



Learning Styles as Predictors of Secondary School Students' Achievement in Mathematics in Owerri Education Zone of Imo State

*Enyinna, V.U. & Okigbo, E. C.

Department of Science Education, Nnamdi Azikiwe University, Awka

*Corresponding author email: victoriauloma98@gmail.com

Abstract

Mathematics occupies a central position in secondary school education due to its relevance to scientific advancement, technological development, and everyday problem-solving. However, persistent low achievement in mathematics among Nigerian secondary school students has continued to generate concern, particularly in the Owerri Education Zone of Imo State. This study investigated the extent to which learning styles predict secondary school students' academic achievement in mathematics. A predictive correlational research design was adopted. The population comprised 17,637 Senior Secondary School II students in government secondary schools within the Owerri Education Zone, from which a sample of 882 students was selected using a multi-stage sampling procedure. Data were collected using the VARK Learning Style Inventory and a Mathematics Achievement Proforma. Validity of the instruments was ensured through expert judgment, while reliability coefficients ranged from 0.72 to 0.79. Data were analyzed using Pearson correlation, multiple regression, and analysis of variance at the 0.05 level of significance. Findings revealed a positive and statistically significant relationship between learning styles and students' achievement in mathematics, with learning styles accounting for 9.9% of the variance in achievement. Among the individual dimensions, auditory, visual, and read/write learning styles significantly predicted mathematics achievement, while the kinesthetic learning style did not. Auditory learning emerged as the strongest predictor. The study concludes that learning styles are significant, though modest, predictors of secondary school students' mathematics achievement in the study area. It is therefore recommended that mathematics instruction should emphasize auditory, visual, and read/write approaches to enhance students' achievement outcomes.

Keywords: Achievement, Learning styles, Mathematics, VARK model.

Introduction

Mathematics remains a foundational subject in the secondary school curriculum because of its relevance to scientific advancement, technological development, and everyday problem-solving. Despite this central role, students' achievement in mathematics across Nigeria has been a persistent concern, reflected in repeated reports of low performance in internal and external examinations. Studies examining national assessment trends show that many learners continue to struggle with essential mathematical concepts, leading to widespread worry among educators, parents, and policymakers. The comparative analysis conducted by Zalmon and Wonu (2017) revealed consistently poor outcomes in the West African Senior School Certificate Examination, illustrating a long-standing pattern of underachievement. These outcomes suggest that the problem goes beyond content difficulty and may be linked to deeper issues involving how learners process information, the match between instructional approaches and student characteristics, and the general classroom environment. As a result, attention has increasingly turned toward understanding learner-centered factors such as learning styles, which influence how students perceive, interpret, and retain mathematical information.

Growing interest in learning styles reflects a broader recognition that students vary significantly in the ways they engage with instructional materials. Evidence from several Nigerian contexts indicates that differences in learning preferences contribute meaningfully to variations in achievement, particularly in mathematics. Research conducted in Enugu State by Chikendu and Chukwunazo (2022) showed that students whose learning styles align

with their learning tasks tend to demonstrate stronger academic performance. Similar findings were reported in Rivers State, where Igwe and Fidelis (2019) identified learning styles as significant predictors of mathematics achievement. Studies in Imo State have also pointed to the influence of learning preferences on students' academic outcomes. For instance, the work of Adedun and Ibeabuchi (2022) demonstrated that high-ability students' learning styles correlate with their motivation levels and achievement patterns. Duru (2021) further established that students' preferred ways of learning, combined with self-regulation and achievement motivation, contribute substantially to their mathematics outcomes. These findings collectively suggest that learning styles are critical variables worthy of close investigation, especially in regions like Owerri Education Zone, where concerns about mathematics performance continue to deepen.

In addition to individual learning differences, instructional processes interact with learning styles to affect mathematics achievement. Classroom strategies such as collaborative learning have shown promise in improving students' engagement and achievement levels, suggesting that learning outcomes rise when instruction resonates with learners' cognitive preferences. Abd Algani (2021) found that collaborative learning techniques enhance students' mathematics performance by encouraging interaction and shared problem-solving. Similar studies by Akinoso et al. (2021) demonstrated that collaborative teaching improves both achievement and attitudes toward mathematics. Research in Akwa Ibom and Nasarawa States by Akpan and Nkan (2022) and by Aku et al. (2022) also highlighted the advantage of collaborative approaches over traditional lecture methods. More locally, Nwoke et al. (2023) confirmed that collaborative learning strengthens problem-solving abilities among learners in Owerri West. While these studies focus primarily on teaching strategies rather than learning styles, their findings underscore a key implication: students benefit most when learning experiences reflect how they naturally interact with information. This reinforces the need to explore learning styles specifically, as they enable teachers to design instruction that aligns with students' cognitive tendencies and supports improved mathematics achievement.

Other learner-related variables, such as gender, motivation, self-efficacy, locus of control, parenting styles, and classroom control, have also been shown to contribute to mathematics achievement, further illustrating the complexity of the problem. Studies across Nigeria reveal mixed trends regarding gender differences, with Adegoke and Adeneye (2020) observing variations in mathematics achievement that sometimes favor males and at other times show no meaningful differences. Research on self-efficacy by Ozuome et al. (2024) points to the crucial role of belief in one's capabilities, as students with high self-efficacy tend to demonstrate more resilience and stronger mathematics outcomes. The influence of locus of control, as reported by Ozuome et al. (2020), shows that learners who believe they can influence their academic outcomes often achieve better results. Additional studies highlight the role of parenting styles and classroom management, with Oguzie et al. (2025) linking parental behavior to academic achievement and Isaac and Odunze (2025) demonstrating that effective class control predicts students' performance in mathematics. While these findings highlight important correlates of achievement, they also indicate gaps in the understanding of cognitive and perceptual factors—particularly learning styles, which remain underexplored within the specific context of Owerri Education Zone.

The theoretical foundation for examining learning styles rests on Kolb's Experiential Learning Theory, which explains that learning occurs through a cyclical process involving concrete experience, reflective observation, abstract conceptualization, and active experimentation. According to Kolb, individuals tend to prefer particular stages of the learning cycle, resulting in distinct learning styles; diverging, assimilating, converging, and accommodating. These styles influence how learners perceive and process academic tasks, including mathematical problem-solving. Research in mathematics education supports the applicability of this theory, as shown by studies like those of Bansilal and Ojeme (2024), which emphasize that understanding students' preferred learning styles enables more effective instructional planning. By acknowledging that learners differ cognitively, Kolb's framework provides a strong foundation for investigating how learning styles predict mathematics achievement within the Owerri Education Zone. Given the persistent issues of low performance documented in the literature, the variation in learners' cognitive patterns, and the need for evidence-based strategies to address mathematics difficulties, this study becomes both timely and essential. The need for the study is thus justified by the continuing underachievement in mathematics, the insufficient attention given to learning styles in this context, and the importance of aligning instructional practices with learners' cognitive preferences. Therefore, the purpose of this study is to determine the extent to which learning styles predict secondary school students' achievement in mathematics in Owerri Education Zone of Imo State.

Statement of the Problem

Persistent low achievement in mathematics among secondary school students in the Owerri Education Zone has continued to generate concern despite various curriculum reforms, improved instructional materials, and diverse teaching strategies. Many students still exhibit poor understanding, low interest, weak retention, and limited problem-solving abilities, suggesting that their individual learning differences are not adequately considered in classroom instruction. Teaching practices in the zone largely adopt a uniform approach that fails to account for the diverse ways students perceive and process information, creating a mismatch that likely contributes to the recurring pattern of poor performance. Teachers often do not assess or incorporate learners' preferred learning styles when planning lessons, resulting in instructional experiences that benefit only a few while leaving many others at a disadvantage. This systemic challenge, coupled with the limited empirical attention given to the role of learning styles in mathematics performance within the zone, highlights a critical gap in understanding how learners' cognitive preferences influence achievement. Consequently, there is a pressing need to investigate the extent to which learning styles predict secondary school students' achievement in mathematics in Owerri Education Zone of Imo State.

Research Questions

The following research questions guided the study:

1. What is the extent to which individual dimensions of learning styles (visual, auditory, read/write and kinesthetic) predict students' academic achievement in mathematics in Owerri Education Zone of Imo State?
2. To what extent do learning styles predict secondary school students' academic achievement in mathematics in Owerri Education Zone of Imo State?

Hypotheses

The following hypotheses were tested at 0.05 level of significance:

1. Individual dimensions of learning styles (visual, auditory, read/write, and kinesthetic) do not significantly predict students' academic achievement in mathematics in Owerri Education Zone of Imo State.
2. Learning styles do not significantly predict secondary school students' academic achievement in mathematics in Owerri Education Zone of Imo State.

Methodology

The study adopted a predictive correlational design to examine the relationship between students' mathematics achievement and multiple independent variables; learning styles and academic resilience, using a population of 17,637 SSII students in the 2023/2024 academic year across 124 government secondary schools in Owerri Education Zone of Imo State. A sample of 882 students (486 males and 396 females) was selected through multi-stage sampling involving stratification of 6 LGAs, random selection of 14 schools, two SSII classes per school, and 63 students per school, adjusted where necessary. Data were collected using three instruments: the 16-item VARK Learning Style Inventory, the 15-item Academic Resilience Scale (score range 15–75), and a Mathematics Achievement Proforma containing students' term and cumulative results. Instrument validity was ensured through expert review, and reliability was established using Cronbach Alpha coefficients, with ARS clusters yielding 0.85, 0.72, and 0.74, and VARKLSI clusters yielding 0.72, 0.77, 0.73, and 0.79, all above the acceptable 0.70 benchmark. Data collection was conducted by the researcher and trained assistants through on-the-spot administration and retrieval within one hour per school over two weeks. Data were analyzed using SPSS version 20 with Pearson correlation, coefficient of determination, and multiple regression, while all hypotheses were tested at the 0.05 significance level, using $p \leq 0.05$ for rejection and $p > 0.05$ for retention of the null hypotheses.

Results

Table 1: Extent to which individual dimensions of learning styles predict students' academic achievement in Mathematics in Owerri Education Zone of Imo State

Variables	R	R ²	Adj. R-square	Std. Error
Auditory	0.315	0.099	0.098	16.858
Visual	0.265	0.070	0.069	17.124
Read/Write	0.265	0.070	0.069	17.125

Kinesthetic	0.057	0.003	0.002	17.731
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The Table 1 shows that auditory learning is the strongest predictor of students' Mathematics achievement in the Owerri Education Zone, with an R value of 0.315 and R² of 0.099, indicating that it explains 9.9% of the variance in achievement. Visual and read/write learning styles follow closely with identical R values of 0.265 and R² of 0.070, each accounting for 7% of the variance. Kinesthetic learning has the weakest relationship, with an R of 0.057 and R² of only 0.003, meaning it contributes just 0.3% to academic achievement.

Table 2: Summary of Regression test on the significant prediction of individual dimensions of learning style to students' achievement in Mathematics in Owerri Education Zone of Imo State

Variables	R	R ²	Adj. R-square	Std. Error	t	Sig.
Auditory	0.315	0.099	0.098	16.858	9.795	.000
Visual	0.265	0.070	0.069	17.124	8.131	.000
Read/Write	0.265	0.070	0.069	17.125	8.131	.000
Kinesthetic	0.057	0.003	0.002	17.731	1.684	.093

The t-test for regression results in Table 2 indicate that auditory, visual, and read/write learning styles significantly predict students' academic achievement in Mathematics in the Owerri Education Zone, while the kinesthetic style does not. Auditory learning shows the strongest predictive power with $t = 9.795$ and a significance value of $p = 0.000$, confirming a highly significant relationship. Visual and read/write learning styles also have significant effects, both with $t = 8.131$ and $p = 0.000$. In contrast, the kinesthetic style has a weak and non-significant influence on Mathematics achievement ($t = 1.684$, $p = 0.093$). Since the significance values for auditory, visual, and read/write learning styles are below 0.05, the null hypothesis (H_0) is rejected for these dimensions, meaning they significantly predict students' performance. However, the kinesthetic style does not significantly contribute to achievement, as its p-value exceeds 0.05.

Table 3: Extent to which learning styles predict academic achievement of secondary school students in mathematics in Owerri Education Zone of Imo State

Variables	R	R-square	Adj. R-square	Std. Error
Learning Styles	.315	.099	.098	16.857
Achievement in Mathematics				

Table 3 shows the summary of the prediction of learning style to students' achievement in mathematics. The result revealed a positive relationship between learning style of secondary school students and their academic achievement in mathematics scores. It shows that learning style predicts 9.9% to the variance observed in students' achievement in Mathematics. This is an indication that an improvement in learning style would lead to increased students' achievement in Mathematics.

Table 4: Summary of ANOVA on the significant prediction of learning styles to achievement in mathematics in Owerri Education Zone of Imo State.

Model	Sum of squares	df	Mean square	F	p-value
Regression	27287.701	1	27287.701	96.028	.000
Residual	248074.694	873	284.163		
Total	275362.395	874			

The ANOVA for regression results in Table 4 indicate that learning styles significantly predict students' academic achievement in mathematics in the Owerri Education Zone. The F-value (96.028) with a p-value of 0.000 confirm a statistically significant relationship. Since the p-value is below 0.05, the null hypothesis (H_0) is rejected, meaning that learning styles have a significant impact on students' mathematics achievement.

Discussion

The result of the study revealed a positive relationship between learning style of secondary school students and their academic achievement in Mathematics scores. The findings of this study indicate that learning styles significantly influence secondary school students' academic achievement in Mathematics within the Owerri Education Zone. Learning styles account for approximately 9.9% of the variance in Mathematics achievement, suggesting that students' preferred learning approaches contribute meaningfully to their academic success. The statistical analysis supports this relationship, leading to the rejection of the null hypothesis. These findings align with the research of Anyamene and Odalonu (2022) and Duru (2021), which underscores the importance of individualized learning preferences in enhancing academic achievement. Other studies, such as those by Chikendu and Chukwunazo (2022), also emphasize that students who utilize learning strategies that align with their preferences tend to achieve better academic results. However, contrary perspectives exist, such as Cuizon et al. (2022), who argue that learning styles may not significantly impact academic achievement and that other factors, including teaching methods and curriculum design, could be more influential.

One possible explanation for these findings is that when students engage in learning activities that align with their preferred styles, they are more likely to process and retain information effectively. According to Akanni (2020), students who are taught using methods suited to their learning styles exhibit greater motivation and improved comprehension. This could explain why students in the Owerri Education Zone who adopt auditory, visual, or read/write learning styles perform better in Mathematics. Another reason for the significant impact of learning styles on Mathematics achievement is the role of cognitive load in learning. The cognitive theory of multimedia learning states that students process information more efficiently when it is presented in a manner that complements their preferred learning style. For instance, auditory learners benefit from lectures and discussions, visual learners understand concepts better through diagrams and illustrations, and read/write learners excel when given textual explanations. This suggests that effective instructional design can enhance learning outcomes by reducing extraneous cognitive load and improving knowledge retention.

Moreover, the findings may also be attributed to the interplay between learning styles and self-efficacy. Adedun and Ibeabuchi (2022) reported that self-efficacy, or the belief in one's ability to succeed, significantly influences academic achievement. Students who learn in a way that suits their cognitive strengths are more likely to experience success, reinforcing their confidence and motivation to perform well in Mathematics. This aligns with the study by Audu (2020), which found that self-regulated learning strategies, often aligned with individual learning styles, contribute to higher academic achievement. Therefore, the significant role of learning styles in Mathematics achievement could be a reflection of broader systemic factors, such as teacher awareness and instructional practices. Research by Villajuan (2019) found that effective teaching strategies that cater to diverse learning styles improve student engagement and performance. In the context of the Owerri Education Zone, teachers who recognize and integrate different learning styles into their instructional methods may be contributing to the observed relationship between learning styles and Mathematics achievement. However, it is important to acknowledge that while learning styles play a crucial role, other variables, including teacher quality, student motivation, and socioeconomic factors, also influence academic success. Future research could explore how these additional factors interact with learning styles to shape students' Mathematics achievement.

When examining individual dimensions of learning styles, auditory learning emerged as the strongest predictor of Mathematics achievement, followed by visual and read/write learning styles, while kinesthetic learning showed minimal influence. Auditory learners demonstrated the highest levels of success in Mathematics, suggesting that verbal instruction and discussion-based learning are particularly beneficial for mastering mathematical concepts. In contrast, kinesthetic learners showed negligible gains, which may indicate that hands-on, movement-based learning methods are less effective in a subject like Mathematics. These findings are consistent with the work of Bosman and Schulze (2018), as well as Ogbonna (2017), who argue that auditory and visual learning approaches are particularly advantageous for subjects requiring logical reasoning and abstract thinking. However, some researchers, such as Njoku and Abdulhamid (2016) remain skeptical about the direct impact of learning styles, suggesting that their role in student achievement may be overstated.

Conclusion

This study concludes that learning styles constitute a statistically significant, though modest, explanatory factor in secondary school students' academic achievement in Mathematics in the Owerri Education Zone of Imo State. The pattern of relationships observed suggests that students' engagement with Mathematics is more strongly aligned with cognitively oriented learning preferences than with activity-based approaches. Overall, learning styles function as a meaningful predictor of achievement, indicating that how students process and interact with mathematical content has measurable implications for performance. However, the proportion of variance explained also implies that Mathematics achievement is shaped by a combination of learning styles and other academic, instructional, and contextual factors beyond the scope of this study. Consequently, aligning instructional practices with dominant learning preferences may enhance achievement outcomes, but such alignment should be integrated within a broader, multifaceted approach to Mathematics teaching and learning.

Recommendations

Based on the findings, the following recommendations are made:

1. Mathematics instruction should prioritize auditory, visual, and read/write teaching methods, as these learning styles significantly predict students' achievement in Mathematics in the study area.
2. Kinesthetic-based strategies should not be relied upon as a primary approach for teaching Mathematics, but rather used only as a supportive method alongside more effective learning-style approaches.

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