Instructional Materials and Secondary School Students' Attitude and Performance in Mathematics in Mkpat Enin Local Government Area

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The study was carried out to examined the effect of instructional materials and secondary school students' attitude and performance in Mathematics in Mkpat Enin Local Government Area. The study design was a quasi-experimental research design. The participant population consisted of all the 1840 junior secondary two Mathematics students in the 16 public secondary schools in Mkpat Enin Local Government Area. The sample for the study was 93 JS 2 Mathematics students. Simple random sampling technique was used to select two (2) schools out of sixteen (16) public co-educational schools in the study area. The instruments used for the study were "Mathematics Performance Test (MPT) and Mathematics Attitude Questionnaire (MAQ)". The instruments were validated by two Mathematics lecturers and an expert in Measurement and Evaluation in the Department of Science Education, Akwa Ibom State University. A reliability coefficient of 0.83 and 0.78 were obtained for the MPT and MAQ using the Kuder-Richardson 20 formula and Cronbach respectively Descriptive statistics, specifically the mean and standard deviation, were employed to address the research questions, whereas the hypotheses were analysed using an independent t-test. Findings revealed a statistically significant improvement in both performance and attitude among students taught linear equations with instructional materials compared to those who received instruction without such resources. The findings also indicated that male and female students exhibited comparable attitudes and performance when taught linear equations with instructional materials, showing no statistically significant gender difference. From these results, the study concludes that the effective integration of instructional materials substantially improves students' attitudes and achievement in Mathematics within Mkpat Enin Local Government Area. Consequently, it is recommended that school administrators promote the consistent use of appropriate instructional materials by teachers to enhance learners' engagement and academic outcomes.

Introduction

Science and technology interplay with societytobringaboutsustainabledevelopment. Nations considered to be developed and largely considered civilized have achieved that status through purposeful scientific education of their citizens (Chima, 2021). In Nigeria, education is perceived as an instrument for achievement of national objectives (Onah, Akanimoh & Ndome, 2021). This emphasis accounts for the

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substantial financial allocation that the government dedicates to the education sector each year. Reflecting the priority placed on science and technology in the National Policy on Education, Mathematics is designated as a compulsory subject for learners at both the junior and senior levels of schooling in Nigeria. This suggests that Mathematics is the key component in all science, due to the fact that in all areas of sciences, its laws and principles are applied.

Beyond its status as a core subject in the national curriculum, Mathematics has evolved into a prerequisite for entry into many programmes in tertiary institutions and remains compulsory across a wide range of social and applied science fields (FRN, 2013). As Nigeria continues to advance economically and technologically, it becomes evident that state governments may struggle to supply teachers with all the standardized instructional materials required for effective classroom delivery (Umanah & Sunday, 2025). Consequently, mathematics teachers are expected to rely on locally available resources and apply professional creativity to ensure that learners can grasp, internalize, and apply mathematical concepts meaningfully (Effiom & Abdullahi, 2021). Despite these efforts, national examinations reveal that students' performance particularly in algebraic word problems assessed in the Basic Education Certificate Examination continues to fall below expected standards (WAEC, 2024). A wide range of factors have been linked to students' persistent difficulties in Mathematics. These include variations in learning styles, the use of examples that are culturally or contextually unfamiliar to learners, overcrowded classrooms, gender-related issues, inadequate access to textbooks, the presence of unqualified teachers, ineffective instructional approaches, and the influence of school location. Other contributing elements are students' poor study habits, low interest in schooling, test-related anxiety, and the limited availability or improper use of instructional materials. Students' attitudes toward science-related subjects have also been identified as an important determinant of their performance (Neji, Ukwetang & Nja, 2014; Idris, 2015; Ojukwu, 2016; Udofia & Sambo, 2021).

Attitude is commonly understood as a predisposition acquired over time that influences how an individual reacts positively or negatively to people, objects, ideas, or situations (Sarmah & Puri, 2014). Research shows that attitudes are not fixed; they evolve as learners grow and experience new contexts (Syyeda, 2016). When students develop favourable attitudes, their motivation and engagement tend to increase, thereby enhancing their learning outcomes (Edet, Umanah & Sunday, 2024). Conversely, unfavourable attitudes can obstruct meaningful learning and negatively shape academic performance (Joseph, 2013). This underscores the centrality of attitude as a critical psychological variable in education. As recent studies suggest, the influence of attitude on achievement may either support or limit students' performance, depending on individual dispositions (Sunday et al., 2025). Students with a positive attitude toward mathematics are more likely to be motivated and engaged in learning activities while students who show negative attitude often develop mathematics anxiety, low confidence, and reduced willingness to participate in learning (Wakhata, Mutarutinya & Balimuttajjo, 2024). When students have a positive attitude and are provided with engaging instructional materials, their performance tends to improve significantly. Even students with initially negative attitudes can develop interest and improve their performance if instructional materials are

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engaging and tailored to their learning needs (Dowker, Cheriton, Horton & Mark, 2019).

Instructional materials comprise various teaching aids that help teachers clarify lesson content and make learning more meaningful for students. They include any resource intentionally employed during instruction to deepen learners' comprehension and promote active engagement in the learning process. These materials can be textual, visual, auditory, or digital, aiding in the effective delivery of educational content. They include textbooks, charts, models, multimedia tools, and interactive technology. Arop, Umanah, and Effiong (2015) explain that instructional materials serve as channels through which teachers convey essential concepts, information, and learning experiences to students. As indicated by Olayinka (2016), instructional materials are those resources employed by educators to facilitate learning by providing concrete experiences that reinforce abstract concepts. Similarly, Ekwueme and Igwe (2017) describe instructional materials as "teaching aids designed to support and enrich the curriculum, making learning more effective and meaningful for students."

"Instructional materials encompass a broad range of visual and audiovisual resources including pictures, flashcards, posters, charts, audio devices, videos, and digital technologies that support the teaching–learning process (Arop, Umanah & Effiong, 2015). These resources enrich classroom instruction by providing concrete experiences that complement teacher explanations. Their absence often hinders students' ability to fully grasp mathematical ideas, thereby affecting overall achievement. In science-related subjects, inadequate use of instructional materials has been consistently associated with lower academic performance. Since students process information through various channels such as listening, note-taking, and visual interpretation. It is essential that instruction incorporates materials that address these diverse learning preferences (Nja, Orim, Neji, Ukwetang, Uwe & Ideba, 2022).

Gender has been another variable of great concern to science educators and is considered in this study. In the global development landscape, advancing gender equality within the sciences is increasingly recognized as a vital strategy for fostering socio-economic progress in nations (Akpan & Akpan, 2017). Umanah (2024) defines gender as a psycho-social construct that encompasses the roles, behaviors, and attributes a society considers appropriate for males and females. This concept carries significant social and psychological dimensions, referring to the culturally established patterns of conduct associated with being male or female (Nnamani & Oyibe, 2016). Given the prevailing view that a student's gender can influence learning processes, this study aims to empirically investigate this potential relationship. The examination of gender-based differences in education has accumulated a significant volume of research over time. For instance, Adeyemi and Oladipo (2018) reported a gender-based disparity in Basic Science and Technology achievement linked to instructional methods, with male students demonstrating superior performance. In contrast, studies like that of Umanah and Sunday (2022) concluded that gender did not significantly predict academic outcomes in Chemistry. Further complicating the picture, Voyer and Voyer (2014) documented a significant female advantage in academic achievement, which was most pronounced in language courses and less evident in mathematics and science.

Consequently, although a common stereotype suggests male superiority in logical reasoning assessments, empirical classroom observations indicate a growing

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propensity for female students to achieve high proficiency in scientific disciplines demanding rigorous logic. This discrepancy between popular perception and emerging educational trends provides the impetus for this study, which aims to empirically validate the prevalence and extent of this observed phenomenon. Therefore, this study seeks to investigate the effect of instructional materials on secondary school students' attitude and performance in Mathematics in Mkpat Enin Local Government Area.

Statement of the Problem

Despite the critical importance of science for personal development and national scientific progress, academic outcomes in science subjects among students remain consistently subpar. A key factor contributing to this trend is students' inability to perceive the connection between the abstract concepts taught in science classrooms and their practical utility in everyday situations. Consequently, the ability to apply knowledge acquired in an academic setting to real-world contexts is often limited. The persistent issue of low student achievement in Nigeria continues to be a significant concern for educational stakeholders, including parents, educators, and policymakers. Historically, excellence in teaching has often been gauged by analyzing student performance on both school-based and standardized national examinations. Scholars frequently identify the root causes of this underperformance as deficiencies in pedagogical knowledge, the use of ineffective teaching methodologies, and a scarcity of appropriate instructional resources.

A significant gap often exists between the instructional resources teachers currently use and the pedagogical strategies required to effectively educate contemporary students. The current digital landscape has fundamentally transformed information acquisition, with students increasingly relying on multimedia platforms as primary sources for educational content. This paradigm shift underscores the imperative to integrate dynamic tools, including advanced visual aids, into mathematics pedagogy. This context prompts a critical inquiry: Can the strategic implementation of these instructional resources foster more positive student attitudes and elevate academic achievement? Hence, this study seeks to investigate the effect of instructional materials on secondary school students' attitude and performance in Mathematics in Mkpat Enin Local Government Area.

Purpose of the Study

The purpose of this study is to investigate the effect of instructional materials on secondary school students' attitude and performance in Mathematics in Mkpat Enin Local Government Area. Specifically, the study sought to;

1. determine the difference in the mean performance scores of Mathematics students taught the concept of linear equations using instructional materials and those taught without.
2. determine the difference in the mean attitude scores of Mathematics students taught the concept of linear equations using instructional materials and those taught without.
3. determine the difference in the mean performance scores of male and female Mathematics students taught the concept of linear equations using instructional materials.
4. determine the difference in the mean attitude scores of male and female Mathematics students taught the concept of Linear Equations using instructional materials.

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Research Questions

1. What is the difference in the mean performance scores of Mathematics students taught the concept of linear equations using instructional materials and those taught without?
2. What is the difference in the mean attitude scores of Mathematics students taught the concept of linear equations using instructional materials and those taught without?
3. What is the difference in the mean performance scores of male and female Mathematics students taught the concept of linear equations using instructional materials?
4. What is the difference in the mean attitude scores of male and female Mathematics students taught the concept of linear equations using instructional materials?

Hypotheses

1. There is no significant difference in the mean performance scores of Mathematics students taught the concept of linear equations using instructional materials and those taught without.
2. There is no significant difference in the mean attitude scores of Mathematics students taught the concept of linear equations using instructional materials and those taught without.
3. There is no significant difference in the mean performance scores of male and female Mathematics students taught the concept of linear equations using instructional materials.
4. There is no significant difference in the mean attitude scores of male and female Mathematics students taught the concept of linear equations using instructional materials.

Research Methods

The research methodology utilized a quasi-experimental design. The study was conducted in Mkpat Enin Local Government Area. The target population encompassed all 1,840 Junior Secondary Two (JS II) students enrolled in Mathematics across the sixteen public secondary schools in the specified local government area. The sample of this study consisted of 93 JS II Mathematics students drawn from two public secondary schools in Mkpat Enin Local Government Area. Simple random sampling technique was used in selecting two schools out of 16 public secondary schools in the study area through balloting. Within the selected school pairings, one school was designated as the experimental group, receiving instruction with the aid of instructional materials, while the other served as the control group, following a conventional teaching approach without such specialized resources. A single intact JS II class was randomly selected from each participating school to form the study's sample. Data were gathered using two researcher-developed instruments: the Mathematics Performance Test (MPT) and the Mathematics Attitude Questionnaire (MAQ). The MPT was divided into two sections: Section A collected demographic data, including the school's name and student gender, while Section B comprised 20 multiple-choice questions, each with four options (A-D). To assess performance, the MPT was given to both the control and experimental groups as a pretest before the intervention and again as a posttest following the instructional treatments.

The Mathematics Attitude Questionnaire (MAQ) was structured in two parts. The first section gathered demographic information, specifically student gender, and the second section contained 15 statements designed to gauge attitudes toward Mathematics. This questionnaire was constructed by the researcher for the specific purpose of assessing students' perceptions and dispositions regarding Mathematics. The MAQ was distributed as a pre-test to

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establish a baseline of student attitudes before the intervention and then again as a post-test to evaluate any shifts in attitude resulting from the instructional treatment. All items on the questionnaire were closed-ended, utilizing a four-point Likert-scale with the following anchors: Strongly Agree (4 points), Agree (3 points), Disagree (2 points), and Strongly Disagree (1 point). For each statement, participants were asked to indicate their level of agreement by selecting the most appropriate response option. To ensure content validity, the instruments and lesson packages were reviewed and validated by a panel of experts comprising two Mathematics Lecturers and a specialist in Measurement and Evaluation from the Department of Science Education, Akwa Ibom State University. A pilot study was conducted with 20 JS II Mathematics students to establish the reliability of the instruments. The internal consistency of the Mathematics Performance Test (MPT) was calculated using the Kuder-Richardson Formula 20 (KR-20), yielding a coefficient of 0.83. For the Mathematics Attitude Questionnaire (MAQ), a Cronbach's Alpha analysis produced a reliability index of 0.78. The collected data were subsequently coded for analysis. Descriptive statistics, including mean and standard deviation, were employed to address the research questions. An independent samples t-test was used to test the study's hypotheses at a 0.05 significance level.

Results

Research question one: What is the difference in the mean performance scores of Mathematics students taught the concept of linear equations using instructional materials and those taught without?

Table 1: Mean and standard deviation of students' performance pre-test post-test score on treatments

Treatment groups	N	Pre-test		Post-test		Mean difference
		Mean	SD	Mean	SD	
Instructional materials	45	10.0	1.8	22.8	1.0	
						2.2
Without instructional materials	48	8.5	1.7	20.6	1.6	

As presented in Table 1, students who were taught linear equations with instructional materials achieved a higher posttest mean score (22.8) compared to their counterparts taught without such materials (20.6). The resulting mean difference of 2.2 points indicates a performance advantage for the group that received instruction supplemented with instructional materials, suggesting their efficacy in enhancing student learning outcomes for this mathematical concept.

Research question two: What is the difference in the mean attitude scores of Mathematics students taught the concept of linear equations using instructional materials and those taught without?

Table 2: Mean and standard deviation of students' post-attitude score on treatment

Treatment	N	Post-attitude		Mean Gain
		Mean	SD	
Instructional materials	45	28.6	4.9	

DOI: https://doi.org/10.5281/zenodo.17929186

				2.6
Without instructional materials	48	26.0	3.5	

Data in Table 2 indicate that students instructed on linear equations using instructional materials recorded a more positive mean attitude score (28.6) than those in the conventional teaching group (26.0). The observed mean difference of 2.6 points demonstrates a favorable disposition towards mathematics among students in the experimental group, highlighting the positive influence of instructional materials on learner attitudes.

Research question three: What is the difference in the mean performance scores of male and female Mathematics students taught the concept of linear equations using instructional materials?

Table 3: Mean and standard deviation of male and female students' pre-test post-test performance scores on treatment

Treatment	Gender	N	Pre-test		Post-test		Mean Gain
			Mean	SD	Mean	SD	
	Male	26	9.9	1.8	22.7	1.1	
Instructional materials							-0.1
	Female	19	10.0	1.8	22.8	0.8	

Analysis of Table 3 shows nearly identical posttest performance for male (22.7) and female (22.8) students taught linear equations with instructional materials, resulting in a negligible mean difference of -0.1. This minimal disparity indicates no meaningful difference in academic achievement between genders when instructional materials were utilized. Therefore, the instructional approach supported equivalent learning outcomes and performance levels for both male and female students.

Research question four: What is the difference in the mean attitude scores of male and female Mathematics students taught the concept of linear equations using instructional materials?

Table 4: Mean and standard deviation of male and female students' post-attitude scores on treatment

Treatment	Gender	N	Post-attitude		Mean Difference
			Mean	SD	
	Male	26	28.0	4.7	
Without instructional materials					-1.4
	Female	19	29.4	5.4	

Table 4 demonstrates a marginally higher mean attitude score among female students (29.4) compared to male students (28.0) when instructional materials were used for teaching linear equations. The resulting mean difference of 1.6 points suggests a more favorable disposition towards mathematics in the female student cohort, indicating that they reported the most positive attitudes following the intervention.

Hypothesis one: There is no significant difference in the mean performance scores of Mathematics students taught the concept

DOI: https://doi.org/10.5281/zenodo.17929186

of linear equations using instructional materials and those taught without.

Table 5: Independent t-test analysis result on students' post-test performance scores in Mathematics based on treatment (N = 100)

Treatment groups	N	Mean	SD	df	t-cal.	P
Instructional materials	**45**	**22.8**	**1.0**			
				91	**7.59**	**.000***
Without instructional materials	**48**	**20.6**	**1.6**			

* = Significance @ P<0.05 probability level

The independent samples t-test results in Table 5 reveal a statistically significant difference in post-test scores between the experimental and control groups (p = .000 < .05). This finding confirms that the use of instructional materials led to a marked improvement in student performance on linear equations compared to conventional teaching methods without such aids. Therefore, the observed performance advantage for the experimental group is unlikely to have occurred by chance.

Hypothesis two: There is no significant difference in mean attitude scores of Mathematics students taught the concept of linear equations using instructional materials and those taught without.

Table 6: Independent t-test analysis results of students' post-attitude score on treatment

Treatment groups	N	Mean	SD	df	t-cal.	P
Instructional materials	45	28.6	4.9			
				91	2.88	.005*
Without instructional materials	48	26.0	3.5			

* = Significance @ P<0.05 probability level

Statistical analysis of the post-intervention attitude scores, presented in Table 6, indicates a significant effect of the instructional method (p = .005 < .05). This result signifies that the group which utilized instructional materials developed a more positive attitude towards linear equations than the group taught through conventional methods. Consequently, the disparity in attitude scores between the two groups is statistically reliable and not due to random variation.

Hypothesis three: There is no significance difference in the mean performance scores of male and female Mathematics students taught the concept of linear equations using instructional materials.

Table 7: Result of independent t-test analysis on male and female students' post-test scores based on treatment

Treatment groups	Gender	N	Mean	SD	Df	t-cal.	P
	Male	**26**	**22.7**	**1.1**			

DOI: https://doi.org/10.5281/zenodo.17929186

Instructional materials					**43**	**-0.49**	**.626***
	Female	**19**	**22.8**	**0.8**			

* = not significance @ P>0.05 probability level

Table 7 shows no statistically significant gender-based difference in post-test performance for students taught linear equations with instructional materials ($p = .626 > .05$). This finding indicates that the instructional materials were equally effective for both male and female students in terms of academic achievement. Therefore, the efficacy of the instructional materials is gender-neutral, promoting equivalent learning outcomes across both genders.

Hypothesis four: There is no significance difference in the mean attitude scores of male and female Mathematics students taught the concept of linear equations using instructional materials.

Table 8: Result of independent t-test analysis on male and female students' post-attitude scores based on treatment

Treatment groups	Gender	N	Mean	SD	df	t-cal.	P
	Male	26	28.0	4.7			
Without instructional materials					43	-0.88	.384*
	Female	19	29.4	5.4			

* = not significance @ P>0.05 probability level

The analysis in Table 8 indicates that gender did not produce a statistically significant effect on post-intervention attitude scores ($p = .384 > .05$). This result demonstrates that the positive impact of instructional materials on student attitudes was consistent for both male and female learners. Consequently, the instructional approach can be considered equitable, fostering similarly improved attitudes toward mathematics regardless of gender.

Discussion of Findings

The analysis revealed a statistically significant advantage in performance for students who learned linear equations with instructional materials compared to those who did not. This superior performance is likely due to the way instructional materials concretize abstract concepts, thereby facilitating a deeper and more accessible learning experience. This finding is plausible given that instructional materials such as visual aids, manipulatives, multimedia, or concrete representations provide multiple representations of abstract concepts, support active engagement, and simplify complex ideas, making it easier for students to grasp and apply mathematical reasoning. This result aligns with the work of Uwitatse et al. (2023), who also documented that the availability and application of instructional resources significantly boost student achievement in mathematics. Similarly, a significant positive shift in attitude was observed among students who used instructional materials for learning linear equations compared to the control group. This improvement in disposition likely stems from the capacity of tools like manipulatives and visual aids to transform abstract mathematical ideas into concrete, interactive, and stimulating learning experiences. These materials can stimulate interest, reduce anxiety, enhance self-efficacy, and foster a more inviting learning environment, all of which contribute to improved attitudes towards mathematics. The finding lends credence to that of Prado,

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et al. (2019) who found that the utilization of instructional materials has demonstrated considerable potential for improving academic outcomes and fostering more favorable attitudes in high school mathematics.

Analysis of gender as a variable indicated no statistically significant disparity in either the academic performance or attitudes of male and female students who learned linear equations using the instructional materials. This finding can be attributed to the fact that well-designed instructional materials such as visual aids, manipulatives, or technology-enhanced tools can mitigate gender-based disparities by offering multisensory engagement, reducing abstraction, and fostering self-paced learning. Such resources help to level the playing field by appealing to diverse learning preferences and helping students navigate complex concepts without bias. This finding aligns with broader educational research suggesting that, under equitable and inclusive instructional conditions, gender differences in mathematics achievement and attitudes tend to diminish or vanish altogether. The positive impact of instructional materials observed in this study corroborates the work of Prado et al. (2019) and Uwitatse et al. (2023), who similarly reported that such resources are effective in boosting academic achievement and fostering positive attitudes in high school students. This outcome, however, contrasts with the findings of Akpan et al. (2023), whose research on geometry identified a significant male advantage and a notable interaction between gender and instructional approach. Conversely, the gender-neutral results of the present investigation align with a body of recent research (Sunday & Edet, 2024; Umanah & Atabang, 2025; Umanah & Akpan, 2024; Umoetuk et al., 2025), which collectively found that gender did not significantly influence academic outcomes in science and mathematics.

Conclusion

This study provides compelling evidence that the strategic integration of instructional materials is a decisive factor in improving both the cognitive and affective domains of mathematics education. It is conclusively established that these materials significantly elevate academic performance and cultivate more positive attitudes among secondary school students in Mkpat Enin Local Government Area. Crucially, the efficacy of this approach was found to be equitable, yielding substantial benefits for both male and female learners without favoring one gender over the other. Therefore, instructional materials serve not only as a catalyst for academic achievement in abstract topics like linear equations but also as a powerful tool for fostering an inclusive and positive learning environment that motivates all students irrespective of gender.

Recommendations

1. The students would engage actively with the instructional materials (manipulating, discussing, questioning) to boost their understanding and attitude toward mathematics.
2. The teachers should always use well-designed instructional materials when teaching linear equations, to improve both students' performance and attitudes, and ensure fair treatment to all students regardless of gender.
3. Other researchers would further investigate which types of instructional materials work best, under what conditions, and whether the gains in performance and attitude persist over time across different contexts.

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References

Akpan, A. O. & Akpan, I. F. (2017). Facilitation-activity strategy and pre-service teachers' achievement in Basic Science and Technology. *Journal of Research and Development in Education, 7(1), 38-47.*

Akpan, I. I., Utibe, U. J. Babayemi, J. O. & Nelson, M. F. (2023). Effect of geo-board and charts on students' achievement in Mathematics in Essien Udim, Akwa Ibom State, Nigeria. *Journal of Research in Education and Society, 14*(2), 91-102.

Arop, B. A., Umanah, F. I. & Effiong, O. E. (2015). Effect of instructional materials on the teaching and learning of basic science in junior secondary schools in Cross River State, Nigeria. *Global Journal of Educational Research, 14, 67-73.*

Chima, T. S. (2021). Basic science curriculum and development in Nigeria: Post covid-19 challenges and prospects. *Unizik Journal of Educational Research and Policy Studies, 7, 100-114.*

Dowker, A., Cheriton, O., Horton, R., & Mark, W. (2019). Relationships between attitudes and performance in young children's mathematics. *Educational Studies in Mathematics*, 100, 211–230.

Edet, A. A., Umanah, F. I. & Sunday, E. S. (2024). Extent of integration of green chemistry resources in teaching of chemistry practical in secondary schools. Conferences Programme and Book of Abstracts: 9th Annual Symposium of American Chemical Society of Nigeria. p186.

Effiom, W. A. & Abdullahi, A. (2021). Effect of polya's problem-solving strategy on senior secondary school students' performance in algebraic word problem in Katsina Metropolis, Katsina State, Nigeria. *Sapientia Foundation Journal of Education, Sciences and Gender Studies (SFJESGS), 3(2), 344 – 351.*

Ekwueme, C. O., & Igwe, R. O. (2017). The impact of instructional materials on the academic performance of students in mathematics. *Educational Research International*, 6(2), 78-85.

Federal Ministry of Education (2013). *Senior secondary school curriculum chemistry*. Nigerian Educational Research and Development Council, 24-25.

Government of Akwa Ibom State Ministry of Information and Strategy (2021). Information about Mkpat Enin Local Government Area. Retrieved from www.https://akwaibomstate.gov.ng/information-about-mkpat-enin on 05/02/2024

Idris, A. O. (2015). The effect of audio-visual materials in teaching and learning of speaking of skills in junior secondary schools in Katsina State Nigeria. *International Journal of Social Science and Human Resources, 3(3), 50–58.*

Joseph, T. K. (2013). *The effects of negative attitudes on students' academic performance*. International Journal of Educational Psychology, 8(1), 112-128.

Neji, H. & Ukwetang, J. O & Nja, C. (2014). Evaluating the adequacy of laboratory facilities on students' academic performance in secondary school in Calabar, Nigeria. *Journal of Research & Method in Education, 4, 11-14.*

Nja, C. O., Orim, R. E., Neji, H. A., Ukwetang, J. O., Uwe, U. E. & Ideba, M. A. (2022). Students' attitude and academic achievement in a flipped classroom. *Heliyon, 8, 1-14.*

Nnamani, S. C. & Oyibe, O. A. (2016). Gender and academic achievement of secondary school students in social studies in Abakaliki urban of Ebonyi State. *British Journal of Education, 4*(8), 72-83.

Ojukwu, M. O. (2016). Perception of students on causes of poor performance in chemistry in external examinations in Umuahia North Local Government of Abia

DOI: https://doi.org/10.5281/zenodo.17929186

state. *International Journal Education Literacy Studies, 4(1), 67–72*.

Olayinka, A. R. (2016). Effects of instructional materials on secondary schools' students' academic achievement in social studies in Ekiti State, Nigeria. *World Journal of Education*, 6(1), 32-39.

Onah, P. O., Akanimoh, M. E. & Ndome, L. E. (2021). Education and the achievement of national development through girl child empowerment in Nigeria. *Global Journal of Educational Research, 20, 89-96*.

Prado, N. I, Tan, D. A. & Capuyan, J. B. (2019). Effects of instructional materials in general mathematics and high school statistics on the attitude, self-efficacy beliefs, and performance of high school students. *Liceo Journal of Higher Education Research, 15*(1), 112-129.

Sarmah, P. P., & Puri, K. (2014). *Understanding attitude formation and its impact on learning behaviors*. Educational Psychology Review, 22(3), 87-102.

Sunday, E. S, Umanah, F. I. & Udofia, S. E. (2025). Enhancing students' academic achievement in chemical reactions through computer-based molecular modelling and hackathon teaching strategies. *International Journal of Research and Innovation in Social Science (IJRISS), 9*(3), 1815-1824.

Sunday, E. S.& Edet, A. A. (2024). Renewable resources in teaching chemistry practical and students' learning outcome in secondary schools. Asia-Africa Journal of Educational Research, 4(1), 119-126.

Syyeda, F. (2016). *Attitude change and its influence on student learning outcomes*. Journal of Learning and Motivation, 11(4), 33-50.

Udofia, S. E. & Sambo, D. D. (2021). Examination dishonesty among senior secondary school science teachers as perceived by SS3 students in Akwa Ibom State, Nigeria. *Journal of Resourcefulness and Distinction, 18*(1),1-15.

Umanah, F. I. & Sunday, E. S. (2022). Crosswords puzzle, flashcards teaching strategies and senior secondary school students' academic performance in chemistry. *International Journal of Educational Benchmark (IJEB), 22(2), 1-12*.

Umanah, F. I. & Akpan, A. O. (2024). Effects of 5E and 7E learning cycle models on students' academic achievement and retention in Chemistry. *Global Journal of Academic Research Forum*, 12(1), 92-106.

Umanah, F. I. & Atabang, A. A. (2025). Effects of animated and static infographic instructional materials on students' academic performance in isomerism in chemistry. *International Journal of Research and Innovation in Social Science*, 9(3s), 1515-1524.

Umanah, F. I. & Sunday, E. S. (2025). Effects of teacher-made model and student-made model instructional materials on senior secondary students' academic performance in unsaturated hydrocarbons in chemistry. *International Journal of Research and Innovation in Social Science, IX*(IIIS), 2454–6186.

Umanah, F. I. (2024). Effects of roundrobin brainstorming and think-pair-share cooperative teaching strategies on students' academic performance in chemistry. *Ibadan Journal of Educational Studies, 21*(1&2), 1-9.

Umoetuk, E. U., Sunday, E. S., Edet, A. A., Elijah, A. M. & Williams, I. E. (2025). Computer simulations and expository teaching strategies on students' academic achievement in Basic Science and Technology in junior secondary schools. *GAS Journal of Education and Literature (GASJEL)*, 2(3), 28-34.

Uwitatse, M. C., Niyibizi, O. & Mutarutinya, V. (2023). Accessing the use of instructional materials on the learner's academic performance in mathematics: A case of selected ordinary level secondary schools of Musanze District, Rwanda.

DOI: https://doi.org/10.5281/zenodo.17929186

Journal of Research Innovations and Implications in Education, 7(4), 12-19.

Voyer, D. & Voyer, S. D. (2014). Gender differences in scholastic achievement: A meta-analysis. *Psychological Bulletin 140(4), 1174–1204.*

Wakhata, R., Mutarutinya, V., & Balimuttajjo, S. (2024). Relationship between students' attitude towards, and performance in mathematics word problems. *PLOS ONE,* 1, 1-12.

West African Senior School Certificate Examination (WASSCE) Chief Examiner Report (2024). Examiners Report in Science Subjects. Lagos: WAEC.

DOI: https://doi.org/10.5281/zenodo.17929186