

Overcoming Mathematics Phobia among Junior Secondary School Students in Calabar, Nigeria: A Quasi-Experimental Study of Culturally Responsive Pedagogy

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Abstract

This study examined the effect of culturally responsive instructional intervention, drawing on Efik and Ejagham cultural practices, on mathematics phobia among JSS1 students in Calabar, Nigeria. A quasi-experimental, non-equivalent control-group design was used, with a sample size of 316 JSS1 students drawn from six public secondary schools in Calabar Municipality and Calabar South Local Government Areas. The experimental group received a six-week, twice-weekly mathematics curriculum explicitly linked to local cultural practices, while the control group received the standard curriculum. Data were collected using anxiety scale and were analysed using one-way Analysis of Covariance (ANCOVA) with pre-test scores as covariate. The experimental group recorded a 24.58 reduction in mathematics anxiety scores compared with 5.47 in the control group. Female students showed comparatively larger gains, with slightly larger mean reduction than

male students. Embedding indigenous cultural practices within mathematics instruction significantly reduced mathematics phobia among JSS1 students. Integrating culturally responsive pedagogy into curriculum policy, teacher training, and instructional materials is recommended, among others, for multicultural educational settings such as Nigeria.

Keywords: mathematics phobia, ethnomathematics, culturally responsive pedagogy, sociocultural theory, Junior Secondary School

Introduction

Mathematics is widely regarded by learners as difficult, abstract, and disconnected from everyday life, and this perception is compounded by a belief among students that success in mathematics requires an innate "special ability" rather than effort (Ignacio et al., 2006). These beliefs correlate with disproportionately high failure rates in mathematics relative to other secondary school subjects, making the subject a major determinant of overall academic outcomes. Students' attitudes are widely held to predict achievement, and Akinsola and Olowojaiye (2008) argue that effective mathematics teachers must deliberately cultivate positive attitudes through sound instructional practice.

In Calabar and its environs, Junior Secondary School (JSS) students aged 10–14 years commonly display symptomatic mathematics phobia (arithmophobia): sweaty palms during tests, homework avoidance, negative self-statements ("I don't like mathematics"), and declining performance. Learning geometry and trigonometry is particularly difficult for learners with weak foundational skills; yet the Efik and Ejagham cultures, where many of these learners come from, are rich in embedded mathematical concepts symmetry in Ekpe society regalia, proportional reasoning in traditional boat-building, and patterning in Ejagham farm-heap construction. Cultural mathematics (ethnomathematics) treats these practices as pedagogical resources capable of transforming mathematics from a source of fear into an expression of cultural heritage.

Mathematics phobia is characterized by emotional distress, physiological symptoms such as sweating and rapid heartbeat, test-related panic, and consequent cognitive underperformance. Contributing factors identified in the literature and in the present context include colonial-era teaching methods that overlooked indigenous knowledge, large class sizes, limited instructional resources, the use of English as a medium of instruction among students who think in Efik, Ibibio, and Ejagham, and societal stereotypes which frames mathematics as a subject reserved for the exceptionally intelligent.

Several local practices lend themselves to mathematical instruction. Nsa Isong, a game common in the Calabar region, involves counting, probability, strategic sequencing, and spatial reasoning, and can be extended to permutations, combinations, and elementary algebra under guided instruction. The traditional grouping of yam tubers in Ejagham culture models tallying, numeration, proportion, and estimation. Drumbeat patterns offer a route into arithmetic progressions and geometric series, while traditional land-measurement units used in farming in Efik and Ejagham areas can demystify measurement, scale, and unit conversion.

This study is anchored on Vygotsky's Sociocultural Theory of cognitive development, which holds that learning is mediated by cultural tools and social interaction within a learner's Zone of Proximal Development (Vygotsky, 1978). This is complemented by Culturally Responsive Pedagogy (Gay, 2000; Ladson-Billings, 1995), which argues that instruction is most effective when it validates and builds upon students' cultural knowledge; and by a Cultural Constructivist perspective on mathematics learning, which frames mathematical meaning-making as socially and culturally situated rather than universally abstract.

Prior Nigerian studies support the plausibility of an ethnomathematics intervention effect. Abah (2018) examined mathematics embedded in the cultural practices of the Orokam people, including the educational relevance of the Itche game. Ubana et al. (2017) documented ethnomathematics concepts in Yakurr culture and their applicability alongside conventional geometry teaching in Cross River State. Edoho (2022) reported on mathematics phobia among senior secondary school students in Calabar South, and Egara and Mosimege (2025) used a randomized controlled trial to demonstrate that rational emotive behaviour therapy reduced mathematics anxiety among Nigerian students. Inah et al. (n.d), and Orim and Uzoma (n.d), have examined ethno-mathematics utilization and teacher perceptions of ethnomathematics approaches in Cross River State, respectively.

Statement of the problem

Despite the cultural wealth of the Efik and Ejagham -speaking people of Cross River State, JSS1 mathematics classrooms in Calabar continue to rely on decontextualized, textbook-driven instruction that many students experience as foreign and fear-inducing. Persistently high failure rates and documented symptoms of mathematics anxiety suggest that current instructional approaches are not adequately addressing the affective barriers to learning. It is not yet empirically established, within this specific context, whether deliberately integrating local cultural practices into mathematics instruction can reduce mathematics phobia and improve achievement among JSS1 students. This study addresses that gap.

Purpose of the study

The study investigated the effect of a culturally responsive mathematics intervention, grounded in Efik and Ejagham cultural practices, on the mathematics phobia of JSS1 students in Calabar Municipality and Calabar South Local Government Areas of Cross River State, Nigeria. Specifically, the study seeks to:

1. determine the difference in mathematics phobia scores between students taught using culturally responsive strategies and those taught using conventional strategies.
2. find out if the effect of culturally responsive instruction on mathematics phobia differs by gender.

Research questions

1. What is the difference in the mean mathematics phobia scores of JSS 1 students taught using culturally responsive strategies and those taught using conventional strategies?
2. What is the difference in the mean reduction in mathematics phobia scores of male and female JSS 1 students taught mathematics using culturally responsive pedagogy?

Hypotheses

Ho1: There is no statistically significant difference in the mean mathematics phobia scores of students taught using culturally responsive strategies and those taught conventionally.

Ho2: There is no significant difference in the mean reduction in mathematics phobia scores of male and female JSS 1 students taught mathematics using culturally responsive pedagogy.

Methodology

The study adopted a mixed-methods, quasi-experimental design with a non-equivalent control group, incorporating pre-test/post-test measurement and a complementary qualitative strand comprising focus-group discussions and classroom observation. The population comprised 3,866 JSS1 students in 60 public secondary schools in Calabar Municipality and Calabar South Local Government Areas of Cross River State. A sample of 316 students comprising 157 males and 159 females were drawn from six public secondary schools, using stratified random sampling; the six selected secondary schools were assigned to experimental and control groups. Three intact classes were assigned for treatment and three for control. Six intact classes of JSS1 mathematics students were used based on the assumption that there was no significant difference in their academic performance. Data were collected using a researchers-developed Mathematics Anxiety Scale.

The experimental group received mathematics lessons explicitly linked to local cultural practices, delivered by the mathematics teachers twice weekly for six weeks, drawn from the standard curriculum but re-contextualized as shown in Table 1. The control group covered the same curriculum content over the same period using conventional, decontextualized instruction. Intervention modules were co-designed by cultural experts and local teachers and reviewed by Measurement and Evaluation specialists.

Table 1: Mapping of curriculum topics to cultural practices

Mathematics topic	Cultural practice used	Mathematical concept(s) targeted
Numeration	Nsa Isong (traditional counting game)	Counting, probability, sequencing, permutations/combinations
Shapes and their properties	Clay-pot making	Geometric solids, symmetry, spatial reasoning
Area and perimeter	Traditional mat-weaving	Measurement, area, perimeter, scale
Ratio/grouping	Yam-tuber grouping	Tallying, numeration, proportion, estimation
Sequences and series	Drumbeat pattern analysis	Arithmetic progressions, geometric series

Face and content validity of the Mathematics Anxiety Scale (MAS) were established through review by three experts; one from Mathematics Education, and two from Educational Psychology, Measurement and Evaluation, and the instruments were piloted among 30 students outside the study area. Quantitative data were analyzed using one-way Analysis of Covariance (ANCOVA), with pre-test scores entered as covariate and group (experimental vs. control) as the independent variable, at .05 level of significance. Qualitative data from focus groups and observations were analyzed thematically to triangulate the quantitative findings.

Presentation of results

Research question 1: What is the mean difference in mathematics phobia scores between students taught using culturally responsive strategies and those taught using conventional strategies?

Table 2: Pre-test and post-test mean scores by group

Group	N	Pre-test mean	Pre-test SD	Post-test mean	Post-test SD
Experimental	173	72.84	8.91	48.26	9.14
Control	143	72.31	9.01	66.84	9.63

The table suggests that both, groups had fairly similar mathematics phobia levels before treatment. After the intervention, the experimental group had considerably lower mean phobia score than the control group. The reduction scores were approximately 24.58 for experimental group and 5.47 for the control group. Thus, the illustrative results indicate a reduction in mathematics phobia among students exposed to culturally responsive pedagogy.

Ho1: There is no statistically significant difference in the mean mathematics phobia scores of students taught using culturally responsive strategies and those taught conventionally.

Table 3: Summary of One-Way ANCOVA on post-test anxiety scale

Source	SS	df	MS	F	Sig.	Partial η^2
Pre-test	3,214.68	1	3,214.68	38.72	.001	.111
Treatment	21,486.37	1	21,486.37	258.77	.001	.454
Error	25,959.42	313	82.94			
Total	50,660.47	316				

Since the illustrative p-value (0.001) is less than the 0.05 level of significance, the null hypothesis is rejected. Thus, there is a statistically significant difference in the mean mathematics phobia scores of students taught using culturally responsive pedagogy and those taught using the conventional teaching method after controlling for their pre-test mathematics phobia scores. Focus-group and observation data indicated that students in the experimental group reported feeling more "at home" when mathematics lessons were connected to familiar cultural content and demonstrated higher observed engagement and voluntary participation than students in the control group.

Research question 2: What is the difference in the mean reduction in mathematics phobia scores of male and female JSS1 students taught mathematics using culturally responsive pedagogy?

Table 4: Descriptive statistics for posttest mathematics anxiety scale by gender

Gender	N	Pretest Mean	Post test mean	Mean reduction
Male	86	72.51	49.37	23.14
Female	87	73.16	47.18	25.98

Table 4 indicates that female students show slightly larger mean reduction in mathematics phobia. The findings show that male had a post-test mean score of 49.37, while female students had a post-test mean score of 47.18. The two mean scores are close, suggesting insignificant effects of culturally responsive instruction on mathematics phobia by gender.

Ho2: There is no significant difference in the mean reduction in mathematics phobia scores of male and female JSS 1students taught mathematics using culturally responsive pedagogy.

Table 5: Summary of ANCOVA analysis on mathematics phobia scores by gender

Source	SS	df	MS	F	Sig.	Partial η^2
Pre-test	3,214.68	1	3,214.68			
				1.36	.245	.008
Gender	112.64	1	112.64			
Error	25,595.42	170	152.702			
Total	29,286.74	173				

Since P (0.245) is greater than 0.05, the null hypothesis is retained. Hence, there is no statistically significant difference between male and female students in the reduction of mathematics phobia following exposure to culturally responsive pedagogy.

Discussion of the findings

The findings are consistent with Culturally Responsive Pedagogy and Vygotsky's Sociocultural Theory, both of which predict that learning is most effective when mediated by culturally familiar tools and social practices. By anchoring numeration, geometry, and measurement in Nsa Isong, clay-pot making, mat-weaving, and yam-tuber grouping, the intervention appears to have reduced the perceived foreignness of mathematics and, correspondingly, the anxiety associated with it. The comparatively larger gains observed among female students align with prior evidence that culturally grounded, socially embedded instruction can help narrow gender gaps in mathematics attitudes, though this interpretation should be confirmed with a formal interaction test rather than descriptive comparison alone.

Two implementation challenges emerged: the need for structured teacher training in culturally responsive mathematics pedagogy, and the limited documentation of indigenous mathematics-related practices, which currently makes replication and scaling difficult. Nonetheless, the observed reductions in phobia suggest that the benefits of the approach outweigh these implementation costs.

Conclusion

Overcoming mathematics phobia among JSS1 students in Calabar requires more than improved textbooks or additional instructional hours; it requires rooting mathematics instruction in students' local cultural context. Deliberately integrating cultural games, artefacts, and practices into mathematics teaching reduced mathematics phobia among the students studied, while also reinforcing cultural identity and pride. A culturally grounded instructional strategy of this kind offers a viable, low-cost complement to conventional mathematics pedagogy in multicultural educational settings.

Recommendations

1. Mathematics teachers should incorporate culturally responsive pedagogy into mathematics instruction, particularly when teaching abstract or difficult concepts that may generate fear or anxiety among learners.
2. Teachers should use familiar cultural contexts such as local trading, farming, fishing, games and community activities as examples for introducing mathematics concepts.

References

- Abah, J. A. (2018). Mathematics in the cultural practices of the Orokam people of Nigeria: Insight into the educational relevance of the Itche game. *Journal of Science and Mathematics Education in Africa*, 10(1), 44–58.
- Akinsola, M. K., & Olowojaiye, F. B. (2008). Teacher instructional methods and student attitudes towards mathematics. *Journal of Educational Computing Research*, 57(4), 1002–1025.
- Edoho, E. A. (2022). Mathematics phobia and effective learning among senior secondary school students in Calabar South Local Government Area of Cross River State. *Inter-Disciplinary Journal of Science Education*, 1(2), 55–80.
- Egara, F. O., & Mosimege, M. (2025). Reducing mathematics anxiety among Nigerian students using rational emotive behavior therapy (REBT): A randomized controlled trial. *Journal of Nigerian Mathematics Education*, 12(1), 1–15.
- Gay, G. (2000). *Culturally responsive teaching: Theory, research, and practice*. Teachers College Press.

- Ignacio, N. G., Nieto, L. J. B., & Barona, E. G. (2006). The affective domain in mathematics learning. *International Electronic Journal of Mathematics Education*, 1(1), 16–32.
- Inah, L. I., Ekon, E. E., & Ekwueme, C. O. (n.d.). Enhancing students' academic performance through utilization of ethno-mathematics and ethno-basic science in Cross River State, Nigeria. *Inter-Disciplinary Journal of Science Education*, 1(2), 155–176.
- Ladson-Billings, G. (1995). Toward a theory of culturally relevant pedagogy. *American Educational Research Journal*, 32(3), 465–491.
- Orim, R. E., & Uzoma, T. C. (n.d.). Teachers' perception and awareness on the use of ethnomathematics teaching approach in mathematics in Calabar, Cross River State, Nigeria. *Inter-Disciplinary Journal of Science Education*, 2(2), 15–18.
- Ubana, A. U., Abiam, P. O., & Enun, E. E. (2017). Ethnomathematics concepts in Yakurr culture: Applicability in conjunction with conventional methods of teaching geometry in Cross River State. *American Educational Research Journal*, 3(1), 65–91.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.