International Journal of Evaluation and Research in Education (IJERE)
Vol. 15, No. 4, August 2026, pp. 3636~3645
ISSN: 2252-8822, DOI: 10.11591/ijere.v15i4.39263

Blended-language instructional-approach as a determinant of science learning in rural classrooms

Atomatofa Rachel Ovuezirie[1], Sekegor Crescentia Ojenikoh[2], Avbenagha Andrew[1], Ewesor Stella[1]
[1]Department of Integrated Science, School of Sciences, Delta State College of Education, Mosogar, Nigeria
[2]Department of Biology, School of Sciences, Delta State College of Education, Mosogar, Nigeria

Article Info

Article history:

Received Feb 27, 2026
Revised Jun 26, 2026
Accepted Jul 1, 2026

Keywords:

Blended language instructional approach
Gravity concepts
Rural classrooms
Science learning outcomes
Translanguaging theory

ABSTRACT

Scientific concepts such as gravity continue to pose challenges for students in rural and under-resourced classrooms, where reliance on a single language of instruction often restricts access to meaning and limits conceptual understanding. This study investigated the impact of a blended English and Urhobo (BEAU) instructional approach on junior secondary one students' learning and retention of gravity concepts in rural Nigeria. A quasi-experimental pre-test–post-test non-equivalent control group design was employed with 243 students assigned to English-only, Urhobo-only, or BEAU instructional conditions. A validated 30-item multiple-choice gravity test was administered, and analysis of covariance (ANCOVA) was used to examine differences while controlling for pre-test scores. The findings show that students taught using the BEAU language approach achieved better significantly in both post-test and retention tests compared to those taught using English-only or Urhobo-only instructional approaches. The findings provide empirical evidence that the blended language instructional approach enhances science learning outcomes in rural Nigerian contexts. Linguistically responsive instructional approach improves conceptual understanding and supports long-term retention of abstract scientific ideas, underscoring the importance of leveraging students' linguistic resources to strengthen science education in rural and under-resourced classrooms.

Corresponding Author:

Atomatofa Rachel Ovuezirie
Department of Integrated Science, School of Sciences, Delta State College of Education
Mosogar, Delta State, Nigeria
Email: atomatofa.ro@gmail.com

1. INTRODUCTION

Science education is central to Nigeria's nine-year basic science program, where gravity is taught as a foundational concept. Students are expected to explain gravitational force, interpret its effects on objects, apply relevant calculations, and relate gravitational principles to everyday life in preparation for the basic science certificate examination. Achieving mastery of these objectives requires not only procedural competence but also deep conceptual understanding, which is mediated through scientific language [1], [2]. Several researchers found out that there is an influence of language on students' performance in science subjects, with evidence showing that many learners, particularly in rural schools, perform poorly due to a lack of understanding of the language of instruction and their everyday communication practices [3], [4]. English is the official instructional language in Nigeria, often serves as a second language for rural learners, hindering comprehension of abstract concepts such as gravity. However, despite these efforts, findings on the correlation between language and achievement remain inconclusive, and systematic investigations into how language mediates conceptual learning in science are limited.

The problem in this study lies in the persistent linguistic disconnect between students' daily language use and the exclusive reliance on English in science classrooms. While research across Africa and Asia highlights the cognitive advantages of mother-tongue instruction [5]–[10] underscores its benefits, few studies have examined this issue within rural communities in central areas of Delta State, where Urhobo dominates everyday communication but is rarely integrated into classroom science teaching. Moreover, there is a scarcity of research that investigates retention of scientific concepts under different language conditions, and almost no studies have emphasized the use of blended-language approaches. This present study systematically seeks to close the aforementioned gaps by exploring the use of a blended English and Urhobo (BEAU) instructional approach. This is theoretically anchored in translanguaging theory as a pedagogical framework for enhancing students' comprehension and retention of gravity concepts in rural classrooms in Delta State. Two research questions and their corresponding hypotheses guided this present study. The research questions for this study were:

- Are there differences in the post-test means of a gravity test among students taught using English-only, Urhobo-only, and BEAU language approaches?
- Are there differences in the mean retention scores on a gravity test among students taught using English-only, Urhobo-only, and BEAU language approaches?

Furthermore, the hypotheses of this study were:

- There is no significant difference in the post-test scores of students in a test of gravity among those taught using English-only, Urhobo-only, and BEAU language approaches.
- There is no significant difference in the retention test mean scores on gravity concepts among students taught using English-only, Urhobo-only, and BEAU language approaches.

2. LITERATURE REVIEW

Findings on the relationship existing between instructional language and academic achievement has remained mixed even though widely studied. A substantial body of research across Africa and Asia indicates that learners achieve better outcomes when taught in the local tongue [5]–[12] underscores the advantages of local language instructional education, particularly in enhancing conceptual understanding and classroom participation. Recent Nigerian studies also confirm that instruction in Indigenous languages improves performance in science subjects, especially in rural contexts [13].

Conversely, some studies report no significant differences in students' achievement when local language and English instruction were compared, despite higher engagement levels [14], [15]. Previous studies [16]–[18] found that students in Northern, Western, and Eastern Nigeria performed comparably regardless of the language of instruction. For example, Dorgu and Chukwuemeka [18] found that there was no significant difference in science achievement between students taught in Igbo and those taught in English. At the same time, Awofala *et al.* [19] reported equivalent performance among Yoruba-speaking students taught in either language. Collectively, these findings suggest that although language influences engagement, its direct impact on achievement remains inconclusive.

Importantly, much of this literature frames language choice in binary terms, English-only versus mother-tongue-only, without sufficient attention to structured bilingual or translanguaging-oriented approaches. Translanguaging, which allows learners to draw on multiple languages, has been shown to enrich science learning by bridging comprehension gaps and fostering inclusivity [20], [21]. Globally, multilingualism is a defining feature of education systems, with over 70% of countries classified as multilingual [22], [23]. In Nigeria, where over 500 indigenous languages coexist, the dominance of English in classrooms often marginalizes local languages, creating barriers to conceptual access in science education [13], [24], [25]. Recent scholarship emphasizes translanguaging as a transformative strategy in multilingual classrooms. Randle *et al.* [26] demonstrated how Nigerian higher education institutions were adopting technology to support translanguaging, thereby enhancing participation and learning outcomes. Study by Aki and Theiss [27] showed that translanguaging in middle school science classrooms improved students' engagement and conceptual understanding. Several previous studies [24], [28]–[30] further highlighted how subject-language perspectives strengthen multilingual students' science learning.

This study is anchored in translanguaging theory, first articulated by Williams [28], and subsequently expanded by García [31] and García and Wei [32]. The theory explains that multilingual learners draw upon an integrated linguistic repertoire rather than operating with separate language systems. Within educational contexts, translanguaging legitimizes learners' full language resources as cognitive tools that can be strategically mobilized to enhance meaning-making and learning. Recent empirical literature underscores the relevance of translanguaging in multilingual classrooms. Huang and Chalmers [33] in their review reported that flexible language use often yields stronger academic language development than strictly monolingual approaches. Similarly, in a systematic review of PK–12 contexts, translanguaging practices

were found to foster engagement, collaboration, and inclusive participation while supporting learners' identities [34]. Kuswidyasari and Kasau [35] further synthesized global research, concluding that translanguaging enhances comprehension and academic performance in linguistically diverse settings, though challenges remain in restrictive language policies and limited teacher preparation. In the Nigerian context, strategic use of home languages in bilingual primary classrooms improved curriculum access and conceptual understanding [36].

Despite these contributions, few theory-driven, quasi-experimental studies have compared structured translanguaging with both English-only and mother-tongue-only instruction in Nigerian junior secondary science classrooms. Moreover, while prior research has examined achievement outcomes, there is a scarcity of studies investigating the retention of scientific concepts under different language conditions. Even fewer studies emphasize the use of a blended-language approach that systematically integrates English with local languages in science instruction. This gap is particularly evident in Delta State, where Urhobo dominate everyday communication but is rarely incorporated into classroom teaching. Guided by translanguaging theory, this study bridges this void by exploring how the use of a BEAU instructional approach influences students' understanding and retention of gravity concepts in rural junior secondary classrooms.

3. METHOD

3.1. Study design

The design for this study is a quasi-experimental, pretest–post-test non-equivalent control group design that examine the impact of three instructional language systems on students' comprehension and retention of gravity concepts in basic science. The design was deemed appropriate for school-based research where random assignment is impractical [32]. Intact classes were used due to administrative constraints. To mitigate threats to internal validity, a pretest was administered to determine baseline equivalence among the groups. Pretest scores were subsequently used as covariates during data analysis to control for initial group differences and enhance the accuracy of treatment effect estimation.

3.2. Population, sampling, and techniques

The study population consists of Basic-7, also known as junior secondary school (JSS) 1 students in rural public schools within Delta State, Nigeria. A purposive sampling technique was employed to select two schools that satisfied the following inclusion criteria: each school had three distinct JS1 classes.

- Located in rural communities.
- Availability of three qualified basic science teachers per school.
- Students were newly admitted into JS1 with no prior exposure to gravity concepts.
- Teachers were proficient in both English and the Urhobo language.

A total of 243 JS1 students from six intact classes participated in the study. The sample size was considered statistically adequate based on established rules of thumb for quasi-experimental designs, which recommend at least 30 participants per group to ensure sufficient statistical power for analysis of covariance (ANCOVA). With group sizes ranging from 76 to 89, the study exceeded this minimum threshold, thereby providing reliable estimates of treatment effects. The students were placed in one of the three instructional languages used:

- Group A: Urhobo-only instruction (n=76)
- Group B: BEAU-BEAU instruction (n=78)
- Group C: English-only instruction (n=89)

All instructional materials and lesson content were standardized and aligned with the Nigerian basic science curriculum to ensure equivalence of coverage across groups. Differences in learning outcomes were therefore attributable to the language of instruction rather than curriculum variation.

3.3. Instrumentation

Data were collected using the multiple-choice gravity test research instrument (MCGTRI), consisting of 30 items and designed to test students' comprehension and retention of gravity-related concepts. The items reflected Bloom's taxonomy cognitive domains. Validation procedures included face and content validity were done by experts in curriculum and educational measurement, as well as pilot testing with 30 JS1 students from a similar rural school. The test-retest reliability coefficient obtained was 0.713, indicating acceptable reliability for classroom-based research.

3.4. Procedure, data collection, and ethical considerations

On the application of BEAU in practice, the instruction in the BEAU group was guided by structured translanguaging strategies rather than spontaneous code-switching. Teachers first introduced and explained key concepts in Urhobo to support conceptual access, then reinforced these concepts using formal scientific terminology in English. For example, the concept of "gravitational pull" was initially explained in Urhobo with everyday analogies, before being linked to its scientific definition and formula in English. This sequencing allowed students to build meaning from familiar linguistic resources before transitioning to abstract scientific language. Teachers were trained to apply BEAU consistently by following lesson plans that specified when to use Urhobo for conceptual scaffolding and when to switch to English for technical precision.

To ensure treatment fidelity, all participating teachers attended a two-day training workshop facilitated by the researchers. The training focused on lesson objectives, instructional sequencing, language-use boundaries specific to each group, and assessment procedures. Fidelity of implementation was monitored using structured classroom observation checklists, periodic researcher-led monitoring, and post-lesson teacher reflection logs. The intervention lasted six weeks and followed the sequence: i) week 1: ethical clearance approval, training of research assistants and teachers, and administration of the pre-test; ii) week 2-5: instructional delivery according to each school's timetable using the assigned instructional language approach, followed by administration of the post-test; and iii) week 6: administration of the retention test to assess long-term understanding.

The school authorities gave full approvals to conduct the study, but the students and teachers voluntarily participated; and students were informed of their right to withdraw at any stage. Teachers also provided informed consent. Given that intact classes were used and instructional activities formed part of regular classroom teaching, the study posed no additional risk beyond normal educational practice. Student data were anonymized using coded identifiers, with no personally identifiable information collected.

3.5. Data analysis

The research questions were answered using means and standard deviation across the three language groups. The null hypotheses were tested at 0.05 alpha level using ANCOVA statistics by comparing post-test and retention test scores while controlling for pre-test scores; and effect sizes (partial eta squared or ηp^2) also calculated determined the magnitude of instructional language effects. Beyond ANCOVA, the study controlled potential threats to internal validity through structured teacher training, standardized lesson plans, fidelity monitoring, ethical safeguards, and careful class-level assignment to students. These measures strengthened confidence that any observed differences in retention would be attributable to the BEAU translanguaging intervention rather than extraneous factors.

4. RESULTS

4.1. Research question 1 and hypothesis 1

As shown in Table 1, students in all three language groups demonstrated improved post-test scores compared with pre-test performance. The BEAU group recorded the highest post-test mean score (M=24.60), followed by the Urhobo-only group (M=23.36), while the English-only group recorded the lowest post-test mean score (M=18.55).

Table 1. Mean scores of students taught using three language groups

Language group	N	Pre-test mean(X)	SD	Post-test mean (X)	SD	Gain score (post-pre)
English-only	89	9.25	2.81	18.55	2.43	9.30
BEAU	78	8.74	2.32	24.60	1.94	15.86
Urhobo-only	76	8.53	2.38	23.36	2.40	14.83
Overall	243	8.86	2.53	22.00	3.50	13.14

As seen in Table 2, the effect of instructional language on post-test performance was examined while controlling for pretest scores. The overall model was significant, $F(3, 239)=112.61$, $p<0.001$, which explains 58.6% of the variance in post-test scores ($R^2=0.586$). Pretest scores did not significantly predict post-test performance, $F(1, 239)=2.81$, $p=0.095$, $\eta p^2=0.012$ (small effect size). Instructional language had a significant effect on post-test scores, $F(2, 239)=168.86$, $p<0.001$, with a large effect size ($\eta p^2=0.586$). The effect sizes in the post-test, ηp^2 for language is .586, indicating an exceptionally large effect size. Consequently, language accounts for 58.6% of the variance in post-test scores after controlling for pretest.

In contrast, the effect size for pretest is 0.012, signifying a negligible effect, with only 1.2% of the variance explained. The effect size for the intercept is 0.870, representing the overall mean, and is typically not interpreted substantively. The model R^2 is 0.586 (adjusted R^2=0.580), elucidating approximately 58% of the variance in post-test scores, which is considerable. In summary, the language factor exerts a profoundly strong and statistically significant influence on post-test scores. The pretest scores do not significantly forecast post-test outcomes within this model. Overall, the model elucidates more than half of the variance in post-test scores, which is substantial. In practical terms, membership in the language group emerges as the predominant predictor of post-test performance, whereas pretest scores contribute minimally once language is considered. Based on the results, hypothesis 1 was rejected. A post hoc was concluded in Table 3.

Table 2. ANCOVA test for students in the three groups

Dependent variable: post-test						
Source	Type III sum of squares	Df	Mean square	F	Sig.	ηp^2
Corrected model	1744.115[a]	3	581.372	112.610	0.000	0.586
Intercept	8250.113	1	8250.113	1598.023	0.000	0.870
Pretest	14.501	1	14.501	2.809	0.095	0.012
Language	1743.538	2	871.769	168.859	0.000	0.586
Error	1233.885	239	5.163			
Total	120590.000	243				
Corrected total	2978.000	242				

a. R^2=0.586 (adjusted R^2=0.580)

Table 3. Bonferroni post hoc comparison of post-test scores across language groups

Dependent variable: post-test Bonferroni multiple comparison						
(I) language	(J) language	Mean difference (I-J)	Std. Error	Sig.	95% Confidence interval	
					Lower bound	Upper bound
Urhobo	BEAU	-1.2341*	0.36760	0.003	-2.1204	-0.3479
	English	4.8179*	0.35621	0.000	3.9591	5.6766
BEAU	Urhobo	1.2341*	0.36760	0.003	0.3479	2.1204
	English	6.0520*	0.35374	0.000	5.1992	6.9048
English	Urhobo	-4.8179*	0.35621	0.000	-5.6766	-3.9591
	BEAU	-6.0520*	0.35374	0.000	-6.9048	-5.1992

*The mean differences are significant at the 0.05 level of significance

The Bonferroni post hoc test revealed significant differences in students' post-test performance across the three language groups. The BEAU group outperformed both the Urhobo-only and English-only groups. Specifically, the BEAU group scored 6.0520 which is higher than the English group (p=0.000) and 1.2341 which is higher than the Urhobo group (p=0.003). Similarly, the Urhobo group outperformed the English group by 4.8179 points (p=0.000) again supporting rejection of hypothesis 1.

4.2. Research question 2 and hypothesis 2

Table 4 shows that the BEAU group obtained the highest mean retention score (M=22.05, Sd=2.53), followed by the Urhobo-only group (M=21.68, Sd=2.32), while the English-only group recorded the lowest mean retention score (M=18.47, Sd=2.63). Table 5 shows that students' retention scores based on the language of instruction was significant. The overall model was significant, F (3, 239)=35.18, $p<0.05$, explaining 30.6% of the variance in retention scores (R^2=0.306; adjusted R^2=0.298). Pretest scores did not significantly predict retention, F (1, 239)=1.14, p=0.286, with a small effect size (ηp^2=0.005). Instructional language had a significant effect on retention, F (2, 239)=52.76, $p<0.05$, with a large effect size (ηp^2=0.306). Based on the result, hypothesis 2 was rejected.

Table 4. Retention test mean scores of students taught using three language groups on a test of gravity

Language	N	Mean	Std. Deviation
English	89	18.4719	2.6332
BEAU	78	22.0513	2.53750
Urhobo	76	21.6842	2.3221
Total	243	20.6255	2.9923

Table 5. ANCOVA tests of between-subjects effects on retention

Dependent variable: retention						
Source	Type III sum of squares	Df	Mean square	F	Sig.	ηp²
Corrected model	663.716[a]	3	221.239	35.176	0.000	0.306
Intercept	7359.141	1	7359.141	1170.056	0.000	0.830
Pretest	7.190	1	7.190	1.143	0.286	0.005
Language	663.652	2	331.826	52.758	0.000	0.306
Error	1503.205	239	6.290			
Total	105542.000	243				
Corrected total	2166.922	242				

a. R^2=0.306 (adjusted R^2=0.298)

On effect sizes in the retention test, ηp² for language is .306, indicating a substantial effect size. This suggests that language accounts for 30.6% of the variance in retention scores after controlling for pretest performance. In contrast, the effect size for the pretest is 0.005, denoting a negligible effect wherein only 0.5% of the variance is elucidated. The intercept value is 0.830, reflecting the overall mean, although it is not typically interpreted substantively. The model R^2 is 0.306 (with an adjusted R^2 of .298), signifying that the model elucidates approximately 30% of the variance in retention scores, which constitutes a moderate-to-strong effect overall. In summary, the language variable exerts a considerable and statistically significant influence on retention scores. Conversely, the pretest scores do not significantly forecast retention outcomes within this framework, and overall, the model accounts for nearly one-third of the variance in retention scores, a significant contribution in behavioral and educational research. Practically speaking, membership in a particular language group emerges as the primary predictor of retention performance, whereas pretest scores contribute marginally once language is considered. Based on these findings, hypotheses 2 is rejected. To identify the direction of group differences, Bonferroni post hoc comparisons were presented in Table 6.

As shown in Table 6, Bonferroni post-hoc analysis reveals that both the BEAU and Urhobo groups performed significantly better than the English-only group. Mean square error (MSE)=6.293; $p<0.05$ meaning no significant difference was observed between the BEAU and Urhobo groups. Hypothesis 2 was therefore rejected.

Table 6. Bonferroni post hoc multiple comparisons for retention

(I) Language	(J) language	Mean diff. (I-J)	Std. Error	Sig.	95% Confidence interval	
					Lower bound	Upper bound
Urhobo	BEAU	-0.3671	0.40434	1.000	-1.3419	0.6077
	English	3.2123*	0.39181	0.000	2.2677	4.1569
BEAU	Urhobo	0.3671	0.40434	1.000	-.6077	1.3419
	English	3.5794*	0.38910	0.000	2.6413	4.5174
English	Urhobo	-3.2123*	0.39181	0.000	-4.1569	-2.2677
	BEAU	-3.5794*	0.38910	0.000	-4.5174	-2.6413

*The mean differences are significant at the 0.05 level of significance

5. DISCUSSION

First, the study demonstrates that the language of instruction exerts a decisive influence on rural students' comprehension of abstract scientific concepts. Students taught through the BEAU achieved the highest post-test and retention scores, with Bonferroni tests confirming BEAU's superiority over English-only and Urhobo-only instruction. This finding aligns with translanguaging theory which stresses that learners' linguistic repertoires should be leveraged to reduce cognitive load and enhance semantic access. Prior studies [27], [34]–[36], corroborate that translanguaging fosters engagement and conceptual understanding, while contrasting evidence from Dorgu and Chukwuemeka [18] and Awofala *et al.* [19] underscores the importance of teaching proficiency, curriculum design, and regional differences as contextual factors. The present study in southern Nigeria, contributes to this debate by showing that linguistically responsive pedagogy is particularly effective in multilingual rural settings. Rejecting hypothesis 1 confirms that instructional language significantly affects achievement in gravity concepts. The superior outcomes of BEAU and Urhobo groups highlight the pedagogical value of incorporating local languages into science instruction, not only for comprehension but also for equitable participation.

Second, retention outcomes further reinforce the importance of instructional language. Students in the BEAU group demonstrated stronger long-term retention, supporting previous research [28] argument that blended language strategies enhanced internalization of complex scientific ideas. This finding is consistent with Aki and Theiss [27] and Villacrusis [29], who showed that translanguaging improves both immediate learning and durable memory. In contrast, Dorgu and Chukwuemeka [18] and Awofala *et al.* [19] reported no

significant differences, highlighting the influence of contextual variables such as teacher expertise and student language background. Rejecting hypothesis 2 confirms that language of instruction significantly affects retention of gravity concepts. Both BEAU and Urhobo groups outperformed English-only instruction, underscoring the importance of linguistically responsive strategies for sustaining conceptual understanding over time. The BEAU model addressed a critical gap in Delta State, Nigeria where Urhobo dominates daily communication but is rarely integrated into science classrooms. By alternating between Urhobo explanations and English scientific terminology, BEAU provided repeated reinforcement and equitable participation. While mother-tongue instruction alone proved effective, BEAU offered added value by scaffolding students into academic English, thereby strengthening both conceptual mastery and language proficiency. This aligns with Huang and Chalmers [33] who argued that translanguaging is a deliberate, theory-driven strategy that validates cultural diversity while enhancing meaning-making.

The study contributes empirical evidence to a previously under-researched context, demonstrating that blended-language instruction reduces barriers to conceptual understanding of abstract science topics. By synthesizing prior findings and situating them within the rural Nigerian context, this research underscores the need for context-specific, linguistically responsive educational strategies. The results inform instructional practice, curriculum design, and policy formulation, offering a pathway to more inclusive and effective science education in multilingual rural settings.

6. CONCLUSION

This study examined how instructional language shapes students understanding of gravity concepts. It demonstrates that instructional language plays a decisive role in students' comprehension and retention of scientific concepts. The findings revealed that the BEAU approach proved most effective, outperforming both English-only and Urhobo-only instructional approach. The findings underscore the value of culturally responsive pedagogy showing that integrating Indigenous language with English enhances learning outcomes and can strengthen engagement and achievement in science education.

The results carry important implications for educational policy and practices suggesting that bilingual or mother-tongue instruction can foster deeper understanding and engagement in multilingual contexts and demonstrates potential of the BEAU language to bridge cultural familiarity with academic rigor. Despite its contributions, the study has limitations. It is focused only on a single science topic, a short intervention period and a sample drawn from only two rural schools which restricts generalizability. Broader replication across diverse subjects, regions, and populations is needed. Investigations into teaching training, instructional materials and classroom perceptions will provide deeper insights and extending research to urban and semi-urban schools will help assess broader applicability. Overall, the findings underscore that the language of instruction is not a neutral choice but a decisive factor in shaping science learning outcomes. It is suggested that research should be carried out to explore long term impacts of bilingual instructions across diverse subjects, regions, and populations. Investigations into teacher training, instructional materials, and classroom perceptions will provide deeper applicability. Overall, the findings underscore that the language of instruction is not a neutral but a decisive factor in shaping science learning outcomes.

The originality of this study, therefore, is in its empirical validation of the BEAU approach in rural Southern Nigeria, a context rarely examined in translanguaging research. By demonstrating that language of instruction significantly enhances both comprehension and retention of abstract science concepts, the study closes a critical gap in multilingual science education. It reconciles conflicting findings in prior literature by highlighting contextual factors such as teacher proficiency and curriculum design, while offering actionable implications for linguistically responsive pedagogy and policy in rural multilingual classrooms.

ACKNOWLEDGMENTS

The authors acknowledge all the participants in this study.

FUNDING INFORMATION

The authors received no funding for the study.

AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Atomatofa Rachel Ovuezirie	✓	✓	✓	✓	✓			✓	✓		✓			
Sekegor Crescentia Ojenikoh		✓				✓		✓	✓	✓	✓	✓		
Avbenagha Andrew			✓			✓	✓			✓		✓	✓	
Ewesor Stella				✓		✓	✓			✓		✓	✓	

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

INFORMED CONSENT

The parents and teachers of the participating students gave their full consent for publication of anonymized data for the study.

ETHICAL APPROVAL

The study was conducted in compliance with national regulations and institutional protocols consistent with the directives of the Delta State Ministry of Education. Ethical clearance was obtained from the participants review board before commencing the data collection.

DATA AVAILABILITY

The data that support the findings of this study are available on request from the corresponding author, [ARO]. Also, derived data supporting the findings of this study are available from the corresponding author [ARO] on request.

REFERENCES

[1] B. K. Mohammed, I. L. Abdullahi, S. S. S. Muhammad, K. K. Kolo, and A. Usman, "Bridging language barriers: promoting multilingualism for quality education and social equity in Niger State," *IOSR Journal of Humanities and Social Science*, vol. 30, no. 7, pp. 9–19, 2025, doi: 10.9790/0837-3007080919.

[2] S. I. Olisakwe, "Causes of students' poor performance in physics in Anambra State secondary schools," M.S. thesis, Federal College of Education (Technical), Anambra State, Nigeria, 2018.

[3] A. A. Isa, M. L. Bashayi, S. A. Umar, and A. Babayo, "Restructuring school education in rural Nigeria: issues and challenges," *International Journal of Research and Innovation in Social Science*, vol. 3, no. 12, pp. 289–291, 2019.

[4] D. A. Gregorio *et al.*, "Assessing the academic performance of learners in rural public elementary schools on science education," *International Journal of Advanced Multidisciplinary Studies*, vol. 4, no. 2, pp. 33–47, 2023.

[5] J. A. Gobana, "Investigating quality education in mother tongue: ensuring children's rights to access and equity schooling," *Cogent Education*, vol. 12, no. 1, p. 2545617, Dec. 2025, doi: 10.1080/2331186X.2025.2545617.

[6] B. Piper, S. S. Zuilkowski, D. Kwayumba, and A. Oyanga, "Examining the secondary effects of mother-tongue literacy instruction in Kenya: impacts on student learning in English, Kiswahili, and mathematics," *International Journal of Educational Development*, vol. 59, pp. 110–127, Mar. 2018, doi: 10.1016/j.ijedudev.2017.10.002.

[7] T. Suadiyatno, "The interference of native language into English pronunciation," *Jo-ELT (Journal of English Language Teaching) Fakultas Pendidikan Bahasa & Seni Prodi Pendidikan Bahasa Inggris IKIP*, vol. 2, no. 1, pp. 1–8, Feb. 2020, doi: 10.33394/jo-elt.v2i1.2407.

[8] K. Heugh, "Conclusion: multilingualism, diversity, and equitable learning: towards crossing the 'Abyss'," in *The Multilingual Edge of Education*, P.V. Avermaet, S. Slembrouck, K. V. Gorp, S. Sierens, and K. Maryns, Eds., London: Palgrave Macmillan UK, 2018, pp. 341–367, doi: 10.1057/978-1-137-54856-6_15.

[9] L. D. Akello and M. C. G. Timmerman, "Local language a medium of instruction: challenges and way forward," *Educational Action Research*, vol. 26, no. 2, pp. 314–332, Mar. 2018, doi: 10.1080/09650792.2017.1319287.

[10] R. Sudoh, "A study of mother tongue as a language of instruction according to official UNESCO documents: the core role of mother tongue and its evolution," *Journal of International Development Studies*, vol. 33, no. 3, pp. 75–90, 2025.

[11] B. A. Bayim, P. O. Ebam, and O. U. Bassey, "The effect of using mother tongue in the teaching and learning of basic science in Cross River State," *International Journal of Education and Evaluation (IJEE)*, vol. 11, no. 2, pp. 105–114, 2025.

[12] UNESCO, *Languages matter: global guidance on multilingual education*. Paris: UNESCO, 2025, doi: 10.54675/MLIO7101.

[13] A. Akindele, O. Olatundun, and R. Akano, "Linguistic diversity, Nigerian indigenous languages and the choice of the English language for Nigeria's national sustainability," *Voices: A Journal of English Studies*, vol. 7, pp. 72–83, 2022.
[14] M. H. Yahiaoui and A. Bouaroua, "English language learning skill and the relationship to academic achievement among primary school students," *Journal of Science and Knowledge Horizons*, vol. 5, no. 1, pp. 78–90, Jun. 2025, doi: 10.34118/jskp.v5i01.4241.
[15] A. Gummi, "Effect of Arabic language as medium of instruction on scientific and technological advancement in Nigeria," *ISRG Journal of Arts, Humanities and Social Sciences*, vol. 3, no. 4, pp. 514–517, 2025, doi: 10.5281/zenodo.16892567.
[16] A. Sanda, A. Kida, and A. Okwute, "Effect of English and Hausa languages on basic adult education learners' academic performance in social studies in Continuing Education Institute, Maiduguri, Borno State, Nigeria," *European Journal of Education Studies*, vol. 5, no. 2, pp. 144–159, 2018, doi: 10.5281/zenodo.1421286.
[17] J. Bernhofer and M. Tonin, "The effect of the language of instruction on academic performance," *Labour Economics*, vol. 78, p. 102218, Oct. 2022, doi: 10.1016/j.labeco.2022.102218.
[18] T. Dorgu and P. Chukwuemeka, "Comparative effects of using Igbo and English languages as media of instructions on academic achievement of pupils in primary school mathematics," *European Centre for Research Training and Development*, vol. 4, no. 2, pp. 80–92, 2016.
[19] A. A. Awofala, A. O. A. Awofala, L. M. Nneji, and A. O. Fatade, "The relation between language and science, technology, and mathematics in Nigerian schools," *International Journal of Mathematics Trends and Technology*, vol. 3, no. 3, pp. 117–124, 2012, doi: 10.14445/22315373/IJMTT-V3I3P505.
[20] A. Karlsson, P. N. Larsson, and A. Jakobsson, "Multilingual students' use of translanguaging in science classrooms," *International Journal of Science Education*, vol. 41, no. 15, pp. 2049–2069, Oct. 2019, doi: 10.1080/09500693.2018.1477261.
[21] J. Fan, "Pedagogical translanguaging- elements in language teaching: book review," *Journal of Language and Education*, vol. 10, no. 2, pp. 153–155, Jun. 2024, doi: 10.17323/jle.2024.18397.
[22] D. M. Eberhard, G. F. Simons, and C. D. Fennig, *Ethnologue: languages of the world*, 23rd ed., Dallas, TX: SIL International, 2020.
[23] Ç. Çavuşoğlu, Y. Çerkez, and Ç. Hatipoğlu, "Editorial: educational policies and practices in emerging multicultural contexts," *Frontiers in Education*, vol. 10, p. 1570342, Mar. 2025, doi: 10.3389/feduc.2025.1570342.
[24] A. Jakobsson and M. Kouns, "Subject-language perspectives on multilingual students learning in science," *European Journal of Science and Mathematics Education*, vol. 11, no. 2, pp. 197–214, Apr. 2023, doi: 10.30935/scimath/12568.
[25] E. I. Ezepue *et al.*, "Evaluating the local language dimensions for effective teaching and learning sustainability in the secondary education system in Southeast Nigeria: Results from a small-scale study," *Sustainability*, vol. 15, no. 9, p. 7510, May 2023, doi: 10.3390/su15097510.
[26] O. Randle, A. David, and F. Kaka, "Adoption of technology in the promotion of translanguaging in African higher education," *International Journal of Learning, Teaching and Educational Research*, vol. 24, no. 12, pp. 776–808, Dec. 2025, doi: 10.26803/ijlter.24.12.33.
[27] M. T. Aki and K. Theiss, "The effect of translanguaging in a middle school science classroom," *International Journal of Education in Mathematics, Science and Technology*, vol. 13, no. 6, pp. 1509–1526, Oct. 2025, doi: 10.46328/ijemst.5734.
[28] C. Williams, "An evaluation of teaching and learning methods in the context of bilingual secondary education," Ph.D. dissertation, University of Wales, Wales, United Kingdom, 1994.
[29] E. M. Villacrusis, "Employing language strategies through blended learning in improving students science achievement and concept retention," *International Journal of Advanced Research*, vol. 12, no. 7, pp. 1127–1136, Jul. 2024, doi: 10.21474/ijar01/19155.
[30] E. Charamba, "Pushing linguistic boundaries: translanguaging in a bilingual science and technology classroom," *Journal of Multilingual and Multicultural Development*, vol. 43, no. 10, pp. 951–965, Nov. 2022, doi: 10.1080/01434632.2020.1783544.
[31] O. García, "Education, multilingualism, and translanguaging in the 21st century," in *Social Justice through Multilingual Education*, T. Skutnabb-Kangas, R. Phillipson, A. K. Mohanty, and M. Panda, Eds., Bristol, U.K.: Multilingual Matters, 2009, pp. 140–158, doi: 10.21832/9781847691910-011.
[32] O. García and L. Wei, *Translanguaging: language, bilingualism and education*. London: Palgrave Macmillan UK, 2014, doi: 10.1057/9781137385765.
[33] X. Huang and H. Chalmers, "Implementation and effects of pedagogical translanguaging in EFL classrooms: a systematic review," *Languages*, vol. 8, no. 3, p. 194, Aug. 2023, doi: 10.3390/languages8030194.
[34] L. Hamman-Ortiz, C. Doughtery, Z. Tian, D. Palmer, and L. Poza, "Translanguaging at school: a systematic review of U.S. PK-12 translanguaging research," *System*, vol. 129, p. 103594, Apr. 2025, doi: 10.1016/j.system.2025.103594.
[35] R. Kuswidyasari and M. Kasau, "Triangulating and educational equity: a narrative review of global practices," *Lingua: Journal of Linguistics and Language*, vol. 3, no. 2, pp. 127–142, Jun. 2025, doi: 10.61978/lingua.v3i2.1048.
[36] O. O. Jegede, "Translanguaging as a pedagogical strategy in bilingual primary classrooms in Nigeria," *Jurnal Ilmu Pendidikan Dasar Indonesia*, vol. 4, no. 1, pp. 57–72, Jan. 2025, doi: 10.51574/judikdas.v4i1.2455.

BIOGRAPHIES OF AUTHORS

Atomatofa Rachel Ovuezirie is a chief lecturer at the Department of Integrated-Science, Delta State College of Education, Mosogar, Nigeria. She obtained a Ph.D. in Science Education from the Delta State University, Abraka. She has lectured science pedagogy and curriculum studies since 2005. Her majors are in science methodology, ICT in science education and now science media literacy and linguistics. She has many publications in peer reviewed journals. She can be contacted at email: atomatofa.ro@gmail.com, rachel.atomatofa@descoem.edu.ng.

Sekegor Crescentia Ojenikoh is a chief lecturer at the Department of Biology Education of the Delta State College of Education, Mosogar, Nigeria. She obtained her Ph.D. from the University of Calabar, Nigeria, with specialization in mammalian reproductive physiology, and she has 20 years of experience in teaching and research in science teacher education, zoology, and environmental physiology. She teaches multiple classes in master's, undergraduate, and certificate courses, including supervision of projects and theses. She can be contacted at email: crescentiaojenikoh.sekegor@descoem.edu.ng.

Avbenagha Andrew is a chief lecturer in the Department of Integrated Science, Delta State College of Education, Mosogar, Nigeria, for 22 years. He obtained a Ph.D. in Science Education Physics option from the University of Education Ajuru, Rivers State Nigeria. He has published in many local and international journals and has served in many capacities in his institution. He has lectured several science courses in the College of Education. He can be contacted at email: avbenaghaandrew@gmail.com.

Ewesor Stella is a principal lecturer in the Department of Integrated-science, Delta State College of Education, Mosogar Nigeria for 22 years. She is currently pursuing her Ph.D. in Science Education in the University of Benin Nigeria. She is teaching several courses in education and sciences and has supervised many students. She can be contacted at email: ewesorstella@gmail.com.