International Journal of Academic Multidisciplinary Research (IJAMR)
ISSN: 2643-9670
Vol. 6 Issue 11, November - 2022, Pages: 16-21

Effect of Ethno-Mathematics Using Guided Instruction (Emgi) and Lecture Method (Lm) on Students' Achievement In Mathematics in Delta State

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Abstract: *The aim of the study was to look into how Senior Secondary students' mathematical achievement in Delta State was affected by the use of ethno-mathematics using guided instructions (EMGI) and the lecture method (LM). A 2x2 factorial, pre-test-post-test control group quasi-experimental design was used for the investigation. The population of the study comprised 19,978 SSII students. 313 SSII students made up the study's sample. The Mathematics Achievement Test (MAT) was the instrument utilized in the study to collect data. With the help of the Kuder-Richardson formula, MAT had a reliability coefficient of 0.79. The scores were collated and analyzed. The outcomes showed that: there was a significant difference between the mathematics mean achievement scores of students taught with EMGI and those taught with LM, favoring students who were taught with EMGI; and there was no significant interaction effect between instructional methods and sex on students' achievement in mathematics. It was concluded that EMGI facilitates students' conceptualization of mathematics concept leading to a better achievement in mathematics than LM. It was recommended amongst others the adoption of EMGI in teaching mathematics at the secondary level of education.*

Keywords: Ethnomathematics, guided instruction, academic achievement

Introduction

Almost every career and highly specialized courses of study benefit from having a solid understanding of mathematics, which is one of the school subjects that every nation mandates for industrial and technical progress. With the use of abstraction and logical reasoning, counting, estimating, measuring and the examination of the shapes and motions of physical objects gave rise to mathematics. The analysis of quantity, structures, space and change is the essence of mathematics. Since mathematics is so important and beneficial in daily life and is seen as the doorway to future careers in a wide range of fields, Umameh (2011) considered it to be one of the core and vital courses at the primary and secondary levels of school. Because of this, mathematics is acknowledged as the subject that must be taught at all levels of school in both developed and developing nations.

Nigerian government positioned mathematics among the main courses in the secondary curriculum after discovering the many benefits and uses of mathematics in daily life and nation-building. Students still perform below standard in external examinations including the West African Senior Secondary Certificate Examination (WASSCE) (WAEC Chief Examiner's report, 2016-2020), despite the numerous benefits and uses of mathematics and the elevated position accorded to mathematics education in Nigeria. This condition necessitates continuing efforts to rectify students' poor mathematics performance. This study was necessary in the researcher's efforts to stem the tide of underperformance.

Several factors that contribute to students' poor mathematics performance have been highlighted in some recent research studies (Suleiman & Hammed, 2019; Ozofor & Onos, 2018). These factors include a shortage of skilled mathematics instructors, a lack of use of teaching resources, and ineffective teaching techniques, among others. In the majority of Nigeria's secondary schools, mathematics is often taught using the lecture method (LM). As part of the learner-controlled and information-centered LM approach, the teacher plays the role of a resource in the classroom. This method involves just the teacher speaking, with the students just paying attention. As a result, the teacher and students are no longer interacting, which makes the classes monotonous. Through their passive engagement in the teaching-learning process, students are able to memorize and recall knowledge they have previously learned.

Numerous teaching strategies for mathematics have been used in recent research studies to help students succeed in the subject. Among other techniques, these include discovery, expository, laboratory, inquiry, target-task, delayed formalization, computer-assisted instruction, and problem-solving techniques. These approaches of teaching mathematics in Nigeria are foreign since they are unrelated to the local culture. Students learn through rote memory using these approaches, which have their roots in British culture. It doesn't move from issues that are prevalent in a culture to difficulties that the students might face, leaving little to no opportunity for the practical aspects of students' daily lives. Therefore, it is necessary to use a technique like ethno-mathematics using guided instruction (EMGI) that can pique and maintain the learner's interest while also assisting them in producing superior results. Determining how EMGI affects students' achievement in mathematics is the goal of this study.

EMGI, according to Abonyi (2016), is the study of numbers and how they are used in culturally specific ways. Furthermore, stressed that these are reflected in cultural artifacts such mats, clay pots, beds, buildings, decorations, baskets, traditional drums, and fish traps. As a result, for the sake of this study, EM has been characterized as a teaching strategy that makes the learning of mathematics extremely meaningful by connecting cultural artifacts to mathematical principles. Mathematical instruction that considers the learner's cultural background is necessary in order to increase student accomplishment and to close the disparity in mathematics performance between native and European-centric mathematics.

In addition, guided instruction (GI) is a teacher-student interaction that includes questioning, dialog, feedback, and the creation of a controlled environment to encourage inquiry, exploration, discovery, and engagement (Carolyn & Scott, 2015). Small, focused groups that are formed depending on how well students performed on formative tests are virtually always used for GI. Students in the groups have a similar educational need that the teacher tries to meet. In GI, the instructor assigns an assignment for the class to perform collectively. The teacher circulates the room, observing and supervising each group as they cooperate to finish the assignment. This gives the teacher the chance to evaluate each student's progress and, if necessary, adapt instruction to match each student's needs. As a result, EMGI might give group members the chance to understand mathematics from their cultural perspective.

Regardless of a student's gender, the use of EMGI in the teaching of mathematics may aid in the development of students' intellectual, psychomotor and emotional learning by utilizing their own distinctive cultural referents. In Nigerian culture, the problem of sex distinction is quite severe. Nigerians hold the view that mathematics should be controlled by men because it is a subject that appeals to men. However, a review of the literature revealed that there is no agreement on whether male students perform better in mathematics than their female counterparts. As a result, It is anticipated that using EMGI in this study will have an equal influence on both male and female students' mathematics achievement. In light of this, the goal of this study was to determine how EMGI and LM affected Delta State students' mathematics achievement.

Statement of Problem

Due to mathematics' abstract nature, students have a very difficult time understanding it. Students did not comprehend the essential calculations, reasoning, or concepts, nor did they comprehend the underlying procedures that produced the mathematical facts. As a result of the traditional lecture method that is primarily used in Nigerian classroom training, which has consistently led to underperformance in mathematics, they turned to learning by memorization. Mathematics educators, researchers and stakeholders in Mathematics have been compelled to introduce innovative teaching strategies to enhance students' achievement in mathematics. But these strategies have not been able to take care of the past experiences the learner came to school with, as to link the past to present, so as to build the future. These situations have created the need for more effective teaching strategy such as EM approach which is a cultural and home-based approach that helps students learn mathematics from their cultural background. Therefore, the researcher want to try this home and cultural-based teaching approach (EMGI) since both the teacher and the learner would use familiar materials from their environment and their cultural activities to teach and learn topics in mathematics. The problem of this study is to determine whether using EMGI will boost students' mathematics achievement more than using the traditional LM.

Purpose of the Study

Examining how EMGI affects students' mathematics achievement in Delta State was the main objective of this study. The study's specific objectives were to ascertain the following:

1. the difference between students taught with EMGI and those taught with LM in terms of mathematics mean achievement scores;
2. the difference between male and female students' mathematics mean achievement scores when taught with EMGI; and
3. the nature of the interaction between the instructional method and sex on students' mathematics achievement.

Research Questions

The following questions guided the study:

1. How do students taught with EMGI and those taught with LM differ in terms of their mean mathematics achievement scores?
2. How do EMGI-taught male and female students differ in terms of their mean mathematics achievement scores?

Hypotheses

The following hypotheses guided this study:

1. The mean mathematics achievement scores of students taught with EMGI and those taught with LM do not significantly differ.
2. The mean mathematics achievement scores of male and female students who were taught with EMGI did not differ significantly.
3. There is no discernible interaction effect between sex and teaching strategies and students' proficiency in mathematics.

Methodology

The study was pre-test, post-test, control group, quasi-experimental, 2x2 factorial in design. The design has two treatment groups (EMGI & LM) across with sex at two levels (male & female). The independent variable is the instructional strategy (EMGI & LM), sex is the intervening variable, while achievement in mathematics is the dependent variables. The design is considered appropriate due to the intact classes and the rigid school time table that does not allowed the researcher to fully randomize the subjects. The design allowed the researcher to assign students to experimental and control groups based on their intact classes. In this study, six intact classes were used. Among the six intact groups, three for ethno-mathematics using guided instruction and three for lecture method. The full group's achievement scores were collected before and after the treatment, respectively. Table 1 displays the study's design.

Table 2: Design for the Study

Group	Pretest	Treatment	Posttest
EMGI (Experimental)	0_1	X_{EGI}	0_2
LM (Control)	0_3	X_L	0_4

Where, 0_1 and 0_3 = Pretest of EMGI and LM group respectively, 0_2 and 0_4 = Posttest EMGI and LM group respectively, X_{EGI} = Treatment with the use of EMGI, and X_L = Treatment with the use of LM.

19,978 SSII students in Delta State's 473 public secondary schools made up the study's population. 313 SSII students made up the study's sample. Using a stratified sample technique, the students were chosen from six intact public secondary school classes in Delta State. Data were gathered using the Mathematics Achievement Test (MAT). Three specialists face validated MAT. Using the Kuder-Richardson formula, MAT has a reliability coefficient of 0.79.

The researcher adopted Ajaja (2013) treatment procedure. The treatment procedure is discussed under the following stages: In the first stage, the researcher asked the principals of the sampled schools for their consent to use the students and teachers in their schools for this study. Thereafter which, the researcher familiarized herself with the mathematics teachers of the schools and briefed them on the purpose of the study. The second stage was the random assignment of the selected schools into experimental (EMGI) and control (LM) groups. In the third stage, for a total of five working days, the researcher used an EMGI training approach to train the normal Mathematics teachers assigned to the experimental group's schools. As for the teachers that handled the control group, they were not trained since LM is the conventional method of teaching. Meanwhile, the researcher provided a lesson plan for the teachers to use during treatment. The lesson contained the exact mathematics concepts as that of the experimental group. The only difference is the instructional procedure. The students in the two groups were pretested with the MAT a day to the beginning of actual treatment that lasted for six weeks.

Teaching geometry and mensuration to SSII students while utilizing the two teaching techniques (EMGI & LM) is the study's actual treatment. The MAT was given to the research participants in the control and experimental groups as a post-test at the conclusion of the six-week treatment period, and they were assessed. The information from the experimental and control groups' pretest and posttest was then compared.

Results

✓ How do students taught with EMGI and those taught with LM differ in terms of their mean mathematics achievement scores?

Table 2: Mean and Standard Deviation of Students Taught Mathematics Using EMGI and LM's Pretest and Posttest Achievement Scores

Group	N	Mean		MG	MGD	SD	
		Pretest	Posttest			Pretest	Posttest
EMGI	152	16.41	59.18	42.77	6.83	5.66	13.31
LM	161	16.45	52.29	35.84		5.64	13.03

N = Number of Subjects, MG = Mean Gain, MGD = Mean Gain Difference, SD = Standard Deviation

As indicated in table 2, the mean gain for students in EMGI group is 42.77, while the mean gain for the students in LM group is 35.84. The average gains of the two groups varied by 6.83, favouring EMGI.

✓ The mean mathematics achievement scores of students taught with EMGI and those taught with LM do not significantly differ.

Table 3: ANCOVA Comparison of Achievement Scores of Students taught Mathematics with EMGI and LM

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3799.406[a]	2	1899.703	10.937	.000
Intercept	107602.328	1	107602.328	619.517	.000
Pretest	78.626	1	78.626	.453	.502
Methods	3716.998	1	3716.998	21.401	.000
Error	53843.073	310	173.687		
Total	1026484.000	313			
Corrected Total	57642.479	312			

As shown in table 3, there is a significant difference between students who received mathematics instruction using EMGI and LM, with $F(1, 311) = 21.460$, $P(0.000) < 0.05$. This outcome renders Ho1 invalid. As a result, there is a substantial difference between the mean achievement scores in mathematics between students taught with EMGI and those taught with LM, favouring those who received EMGI instruction.

✓ How do EMGI taught male and female students differ in terms of their mean mathematics achievement scores?

Table 4: Male and Female Students Taught Mathematics with EMGI's Achievement Scores

Sex	N	Posttest		Mean Difference
		Mean	SD	
Male	70	59.14	13.76	0.08
Female	87	59.22	13.00	

As indicated in table 4, the posttest mean achievement score for male students in the EMGI group was 59.14, with a standard deviation of 13.76, while the posttest mean achievement score for female students was 59.22, with a standard deviation of 13.00. Male students are favoured by the mean difference between the two groups, which is 0.08.

✓ The mean mathematics achievement scores of male and female students who were taught with EMGI did not differ significantly.

Table 5: ANCOVA Comparison of Achievement Scores of Male and Female Students taught Mathematics with EMGI

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	21.164[a]	2	10.582	.059	.943
Intercept	58292.837	1	58292.837	324.992	.000
Pretest	20.942	1	20.942	.117	.733
EMGI	.440	1	.440	.002	.961
Error	26725.678	149	179.367		
Total	559168.000	152			
Corrected Total	26746.842	151			

$F(1, 149) = 0.002$, $P(0.961) > 0.05$ in table 5 demonstrates that there is no significant difference between the mean achievement scores of male and female students taught mathematics with EMGI. Ho5 is therefore not rejected. As a result, there is no discernible difference between the mean achievement scores in mathematics between male and female students who received EMGI instruction.

Hypothesis 3: There is no discernible interaction effect between sex and teaching strategies and students' proficiency in mathematics.

Table 6: ANCOVA Summary on Interaction Effect of Instructional Methods and sex on Mathematics Achievement

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4493.858[a]	4	1123.464	6.511	.000
Intercept	105690.797	1	105690.797	612.486	.000
Pretest	45.129	1	45.129	.262	.609
Methods	3687.324	1	3687.324	21.368	.000
Sex	318.746	1	318.746	1.847	.175
Methods * Sex	355.600	1	355.600	2.061	.152
Error	53148.621	308	172.560		
Total	1026484.000	313			
Corrected Total	57642.479	312			

With reference to students' mean achievement scores in mathematics, table 6 demonstrates that there is no significant interaction effect of instructional approaches and sex, $F(1, 308) = 2.061$, $P(0.152) > 0.05$. Therefore, Ho_7 is not rejected. As a result, there is no discernible interaction effect of sex and teaching strategies on students' achievement in mathematics.

Discussion of Findings

The results of the study showed that students who were taught using EMGI had significantly higher mean mathematics achievement scores than those who were taught with LM. The explanation for this observation could that the EMGI aligned the learning process to the cultural practices of the students thereby making the learning more real. In addition, the students taught with EMGI were active using their cultural practices to master the mathematics concepts taught. Furthermore, the students actively interacted with the learning materials, fellow students and the teacher during the course of learning. This is not the case for students in taught mathematics using the LM. The students taught with the LM only listened to the teacher explanation. In otherwords, information, ideas and knowledge were transmitted to the students in the final form with the students given little opportunity to ask questions as the lesson progresses. This may have explained why students who were taught mathematics using LM had lower achievement results than those who were taught using EMGI. This finding is consistent with that of Ubana, Abiam, and Enun (2017),

who found that EMGI teaching techniques considerably improve students' learning and achievement in geometry compared to traditional methods. This result supports the findings of Abiam, Abonyi, Ugama, and Okafor (2016), who discovered that an EM-based instructional strategy was more effective than the traditional technique at raising students' achievement in geometry.

The study also showed that there is no discernible difference in the mathematics mean achievement scores between students who were taught using EMGI who are male and female. This implies that EMGI is not sex dependent relative to students' achievement in mathematics. The fact that both male and female students participated actively in the teaching and lesson process clearly explains this discovery. Furthermore, since varieties of cultural practices were employed during instruction, individual differences resulting from students of different background and sex were eradicated. This finding agrees with that of Ozofor and Onos (2018) who found that both sex benefited significantly in achievement using EM approach. This result is also consistent with that of Khasanah, Usodo, and Subanti (2017), who discovered that when exposed to the EM technique, male and female students learned mathematics equally well.

The study also showed that there is no discernible interaction between sex and teaching on students' proficiency in mathematics. This suggests that students' sex has no bearing on their mathematics proficiency results when compared to the teaching strategy. This result supports Ubana, Abiam and Enum's (2017) conclusion that there is no significant interaction between EM and sex and student achievement in geometry.

Conclusion

Based on the study's findings, it was concluded that EMGI, more than LM, facilitates students' knowledge of mathematics concept leading to a better achievement. It is also concluded EMGI is not sex dependent in relation to achievement in mathematics.

Recommendation

The researcher recommended the following based on the conclusion drawn from this study:

i. The adoption of EMGI in teaching mathematics at the secondary school level. This may help make the teaching and learning of Mathematics look real.
ii. Furthermore, students' cultural background and practices should be incorporated into the teaching and learning process by Mathematics teachers to facilitate students' comprehension of mathematics concepts.
iii. Mathematics teachers should ensure that students' varied cultural practices are catered for during the use of EMGI by employing varieties of cultural practices.

Contribution to Knowledge

This following are the contributions of this study to knowledge.

i. The study established that EMGI is a more effective instructional method than the LM in promoting students' achievement in mathematics.
ii. The study re-affirmed that EMGI did not affect male and female students differently in relation to achievement in mathematics.

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