that mathophobia is a major contributory factor to the problem of learning and teaching Mathematics. VaraidzaiMakondo and Makondo (2020) citing Larzim, Abu, and Wan (2003) have also observed that students' interest in Mathematics declines as they move from primary school to secondary school level because they fear that Mathematics is a difficult subject. Mathophobia can be caused by teachers' methodology, mathematical knowledge, assessment, and the nature of the discipline of Mathematics. Many students believe that Mathematics is a difficult subject (Camenda *et al.*, 2021). The notion of Mathematics as a difficult subject is taken by some people as a challenge such that if they succeed in solving

Mathematical problems they feel satisfied and motivated to higher-level Mathematics. Conversely, if they fail the sense of failure results in low self-esteem.

Since the teacher's methodology is one of the factors that often undermine students' academic performance in mathematics it is characterized by a set of principles, procedures or strategies to be implemented by teachers to achieve desired learning in students (Liu & Shi, 2007; Maryati *et al.*, 2022; Hashim *et al.*, 2021). These instructional strategies are techniques teachers use to help students become independent, strategic learners or ensure smooth delivery of the instruction. Effective instructional and learning strategies can be used across different levels of education, and subject areas, and can accommodate a range of students' differences. The selection of a proper instructional strategy ensures the performance of the stated instructional objectives effectively. These instructional strategies can either be learner-centered or teacher-centered.

The learner-centered strategies of teaching are often seen as advantageous as the learner is more active in the learning process rather than being a passive recipient. Evidence shows that applying learner-centered approaches is more effective than teacher-centered ones. In recent years under the influence of humanistic and communicative theories great emphasis has been placed on learner-centered teaching. While the teacher-centered approach of teaching is an approach to teaching that places the teacher as the director of learning and is mainly accomplished by lectures, repetitive practice of basic skills, and constructive feedback.

Guided inquiry is generally regarded as a motivating method, enjoyed by learners. Students learn independently, they are interested to learn the new material guided by the teacher. In line with that, guided inquiry as a process that the teachers use to introduce new materials, explore centers or areas of the classroom, and prepare learners for various aspects of the curriculum. The teacher in this approach of instruction is behind the curtain. He guides facilitates and prompts students to conduct investigations and construct their meaning of the events and phenomena that occur naturally (Ezeoba *et al.*, 2013).

On the other end, explicit instruction often called direct instruction refers to an instructional practice that carefully constructs interactions between students and their teacher. Teachers clearly State a teaching objective and follow a defined instructional sequence. They assess how much students already know on the subject and tailor subsequent instruction, based on that initial evaluation of student skills. Students move through the curriculum, both individually and in groups, repeatedly practicing skills at a pace determined by the teacher's understanding of student needs and progress (Swanson, 2001). Explicit instruction is especially successful when a child has problems with a specific or isolated skill (Kroesbergen & Van Luit, 2003).

Ukata *et al.* (2017) stated that this explicit instructional strategy is highly "teacher-centered". It is a teacher-led teaching method through which instructions were given to students from the front of the classroom or lecture hall such as lecture instruction, direct teaching, didactic questioning, demonstration practice, driving instruction, etc. There are three general elements of explicit instruction in math: teacher modeling, guided practice, and academic feedback. However, the teaching of primary mathematics in the classroom today does not reflect a learner-centered approach. What predominates 'in our primary and post-primary mathematics classrooms is the teacher-centered or traditional approach (Leghara, 2008). The moderating variable of interest in this study is gender. Gender is the range of characteristics that is relevant to, and distinguishing between, masculinity and femininity. It is often believed that the male sex enjoys a form of superiority over the female sex (Nnamani & Oyibe, 2016). This superiority is also argued in the area of academic performance. To this end, many studies been conducted on the effect of gender on the academic performance of

learners in various school subjects but the findings of these studies have not been consistent. Hence, this study intends to factor in gender as a moderator variable in this study to cushion the unexpected effect it may have on the lower basic students' academic performance in mathematics.

Another moderating variable of interest in this study is school type. Public schools are those schools established, managed, financed, as well as supervised by the government. Public schools are more accessible than private schools in Nigeria since they are found in cities, as well as villages even in some hamlets (Babatunde, 2019). The two types of schools share a similar vision of preparing learners to become self-reliant and useful to the development of the nation, but they differ in several ways. Swanson (2001) submitted that a public school differs from a private school in terms of effectiveness which is expressed via the academic performances of the students through standardized examinations. Munanu conducted a study on the relationship between school type and secondary school student's academic performance. The findings unfolded that school type does not influence the academic performance of students.

It is apparent from the above that the effect of school type on the academic performance of students has suffered findings inconsistency and this justifies the need to include school type as a moderating variable in this study. Also, most people do not have an accurate picture of mathematics. They view mathematics as a set of formulas to be applied to a list of problems at the ends of textbook chapters which makes the students develop mathophobia as a result of poor teaching strategies used by the mathematics teachers in other to solve problems. Based on the research gap established above, the researchers were motivated to research to examine the effect of guided inquiry and explicit-instructional strategies on lower basic students' academic performance in mathematics in Oyo East Local Government Area of Oyo State, Nigeria. The purpose of this study was specifically to:

- (i) Determine the significant main effect of guided-inquiry instructional strategy on the students' mathematics academic performance.
- (ii) Determine the significant main effect of explicit instructional strategy on the students' mathematics academic performance.
- (iii) Find out the interaction effect of guided-inquiry instructional strategy, gender, and school type on lower basic students' academic performance in mathematics.
- (iv) Find out the interaction effect of explicit instructional strategy, gender, and school type on lower basic students' academic performance in mathematics.

The following research hypotheses were formulated to guide the study based on the research purposes.

- (i) H_{01} : There is no significant main effect of guided-inquiry instructional strategy on the students' mathematics academic performance in Oyo State.
- (ii) H_{02} : There is no significant main effect of explicit instructional strategy on the students' mathematics academic performance in Oyo State.
- (iii) H_{03} : There is no significant interaction effect of guided-inquiry instructional strategy, gender, and school type on lower basic students' academic performance in mathematics in Oyo State.
- (iv) H_{04} : There is no significant interaction effect of explicit instructional strategy, gender, and school type on lower basic students' academic performance in mathematics in Oyo State.

2. METHOD

The researchers employed a non-randomized pretest-posttest control group quasi-experimental design. The population for the study comprised all students in lower basic

primary schools in Oyo East Local Government, Nigeria while the target sample consisted of basic three students in six intact classes with 44 students using guided inquiry, 40 students using explicit instructional strategy, and 48 students in the control group with the total number of 132 students all in lower basic schools.

The mathematics Performance Test (MPT) was developed by the researchers. This was used as a pretest and posttest which is made up of twenty (20) multiple-choice items drawn from the content area of the fractions using a table of specification. The content validity of the instrument was ascertained by two experts in mathematics education. To establish the reliability of the instrument was administered twice to basic three students in another school outside the scope of the study with an interval of two weeks. The data that was collected from the trial testing were subjected to Pearson Product Moment Co-efficient (PPMC) and the reliability estimates of the instrument yield 0.78. The research hypotheses were tested using Analysis of Covariance (ANCOVA) at a 0.05 level of significance.

3. RESULTS AND DISCUSSION

3.1. H₀₁: There is no significant main effect of guided-inquiry instructional strategy on the students' mathematics academic performance.

From **Table 1**, the value of F is 80.852 which is significant at 0.05 alpha level $p < 0.05$. Therefore, the null hypothesis that stated there is no significant main effect of guided-inquiry instructional strategy on students' mathematics performance in lower basic schools in Oyo State was rejected.

Table 1. The Summary of analysis of covariance showing the main effect of guided-inquiry instructional strategy on students' mathematics academic performance.

Source	Type III Sum of squares	df	Mean square	F	Sig.	Remark
Corrected model	655.882 ^a	2	327.941	74.318	0.000	
Intercept	240.785	1	240.785	54.567	0.000	
Pretest	27.245	1	27.245	6.174	0.015	
Group	356.774	1	356.774	80.852	0.000	Significant
Error	392.726	89	4.413			
Total	9466.000	92				
Corrected total	1048.609	91				

Note: R Square = 0.625 (Adjusted R Squared = 0.617)

This implies there is a significant effect in using a guided-inquiry instructional strategy on mathematics compared to the control group using the conventional strategy at the primary school level in Oyo State.

3.2. H₀₂: There is no significant main effect of explicit instructional strategy on the students' mathematics academic performance in Oyo State.

Results in **Table 2** show that there is a significant effect of explicit instructional strategy on students' mathematics performance in lower basic schools in Oyo State. This is evident in the calculated F-value of 116.800 which is significant at 0.05 alpha level. The null hypothesis is hereby not accepted. Hence, there is a significant main effect of explicit instructional strategy on students' mathematics academic performance in lower basic schools in Oyo East Local Government.

Table 2. Summary of analysis of covariance showing the main effect of explicit instructional strategy on students’ mathematics academic performance.

Source	Type III Sum of squares	df	Mean square	F	Sig.	Remark
Corrected Model	923.864 ^a	2	461.932	110.593	0.000	
Intercept	252.543	1	252.543	60.462	0.000	
Pretest	33.679	1	33.679	8.063	0.006	
Group	487.856	1	487.856	116.800	0.000	Significant
Error	355.034	85	4.177			
Total	10019.000	88				
Corrected total	1278.898	87				

Note: ^aR Square = 0.722 (Adjusted R Squared = 0.716)

3.3. H₀₃: There is no significant interaction effect of guided-inquiry instructional strategy, gender, and school type on lower basic students’ academic performance in mathematics in Oyo State.

Table 3 shows the significant interaction effect of guided-inquiry instructional strategy, gender, and school type on lower basic students’ academic performance in mathematics in Oyo State. The results show that there is a significant interaction effect of guided-inquiry instructional strategy, gender, and school type on lower basic students’ academic performance. The calculated F-value of 0.004 is significant at a 0.05 alpha level of significance. Therefore, the stated null hypothesis is not accepted.

Table 3. ANCOVA table on significant effect interaction effect of guided-inquiry instructional strategy, gender, and school type on lower basic students’ academic performance in mathematics.

Saource	Type III sum of squares	df	Mean square	F	Sig.	Remarks
Corrected model	108.122 ^a	4	27.030	2.996	0.023	
Intercept	223.669	1	223.669	24.787	0.000	
Pretest	81.093	1	81.093	8.987	0.004	
Gender	10.934	1	10.934	1.212	0.274	
School type	18.880	1	18.880	2.092	0.152	Significant
Gender * school type	0.037	1	0.037	0.004	0.024	
Error	785.041	87	9.023			
Total	11741.000	92				
Corrected total	893.163	91				

Note: aR Square = 0.121 (Adjusted R Squared = 0.081)

3.4. H₀₄: There is no significant interaction effect of explicit instructional strategy, gender, and school type on lower basic students’ academic performance in mathematics in Oyo State.

From **Table 4**, the value of F is 0.226 which is significant at alpha level $p < 0.05$. Therefore, the null hypothesis that stated there is no significant interaction effect of explicit instructional strategy, gender, and school type on lower basic students’ academic performance in mathematics in Oyo State was rejected. This implies that there is a significant interaction effect of explicit instructional strategy, gender, and school type on lower basic students’ academic performance in mathematics.

Table 4: ANCOVA table on significant effect interaction effect of explicit instructional strategy, gender, and school type on lower basic students' academic performance in mathematics.

Saource	Type III Sum of Squares	df	Mean Square	F	Sig.	Remarks
Corrected Model	260.834 ^a	4	65.209	7.119	0.000	
Intercept	147.692	1	147.692	16.124	0.000	
Pretest	200.755	1	200.755	21.917	0.000	
Gender	19.050	1	19.050	2.080	0.153	
School Type	7.089	1	7.089	0.774	0.382	Significant
Gender * School Type	2.072	1	2.072	0.226	0.002	
Error	760.257	83	9.160			
Total	12294.000	88				
Corrected Total	1021.091	87				

Note: aR Square = 0.255 (Adjusted R Squared = .220)

3.5. Discussion of Result

Hypothesis one shows that there is a significant main effect in the use of guided-inquiry instructional strategy on mathematics compared to the control group using the conventional strategy at primary schools. The researcher find out that the differences might be a result of the treatment being given to the students in the experimental group which allows students to work with their peers, collaborate, and learn communication skills. This supported the findings of [Nwanekezi \(2018\)](#) who found that the guided inquiry learning strategy proved to be more effective than the lecture method. It was also in line with the study of [Ugwu \(2015\)](#) who reported that students taught using a guided inquiry instructional strategy recorded high academic performance in mathematics than those taught using the conventional method. The study also corroborates the finding of [Uloaku \(2015\)](#) who found that students' performance increased when they are engaged in interactive strategies.

Moreover, the findings revealed that there is a significant main effect of explicit instructional strategy on students' mathematics academic performance in lower basic schools in Oyo East Local Government. The researcher found out that the difference was shown after the treatment was applied. Also, there is proper monitoring of their teacher's attitudes to work and teaching styles by the parent's teachers association and the school management. The finding is in agreement with [Tella \(2013\)](#) who reported that explicit and peer tutoring could improve students' achievement in Mathematics. The result, however, disagrees with the findings of [Bolaji and Adeoye \(2022\)](#) who found an explicit instructional strategy to be the least effective strategy as it does not have a significant effect on students' achievement in mathematics.

Similarly, hypothesis three shows that there is a significant interaction effect of guided-inquiry instructional strategy, gender, and school type on lower basic students' academic performance. The researcher sees this interaction effect of strategy, gender, and school type as what brings the students together in competing and collaborating in classroom activities that promote their learning. This result agrees with the findings of [Shawson \(2001\)](#) cited by [Jegede and Fatoke \(2014\)](#) who pointed out that students did not exhibit gender differences in achievement when using guided inquiry. However, this result did not agree with those whose works revealed a significant difference in the performance of male and female students in favor of males; and vice versa. [Babatunde \(2019\)](#) revealed that there is no significant difference between the academic performance of private and public school students in basic science when using a guided-inquiry strategy.

Finally, research hypothesis four shows that there is a significant interaction effect of explicit instructional strategy, gender, and school type on lower basic students' academic performance in mathematics. The researcher believed that from the sampled schools, the use of improvised instructional materials to aid the teaching and learning process improved the interaction effect of the teaching strategy. This finding is in line with Raba (2017) who found that explicit instructional strategies play a positive role in improving students' oral communicative skills and enhancing students' motivation to learn better. Olibie and Ezeoba (2014) also found that private school students perform better than public school public when appropriate teaching strategies were not used when teaching social studies.

4. CONCLUSION

Based on the findings made in this study, the researchers concluded that the acquisition of skills on guided inquiry and explicit instructional strategies showed that students with Mathophobia could acquire the skills and use the skills to learn mathematics without any fear or difficulties. Also, the two instructional strategies were not gender-sensitive when compared with their performance in mathematics. Based on the findings and conclusions of this study, it was recommended:

- (i) Mathematics teachers should endeavor to use constructivist practices through guided inquiry to engage their students in thinking and creative learning, rather than using conversational methods.
- (ii) Mathematics teachers should make all their lessons problem-oriented because students always show interest when they are faced with a puzzle.
- (iii) Workshops and seminars should be organized by the government and school administrators for mathematics teachers to sensitize them on the importance and use of appropriate learning strategies from time to time, such as Guide-inquiry and explicit instruction strategies.
- (iv) Teachers should create an atmosphere conducive to learning to enhance the development of students learning experiences.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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