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ENHANCING STUDENTS' ACADEMIC PERFORMANCE THROUGH UTILIZATION OF ETHNO-MATHEMATICS AND ETHNO-BASIC SCIENCE IN CROSS RIVER STATE, NIGERIA.

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ABSTRACT

This study investigated the effect of ethno-mathematics and ethno-basic science on students' academic performance in Calabar Municipality. The study adopted a quasi-experimental pretest posttest design. The population comprised all the four thousand, five hundred and seventy-six (4,576) Junior Secondary School Students in the fourteen (14) Government-owned schools in the study area. Four (4) schools were randomly selected as sample with two (2) schools selected for experimental group and the other two (2) for control group with the total number of 160 students (an intact class of eighty students in each of the groups). The instrument used for data collection was Mathematics and Basic Science Achievement Test (MBSAT) comprising 25 questions on mathematics for section A and 25 questions on basic science for section B which were scored separately. The instrument went through face and content validity with the reliability coefficient of 0.89 and 0.78 respectively using Kuder Richardson (KR21). Four research questions were answered using descriptive statistics of mean and standard deviations while the four hypotheses were tested using t-test statistic at 0.05 level of significance. Major findings of the study revealed that ethno-mathematics and ethno-basic science enhances effective learning of mathematics and basic science. The mean performance score difference between male and female students was negligible, thus the strategy is gender friendly. It was thus recommended among others that Junior Secondary School teachers should adopt the use of ethno-mathematics and ethno-basic science in the teaching of these subjects.

Keywords: Academic Performance, Ethno-Basic Science, Ethno-Mathematics and Gender.

INTRODUCTION

Learning difficulties in school mathematics and basic science have been the focus and concern here. Students' academic achievement in mathematics and basic science have declined over the years (Shaibu, 2014). Students often become bored in science and mathematics classes, complaining that the subjects are difficult to understand (Olotu & Ugwuanyi, 2017), also the process of teaching is done out of its relativity with the culture and the environment of the learners (UNESCO, 2004). It therefore, means that most teachers are adopting a method of instruction that may not help the students

understand these subjects to enable them perform well in external and internal examinations. Research studies like Udo (2015) posited that these methods used are teacher-centered and hence students do not understand fundamental mathematics and basic science concepts correctly. Teachers are expected to stay up-to-date on the latest research and implement new teaching strategies in an effort to be more effective in the classroom. The best way of guiding the students to learn as proposed by recent educators and researchers (Hussaini,2018 and Ekwueme,2013) is to make use of materials that are familiar and culturally-based with the aim of bringing the students face to face with the society rather than presenting mathematics and basic science as abstract subjects. Hence, the introduction of ethno-mathematics and ethno-basic science as a substitute and better pedagogy for the teaching and learning of mathematics and basic science.

Ethno-mathematics and ethno-basic science in this context can be seen as the teaching and learning of mathematics and basic science which takes into consideration the culture and environment in which the learners are from. Ekwueme (2013) described ethno-mathematics as a discipline that is interested in the study of mathematics and mathematics education in the cultural milieu of the learners. Also, Olotu and Ugwuanyi (2017) stated that educators need to understand the fundamental and culturally-based beliefs that the students bring to the class and how these beliefs are supported by students' culture because science is successful only to the extent that science find a niche in the cognitive and socio-cultural milieu of the students. Ethno-teaching strategy is practiced among identifiable cultural group. In mathematics, it refers to a broad cluster of ideas ranging from distinct numerical and mathematical system to multicultural mathematics education. This also cuts across all disciplines. Ekwueme further added that the goal of ethno-mathematics is to contribute both to the understanding of culture and the understanding of mathematics and mainly to lead to an appreciation of the connection between them. Accordingly, Hammond (2000) defines ethno-mathematics as the study of culturally related aspect of mathematics. This deals with the comparative study of mathematics and basic science of different human culture and environment especially in regards to how these subjects have shaped and in turn have been shaped by the values and beliefs of groups of people. Johnson (2008) exerted that students' perception in the classroom is a function of their cultural setting and religious idiosyncrasies. The ability to decode messages and concepts by the learners depends on the learners' cultural background. In the same vein, Ineji (2013) found out that if a teacher explains a concept to the learner, any meaning that the learner ends up with, is entirely built from the idea, experience and attitude that learners already have prior to the message. Also, Mtsem (2009) posited that many students fail to understand some concepts in mathematics and basic science because of the absence or non-reference to sound entry behavior. With the use of ethno-mathematics and ethno-basic science students will understand fundamental concepts better in mathematics and basic science since the teacher uses materials and concepts that the learners are familiar with.

There are several illustrations to show that if teachers make reference to the environment where the learners study, it could help the students understand concepts better. For example, the preparation of hydrogen in basic science can be illustrated comfortably using Tamarind and Potash (Akang), transparent plastic bottles to represent flask and drinking straw to replace the delivery tubes (Hussaini,

2018). Again, in method of separation of mixtures, alcohol could be extracted from locally produced palm-wine through the process of distillation; iron flakes/ filings from welders could be collected, mixed with saw dust from timber market and this can be separated using a piece of magnet (Mandor,2004). Mandor further stated that salt could be produced from sea water through the process of evaporation as well as decantation, which could also be taught using locally produced raw pap (akamu). The researchers proposed that, teachers could make trips to places like Zoo, Cercopan and Marina Resort in Calabar to teach the students about behaviours, structures and relationships between plants and animals in their natural habitat.

Different local tribes in Cross River are rich in concepts such as riddles, games, crafts, events, objects and other traditional festivals. In mathematics, concepts like number bases and modular arithmetic could be taught using market days which comes up every five days in Bekwarra local government area of Cross River state. Also, the concept of ratio could be taught using marriage rituals in Ugep where marriage cannot be completed except these five requirements are met (Food, Drinks, Meat, Kola nut and Traditional decorations) and are shared as follows: father 60%, mother 20%, Daughter 20%. Likewise, Calabar dancing styles are in curves, circles, semi-circle and straight lines and these could be useful in the teaching of geometrical concepts in mathematics. Traditional counting system in most cultures in Cross River are in 5s, 10s, 20s among others. This could be used in teaching number bases in mathematics classrooms. Considering the structure of houses in Calabar, Cross River, the shape of the doors and windows are rectangular, the roofs are in triangular shapes and trapezium. Other parts of the houses show some geometrical shapes like cylindrical, conical and square. This can be used in teaching geometrical concepts. (Agwu, Ajie, Azuka,Oluwaniyi, Oloda, Awogbemi, Durojaiye, Okwuoza, Lemo&Pelemo, 2019).

Another variable investigated in this study is gender. Gender can be explained as an identifiable human characteristic that can affect students' level of performance in the various subjects (Bala, 2018). Recent studies in education like Bala and Ekon & Eni (2015) had expressed concern on gender related issues with a view to improve teaching and learning in schools. Jimoh (2005) reported that the position of females in science, mathematics and vocational education is below average when compared to males. Ahmed (2008) reported that studies have shown that girls and boys have different attitudes towards science and mathematics. Ekon and Eni asserted that gender did not significantly influence the acquisition of science process skills visa-vis their academic performance in a study conducted to examine gender and acquisition of science process skills in Calabar municipality of Cross River state, Nigeria. Bala also reported a negligible mean performance score difference between male and female students, indicating a gender friendly teaching strategy used in the study.

Therefore, multi culturizing mathematics and basic science curriculum is considered important in order to improve its quality to upgrade the cultural confidence of all learners. Hence, the researchers investigated the influence of ethno-mathematics and ethno-basic science on students' academic achievement.

Problem of the study

The Federal Government of Nigeria (FGN, 2014) explained that the teaching of mathematics and basic science at the junior secondary level should be in an integrated manner to promote students' learning through the learners' application of the skills and knowledge obtained into solving problems. The strategy should also be activity-based, using materials and methods that learners are familiar with for better understanding of concepts. Unfortunately, most mathematics and basic science teachers do not possess such skills, rather are dogmatic on the use of chalk and board strategies.

The lack of the use of ethno-mathematics and ethno-basic science strategies which are activity-based have resulted into learners' poor achievement in mathematic (Ekwueme, 2013) and basic science (Mandor, 2004) as this is evidenced in the poor performance of students in Junior Secondary School Certificate Examination. Duguryil (2017) revealed a similar situation of consistent decline in performance of learners in an analysis of JSSCE result in Mathematics and Basic Science in public secondary schools in Jos, Plateau state from 2014-2017. The reason could be that the mathematics and basic science taught in most schools are foreign, Eurocentric in origin and built on Western cultural background, making students to learn by rote or memorization thereby having poor performance (Ozofor&Onos; 2018). In view of the above, there is therefore the need to develop and adopt teaching methods that are capable of improving the reasoning and logical ability of the leaners to enable them retain concepts. There are also gender disparities in mathematics and basic science performance. Could the use of ethno-mathematics and ethno-basic science be gender friendly? It is on this note that the researchers sought to determine the effect of ethno-mathematics and ethno-basic science on secondary school students' academic performance.

Purpose of the study

The main aim of the study is to:

i. Investigate the effect of ethno-mathematics on students' academic achievement in mathematics.
ii. Ascertain the effect of ethno-science on students' academic achievement in basic science.
iii. Examine if the use of ethno-mathematics in teaching is gender sensitive.
iv. Examine if the use of ethno-basic science in teaching is gender friendly or not.

Research questions

i. How do the mean academic achievement scores of mathematics students taught using ethno mathematics differ from those taught using lecture method?
ii. How do the mean academic achievement scores of basic science students taught using ethno science differ from those taught using lecture method?
iii. What is the difference in the mean academic performance scores of male and female students when taught using ethno-mathematics?
iv. What is the difference in the mean academic performance scores of male and female students when taught using ethno-basic science?

Research hypotheses

i. There is no significant difference in the academic achievement of Junior Secondary School students taught mathematics using ethno-mathematics and those taught using lecture method.
ii. There is no significant difference in the academic achievement of Junior Secondary School students taught Basic Science using ethno-science and those taught with lecture method.

iii. There is no significance difference in the mean performance of male and female students when taught with ethno-mathematics.
iv. There is no significance difference in the mean performance of male and female students when taught with ethno-basic science.

METHODOLOGY

The design used for this study was quasi-experimental and control group design. A pre-test was administered to both experimental and control group students using the same test instrument before treatment. This was done to determine the entry knowledge level of the students. The study was conducted in Calabar municipality in Cross River State. The population of the study comprised all the fourteen (14) government-owned Junior Secondary School two (JSS2) students in 2021/2022 academic session and they were four thousand, five hundred and seventy-six (4,576) students (State Education Resource Center) in Calabar municipal council area, Cross River state.

Sample and sampling technique

One hundred and sixty (160) students were sampled from a total of 4,576 Junior Secondary School two (JSS2) students using simple random sampling technique. The simple random sampling technique was used to select four schools from the population. Two schools were used for the experimental group and the other two, for the control group.

Intervention

The experimental group were taught using ethno-mathematics and ethno-basic science strategy while the control group were exposed to the same content using lecture method. For the experimental group the lesson plan on the use of ethno-mathematics and ethno-science were separately developed by the researchers and given to the research assistance (host teachers) after training them on their use.

For the control group, lesson plan was developed using lecture method and given to the host teachers for use. The two groups were taught separately for a period of six weeks and a duration of 40 minutes for each lesson. At the end of the treatment, post-test was administered to each of the groups to determine their academic achievement and the effect of the treatment.

Instrument for data collection

The instrument used for data collection was Mathematics and Basic Science Achievement Test (MBSAT) comprising 25 questions on mathematics for section A and 25 questions on basic science for section B which were scored separately. The instrument was a researchers' constructed pre-test and post-test which were with items of the same difficulty level and pattern. The instruments were made up of 50 multiple choice test items drawn from Basic Education Certificate Examination past question papers. Twenty-five questions were on basic Science while the remaining twenty-five were on mathematics. Each correct answer was given two marks while wrong answer or unanswered question attracted zero score.

Validity and reliability

The pre-test and post-test questions were subjected to face and content validity by experts in the Department of Educational Foundation, University of Calabar, Calabar, Cross River state. A pilot testing of the instrument was carried out on a sample of 50 students outside the target sample. Kuder

Richardson (KR 21) was used to determine the reliability coefficient for section A (Mathematics achievement test) and section B (Basic science achievement test) and these were found to be 0.89 and 0.78 respectively.

Administration of the instrument

The pretest was administered to both the control group and experimental group before the commencement of the treatment. After the treatment, the post-test was also administered. The duration for the test was 50 minutes each for the pretest and post-test, after which the answer scripts were collected and marked by the researchers.

Method of data analysis

Mean and standard deviations were used to answer the research questions while independent t-test statistic was used to test the null hypotheses at 0.05 level of significance.

RESULT

Research question one: How do the mean academic achievement scores of mathematics students taught using ethno-mathematics differ from those taught using lecture method?

Table 1: Descriptive statistics for Post-test mean academic performance between Experimental and Control group when taught using ethno-mathematics and lecture method respectively

Group	N	Mean	S.D.	Mean Difference
Experimental	80	85.53	09.33	30.63
Control	80	54.90	06.23	

Table 1 presents the mean scores and standard deviation of the experimental and control groups post-test scores. The mean post-test performance score for experimental group was 85.53 with a standard deviation of 09.33. In the same vein, the control group had 54.90 with a standard deviation of 06.23. From the table, the experimental group students had a higher mean score of 85.53 while the control group had 54.90. This indicates that students taught with ethno-mathematics performed better than their counterparts taught with lecture method.

Research question two: How do the mean academic achievement scores of basic science students taught using ethno-science differ from those taught using lecture method?

Table 2: Descriptive statistics for post-test mean academic performance between experimental and control group when taught using ethno-science and lecture method respectively.

Group	N	Mean	S.D.	Mean Difference
Experimental	80	67.00	06.10	18.30
Control	80	48.70	05.28	

Table 2 presents the mean scores and standard deviation of the experimental and control groups post-test scores. Students taught using ethno-science had the mean post-test performance score of 67.00 which was significantly higher than those taught with lecture method who had the mean score of 48.70. This implies that experimental students performed better in Basic Science when taught using ethno-science strategy than those in the control group who were taught with lecture method.

Research question three: What is the difference in the mean academic performance scores of male and female students when taught using ethno-mathematics?

Table 3: Descriptive statistics for post-test mean academic performance between male and female students in the experimental group taught using ethno-mathematics

Gender	N	Mean	S.D.	Mean Difference
Male	36	87.13	08.11	2.92
Female	44	84.21	07.97	

Table 3 shows the mean scores and standard deviations of the male and female students post-test scores. Male students taught using ethno-mathematics had the post-test mean academic performance score of 87.13 and standard deviation of 08.11 which was slightly significantly higher as compared to female students with the mean score of 84.21 and standard deviation of 07.97. This implies that male students slightly performed better than their female counterparts in mathematics when taught using ethno-mathematics strategy.

Research question four: What is the difference in the mean academic performance scores of male and female students when taught using ethno-basic science?

Table 4: Descriptive statistics for post-test mean academic performance between male and female students in the experimental group taught using ethno- basic science

Group	N	Mean	S.D.	Mean Difference
Male	36	67.98	07.62	1.66
Female	44	66.32	07.53	

Table 4 also had similar case, where the males had slight mean score difference of 67.98 and standard deviation of 07.62 as compared to their female counterparts with a mean score of 66.32 and standard deviation of 07.53. Hence, male students taught with ethno-basic science performed slightly better than their female counterparts.

Null hypothesis

$H0_1$: There is no significant difference in the mean academic achievement of Junior Secondary School students taught mathematics using ethno-mathematics and those taught using lecture method.

Table 5: Independent t-test analysis of students' scores in mathematics

Group	N	Mean	S.D.	t-cal	t-cri	
Experimental	80	85.53	09.33	10.68	1.96	
Control	80	54.90	06.23			

df 158, significant at 0.05 level.

From table 5, the calculated t-value of 10.68 is greater than the table value of 1.96 with the degree of freedom 158 at 0.05 level of significance. This implies that the null hypothesis is rejected, hence it is concluded that there is significant difference between junior secondary school students taught mathematics using ethno-mathematics strategy and those taught using lecture method, as those in the experimental group outperformed those in the control group.

HO2: There is no significant difference in the mean academic achievement of Junior Secondary School students taught basic science using ethno-science and those taught with lecture method.

Table 6: Independent t-test analysis of students' post-test scores in Basic Science

Group	N	Mean	S.D.	t-cal	t-cri	
Experimental	80	67.00	06.10	6.73	1.96	
Control	80	48.70	05.28			

df 158, significant at 0.05 level.

Table 6 revealed the value of t-calculated to be 6.73 which is greater than t-critical value of 1.96 with the degree of freedom 158 at 0.05 level of significance. This means that the null hypothesis is rejected. This analysis shows that there was a significant difference in students' mean academic performance when taught using ethno-science strategy and when taught with lecture method. It therefore, implies that students taught with ethno-basic science in the experimental group out-performed their counterparts in the control group.

HO3: There is no significance difference in the mean performance of male and female students when taught with ethno-mathematics.

Table 7: Independent t-test analysis for post-test mean academic performance between male and female students in the experimental group taught using ethno-mathematics.

Group	N	Mean	S.D.	t-cal	t-cri	
Male	36	87.13	08.11	0.86	1.98	
Female	44	84.21	07.97			

df 78, significant at 0.05 level.

Table 7 shows the t-test analysis for post-test performance between male and female students in the experimental group taught using ethno-mathematics. The analysis revealed the value of t-calculated as 0.86 and t-critical as 1.98 with degree of freedom of 78 at 0.05 level of significance. It was observed that the calculated t value of 0.86 is less than the critical t- value of 1.98. Therefore, the null hypothesis is retained. This implies that there was no significant difference in the academic achievement of male and female students taught using ethno-mathematics.

HO4: There is no significance difference in the mean academic performance of male and female students when taught with ethno-basic science.

Table 8 Independent t-test analysis for post-test mean academic performance between male and female students in the experimental group taught using ethno-basic science.

Group	N	Mean	S.D.	t-cal	t-cri	
Male	36	67.98	07.62	0.46	1.98	
Female	44	66.32	07.53			

df 78, significant at 0.05 level.

Table 8 shows the t-test analysis for post-test performance between male and female students in the experimental group taught using ethno-basic science. Analysis revealed the value of t-calculated as 0.46 with degree of freedom of 78 at 0.05 level of significance. It was observed that the calculated t value of 0.46 is less than the critical t- value of 1.98. Therefore, the null hypothesis is retained. This implies that there was no significant difference in the academic achievement of male and female students taught using ethno-basic science.

DISCUSSION OF FINDINGS

The findings of this study revealed among others that students taught with either ethno-mathematics or ethno-basic science in the experimental groups outperformed their counterparts in the control groups taught with lecture method in the two subjects. This indicates that the students understood the concepts taught in these subjects because the learning materials used were familiar and culturally based. These findings are in agreement with Mtsem (2009) who discovered that many students failed to understand some concepts in mathematics/Basic Science because of absence or non-reference to the use of familiar objects and culturally based events. The study suggests that presenting learning materials that are familiar to the students' environment and culturally based events in the classroom help to stimulate students' interest and curiosity. This led to the students' high academic performance in their various subjects in the experimental group.

Findings from this study also revealed that, the mean performance score difference of male and female students was negligible. This indicates that both male and female students had almost the same performance as the strategy does not discriminate gender. This is in consonance with previous studies where Ekon and Eni (2015) registered no significant difference in gender and Bala (2018) who reported negligible academic mean score difference in gender. Thus, ethno-mathematics and ethno-basic science strategies are gender friendly, in this case it does not discriminate between gender.

CONCLUSION

Based on the findings of this study, it is obvious that students taught with ethno-mathematics and ethno-basic science are directly linked to improved performance. When students are exposed to familiar, environment friendly and culturally-based materials, concepts learnt are easily understood vis-à-vis their performance.

Recommendations

I. Basic science and mathematics teachers should try to relate academics to the students' environment.
ii. Ministry of Education should organize seminars and workshops on a regular basis to update teachers' knowledge on innovative strategies which are activity and culturally based.

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