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Mathematical Understanding and Neurodivergent Classroom as Predictors of Students' Performance in Mathematics in Southwest, Nigeria

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Research Article

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Abstract

This study examined neurodivergent classroom characteristics and mathematical understanding as predictors of secondary school students' academic performance in mathematics. The study adopted a descriptive survey research design using a Stimulus-Person-Outcome (SPO) factor design. Neurodivergent classroom variables served as the stimulus factors, mathematical understanding as the person factor, and academic performance in summative assessment as the outcome variable. A multistage sampling procedure was used to select 316 respondents from three states in Southwest Nigeria: 269 neurodivergent (visually and hearing-impaired) students and 47 mathematics teachers. Data were collected through the Neurodivergent Students Questionnaire" (NSQ) and Teachers' Perceptions toward Neurodivergent Students (TPNS), alongside students' summative assessment scores in mathematics. Student questionnaires focused on cognitive processing differences, attention and focus challenges, language and comprehension barriers, sensory sensitivity, dyscalculia, dyslexia, and dysgraphia. Teacher questionnaires examined assessment practices involving multisensory learning approaches, chunking and task segmentation, flexible representation, and strength-based mathematical problem content. The study analyzed data using descriptive and inferential statistics. Findings revealed that neurodivergent classroom variables and mathematical understanding significantly predicted students' academic performance in Mathematics. The study recommended that inclusive instructional practices, specialized teacher training, and adaptive assessment strategies should be intensified to improve learning outcomes among neurodivergent students.

Introduction

The pursuit of inclusive education in man's development has gained a significant global attention, with increasing recognition of the need to provide equitable learning opportunities for students with special needs regardless of their emotional, mental, or psychometric differences. Inclusive education enables students with disabilities feel loved and accommodated. It goes beyond physical integration to providing a conducive learning environment for such students. According to Manzoor et.al. (2025), inclusive education is necessary for enhancing exposure, improving social skills, developing independence, building confidence and empowering them for future challenges. Inclusive education helps in mind development of visually and hearing impaired as it develops creativity in them which inturn improves their communication skills because of interaction with others.

Neurodivergent students represent a significant group that requires a specialized instructional and assessment approaches such as differentiated instruction, multisensory instruction, explicit and structured instruction, formative assessment, flexible assessment formats, alternative testing environment among others. Neurodiversity recognizes neurological differences as variations in human natural functioning (Singer, 2017). Students with visual and hearing impairments may experience distinctive sensory, communication, and accessibility needs in mathematics classrooms, while specific learning difficulties such as dyslexia, dyscalculia, and dysgraphia represent separate conditions that

should be identified using appropriate diagnostic or documented criteria rather than inferred solely from students' reported learning difficulties. (Armstrong, 2015).

Mathematics is an important subjects that contributes significantly to critical thinking, logical reasoning, problem-solving, and scientific literacy (National Council of Teachers of Mathematics (NCTM, 2020).According to Oginni (2022), mathematics is the language of science and other discipline as the symbolic means of communication. However, students encountering difficulties in mathematical understanding due to differences in cognitive processing, sensory limitations, and language comprehension, these could be traced to their neurodivergent characteristics (Geary, 2019). Inclusive education is an approach to schooling that supports the idea that all children, regardless of their physical, mental, social, emotional, or language differences, should be welcomed in schools (Ayodele, Okunade & Akinbebije, 2026). Inclusive classroom environments have been found to improve students learning with disabilities by providing access to equitable learning opportunities (UNESCO, 2023). Consequently, the quality of neurodivergent classroom practices may significantly influence students' mathematical understanding (Meyer, Rose, & Gordon, 2014).

Neurodivergent students constitute an important population within contemporary education, and their classroom is essential to inclusive education, because diverse learning needs are accommodated to advocate for educational variations (Ainscow, 2020). Such classrooms acknowledge that students process information differently and therefore require differentiated instructional strategies (Armstrong, 2015). Neurodivergent students in this study are those with sensory and learning difficulties impairment students. Sensory impairments involve students with difficulties in their sensory functions, particularly vision and hearing while learning difficulties students are those affected in the aspects of learning such as dyslexia, Dyslexia and Dysgraphia. Students with hearing impairments appear to be more challenging to understand complex mathematical concepts and keep up with the dynamics of the class if they are unable to hear necessary inputs (Nunes & Moreno, 2002). Additionally, emotional and social difficulties could be the reasons for hearing-impaired students in mathematics to increase. Their inability to keep up with peers could be due to communication issues, low self-worth, and frustration (Kritzer, 2009). Sensory impairments often benefit from instructional adaptations that emphasize accessibility, flexibility, and multiple means of engagement (Meyer et al., 2014). These adaptations enhance participation and promote academic achievement (Florian & Black-Hawkins, 2011, Bismark, 2024). Language skills are fundamental to the development of cognitive, social, and academic abilities in mathematics learning, thorough evaluations could pinpoint the root reasons and provide therapy that may be used as intervention to enhance vocabulary, grammar, articulation, and pragmatic language abilities.

Visual impairment include those with challenges of a sighted person, ranging from possessing some sight issue to having no vision at all. Visual impairments students can find great difficulty learning new ideas in mathematics which may need diagrams heavily reliant on sight. According to Beal & Rosenblum, (2018), activities that involve reading and analyzing mathematical equations are more complex algorithms and images that may hinder visual processors. Visually impaired students experience struggles with socialization and mental health, individuals with visual problems tend to feel isolated from

most social situations and, consequently, lose self-esteem and motivation for studying Mathematics. Despite the numerous merits of inclusive learning, such as encouraging interaction and instilling self-assurance in students, visually disabled learners struggle immensely because of the dependency of mathematics on visual learning aids. These aids include graphs, diagrams, and the ability to envision space, which are almost impossible for the visually impaired to use. The unavailability of learning materials such as Braille-making processes, and the absence of adequate technological devices, worsen the situation.

Mathematical understanding extends beyond procedural knowledge to include conceptual understanding, strategic competence, and a higher academic achievement (Hiebert & Grouws, 2007). Common misconception like misuse of data, logically invalid inference, technical and mechanical errors could be addressed by procedural knowledge and conceptual understanding of students in mathematics (Oginni, 2016). Similarly, Boaler (2016) argued that mathematics develops flexible and creative thinking rather than merely requiring students' adaptive reasoning, and productive disposition (Kilpatrick, Swafford, & Findell, 2001). According to Skemp (1976), relational understanding enables students to know both what to do and why they are doing it. Students with strong conceptual understanding are more likely to transfer mathematical knowledge to new contexts and memorize formulas and procedures. In her view, learners can use mathematics to identify patterns, explore relationships, make predictions and develop different strategies for solving problems. Mathematics therefore encourages students to think critically and creatively when faced with unfamiliar situations. Dyscalculia is a specific learning difficulty characterized by persistent challenges in understanding numbers and performing arithmetic calculations (Butterworth, 2018). Students with dyscalculia often struggle with number sense, mathematical memory, and problem-solving skills (Geary, 2019). Research has shown that dyscalculia can significantly affect academic performance when appropriate interventions are not provided (Butterworth, Varma, & Laurillard, 2011).

Dyslexia primarily affects reading accuracy, fluency, and comprehension (International Dyslexia Association, 2023). In mathematics, dyslexia can impair students' ability to interpret word problems, understand mathematical vocabulary, and follow written instructions (Shaywitz, 2020). According to Oginni & Olugbuyi (2014), dyslexia and dyscalculia are learning disability that affect learner's ability to read and comprehend mathematics language, which could be attributed to feeling of tension, mental disorganization and other mathematical problems. Dygraphia is associated with difficulties in handwriting, written expression, and motor coordination during writing tasks (Berninger, 2015). Students with dygraphia may understand mathematical concepts but struggle to record solutions effectively during examinations (Berninger & Wolf, 2016). Multisensory instruction engages multiple sensory pathways simultaneously, including visual, auditory, tactile, and kinesthetic channels (Birsh & Carreker, 2018). Studies indicate that multisensory approaches enhance retention and comprehension among neurodivergent learners (Sousa, 2022). Chunking involves dividing information into smaller, manageable units to reduce cognitive load (Miller, 1956).

Cognitive load suggests that breaking mathematical tasks into smaller and flexible components facilitates learning and improves students' performance (Sweller, Ayres, & Kalyuga, 2019). Flexible representation is a key principle of Universal Design for Learning (UDL), which advocates presenting information in multiple formats to accommodate diverse learners (Meyer et al., 2014). Research demonstrates that flexible representations improve accessibility and comprehension for students with disabilities (CAST, 2021). Strength-based education focuses on students' interests, talents, and capabilities rather than deficits (Lopez & Louis, 2009). Integrating students' interests into mathematical tasks has been associated with increased motivation and engagement (Tomlinson, 2017). The Stimulus-Person-Outcome (SPO) framework developed by Tett and Burnett (2003) posits that environmental stimuli influence individual characteristics, which subsequently determine behavioral and performance outcomes. In this study, neurodivergent classroom factors constitute the stimulus variables, mathematical understanding represents the person variable, and summative assessment performance serves as the outcome variable.

Research has increasingly highlighted the importance of neurodivergent classrooms characterized by inclusive pedagogical practices such as multisensory instruction, flexible representation of concepts, chunking of tasks, and strength-based learning approaches. Such classroom environments can significantly enhance engagement, comprehension, and academic achievement among students with diverse learning profiles. Despite the growing attention to inclusive education in Nigeria, empirical studies examining neurodivergent classroom factors and mathematical understanding as predictors of academic performance among visually impaired and hearing-impaired secondary school students remain limited. This study therefore investigates the predictive influence of these variables on students' performance in mathematics.

Statement of the Problem

The increasing inclusion of neurodivergent students in mainstream and special secondary schools has created new challenges for mathematics instruction and assessment. Students with visual and hearing impairments frequently encounter difficulties in accessing mathematical concepts due to sensory limitations, language barriers, and cognitive processing differences. Additionally, learning disorders such as dyscalculia, dyslexia, and dysgraphia may further complicate students' ability to understand mathematical concepts, solve problems, and demonstrate learning during Mathematics lesson. Traditional assessment methods often fail to accommodate these differences, resulting in underestimation of students' capabilities. While several studies have examined academic achievement among students with disabilities, limited attention has been given to the combined influence of neurodivergent classroom characteristics and mathematical understanding on summative assessment performance. This gap necessitates empirical investigation, particularly within the Nigerian educational context.

Objectives of the Study

The study:

1. Examined the relationship between neurodivergent learning characteristics and students' Mathematics performance.
2. Determined the influence of mathematical understanding on neurodivergent students.
3. Assessed teachers' perceptions of inclusive practices in mathematics classroom.

Research Questions

The following research questions were raised to guide this study.

1. What is the performance level of neurodivergent students in Mathematics?
2. What are the factors influencing neurodivergent students' performance in Mathematics?
3. What techniques can be implemented to enhance the inclusivity of neurodivergent students' performance in mathematics?

Research Hypotheses

The following null hypotheses were formulated to guide this study.

H01: Neurodivergent learning-related characteristics do not significantly predict students' performance in Mathematics.

H02: Neurodivergent learning differences do not significantly predict students' understanding of Mathematics.

H03: Gender is not significantly related to neurodivergent students' performance in Mathematics.

Methodology

The study adopted a descriptive survey design employing the Stimulus-Person-Outcome (SPO) factor design. The population comprised all visually impaired and hearing-impaired secondary school students and their mathematics teachers in Southwest Nigeria. A multistage sampling procedure was employed. Three states were randomly selected from Southwest Nigeria. Special and inclusive secondary schools within the selected states were chosen based on school type. Schools were randomly selected from each stratum. Visually impaired and hearing-impaired students were proportionately selected from the sampled schools. Mathematics teachers responsible for teaching the selected students were purposively selected. A total sample of 269 neurodivergent students and 47 mathematics teachers were utilized for the study. Neurodivergent Students Questionnaire (NSQ) and Teacher questionnaire which made up of two sections respectively. Student questionnaires focused on cognitive processing differences, attention and focus challenges, language and comprehension barriers, sensory sensitivity,

dyscalculia, dyslexia, and dysgraphia. Teacher questionnaires examined assessment practices involving multisensory learning approaches, chunking and task segmentation, flexible representation, and strength-based mathematical problem content. Section A comprised demographic Information of the respondents while Section B comprised 25 items each. Content and face validity were established through experts review in Mathematics Education, Educational Psychology and neurodivergent specialist in Mathematics. A pilot study was conducted and reliability coefficients determined for the two instruments using Cronbach's Alpha which yielded 0.70 and 0.81 respectively. Research questions were answered using frequency counts, percentages, mean and standard deviation. Hypotheses were tested using: Multiple regression analysis, Pearson's Product Moment Correlation, Analysis of Variance (ANOVA) at 0.05 level of significance. The study revealed that neurodivergent learning-related characteristics and inclusive classroom practices are statistically associated with students' mathematics understanding and performance.

Results

Research question 1

What is the performance level of neurodivergent students in Mathematics?

To answer this research question, the scores obtained by the 269 neurodivergent students in the Mathematics Conceptual Understanding Test (MCUT) were classified into three performance levels: Low (0–49%), Moderate (50–69%), and High (70–100%). The results are presented in Table 1.

Table 1
Performance level of neurodivergent students in Mathematics (N = 269)

Performance Level	Score Range (%)	Frequency (F)	Percentage (%)
Low	0–49	49	18.2
Moderate	50–69	145	54.0
High	70–100	75	27.9
Total	—	**269**	**100.0**

Mean = 60.60; Standard Deviation = 20.0

Table 1 showed that out of the 269 neurodivergent students assessed in Mathematics, 49 students (18.2%) had low performance, 145 students (54.0%) had moderate performance, while 75 students (27.9%) recorded high performance. The mean score of 60.60 with a standard deviation of 20.00 indicates that the students' performance was generally within the moderate performance level, with noticeable variation in scores among the students.

Research question 2

What are the factors influencing neurodivergent students' performance in Mathematics?

To answer this research question, responses obtained from the Observed Neurodivergent Support Measures (ONSM) were analysed across the four identified dimensions: cognitive processing differences, attention and focus challenges, language and comprehension barriers, and sensory sensitivities. The mean and standard deviation were used to determine the extent to which each factor influences students' mathematics performance. A criterion mean of 2.50 was adopted for decision-making.

Table 2
Factors Influencing Neurodivergent Students' Performance in Mathematics (N = 269)

S/N	Factors	Very Often f(%)	Often f(%)	Rarely f(%)	Not Often f(%)	Mean	SD	Decision
1	Cognitive Processing Differences	126 (46.8)	99 (36.8)	27 (10.0)	17 (6.4)	3.23	0.83	Influential
2	Attention and Focus Challenges	117 (43.5)	90 (33.5)	45 (16.7)	17 (6.3)	3.13	0.86	Influential
3	Language and Comprehension Barriers	99 (36.8)	108 (40.1)	45 (16.7)	17 (6.4)	3.07	0.83	Influential
4	Sensory Sensitivities	89 (33.1)	99 (36.8)	54 (20.1)	27 (10.0)	2.93	0.91	Influential
	Grand Mean					3.09	0.86	Influential

Criterion mean = 2.50

Table 2 showed that all four factors were perceived as influential on neurodivergent students' performance in Mathematics, as their mean scores exceeded the criterion mean of 2.50. Cognitive processing differences recorded the highest mean (3.23, SD = 0.83), followed by attention and focus challenges (3.13, SD = 0.86), language and comprehension barriers (3.07, SD = 0.83), and sensory sensitivities (2.93, SD = 0.91). The grand mean of 3.09 (SD = 0.86) revealed that the identified factors were perceived as influential in determining the Mathematics performance of neurodivergent students.

Research question 3

What techniques can be implemented to enhance the inclusivity of neurodivergent students in mathematics?

To answer this research question, responses from the Teachers' Opinions Toward Neurodivergent Students (TOTANS) were analysed. The responses were categorized into Very Often (VO), Often (O),

Rarely (R), and Not Often (NO). Frequency, percentage, mean and standard deviation were used to determine the techniques that can be implemented to enhance the inclusivity of neurodivergent learners in Mathematics. A criterion mean of 2.50 was adopted for decision-making.

Table 3
Techniques for Enhancing the Inclusivity of Neurodivergent Learners in Mathematics (N = 47)

S/N	Techniques	Very Often f(%)	Often f(%)	Rarely f(%)	Not Often f(%)	Mean	SD	Decision
1	Multi-sensory Learning Approaches	23 (48.9)	18 (38.3)	5 (10.6)	1 (2.2)	3.30	0.76	Accepted
2	Chunking and Task Segmentation	22 (46.8)	19 (40.4)	5 (10.6)	1 (2.2)	3.28	0.75	Accepted
3	Flexible Representation of Mathematical Content (UDL Framework)	20 (42.6)	21 (44.7)	5 (10.6)	1 (2.1)	3.24	0.74	Accepted
4	Strength-Based and Interest-Led Problem Contexts	19 (40.4)	20 (42.6)	7 (14.9)	1 (2.1)	3.26	0.74	Accepted
	Grand Mean					3.27	0.75	Accepted

Criterion mean = 2.50

Table 3 showed that multi-sensory learning approaches recorded the highest mean (3.30, SD = 0.76), followed by chunking and task segmentation (3.28, SD = 0.75), strength-based and interest-led problem contexts (3.26, SD = 0.74), and flexible representation of mathematical content using the UDL framework (3.24, SD = 0.74). The grand mean of 3.27 (SD = 0.75) showed that the respondents accepted the identified techniques as useful for enhancing the inclusivity of neurodivergent learners in Mathematics.

Testing of Hypotheses

Hypothesis 1

Neurodivergent learning-related characteristics do not significantly predict students' performance in Mathematics.

Table 4
Structural Equation Model of Neurodivergent learning-related characteristics as Predictors of Students' Academic Performance in Mathematics

Path	Estimate (β)	S.E.	C.R.	p	Decision
Cognitive Processing Differences → Mathematics Performance	-0.42	0.08	-5.25	< 0.001	Significant
Attention and Focus Challenges → Mathematics Performance	-0.29	0.09	-3.22	0.001	Significant
Language and Comprehension Barriers → Mathematics Performance	-0.25	0.08	-3.13	0.002	Significant
Sensory Sensitivities → Mathematics Performance	-0.20	0.09	-2.22	0.026	Significant
Neurodivergent Learning Styles → Mathematics Performance	**-0.61**	**0.07**	**-8.71**	**< 0.001**	**Significant**

Model fit indices

$\chi^2 = 6.84$, df = 6, p = 0.336; CFI = 0.992; TLI = 0.981; RMSEA = 0.061; SRMR = 0.038.

The SEM results in Table 4 showed that neurodivergent learning-related characteristics significantly predict students' academic performance in Mathematics (β = -0.61, S.E. = 0.07, C.R. = -8.71, p < 0.001). The negative path coefficient indicates that greater difficulties associated with neurodivergent learning characteristics are associated with lower Mathematics performance. At the dimension level, cognitive processing differences significantly predicted Mathematics performance (β = -0.42, p < 0.001), followed by attention and focus challenges (β = -0.29, p = 0.001), language and comprehension barriers (β = -0.25, p = 0.002), and sensory sensitivities (β = -0.20, p = 0.026). All four dimensions made statistically significant contributions to Mathematics performance. Since the overall structural path is significant at p < 0.05, the null hypothesis was rejected. Therefore, neurodivergent learning-related characteristics significantly predict students' academic performance in Mathematics.

Figure 1 showed that each of the four dimensions; cognitive processing differences (β = − 0.42), attention and focus challenges (β = − 0.29), language and comprehension barriers (β = − 0.25), and sensory sensitivities (β = − 0.20) have a negative, statistically significant effect. Together, they form the higher-order latent construct neurodivergent learning styles, which itself negatively predicts mathematics performance (β = − 0.61**). In summary, the model highlights that greater neurodivergent learning challenges collectively reduce students' achievement in mathematics.

Hypothesis 2

Neurodivergent learning differences do not significantly predict students' understanding of Mathematics.

Table 5
SEM Analysis of Neurodivergent Learning Differences as Predictors of Students' Understanding of Mathematics

Structural Path	Estimate (β)	S.E.	C.R.	P-value	Decision
Cognitive Processing Differences → Mathematics Understanding	-0.38	0.08	-4.75	< 0.001	Significant
Attention and Focus Challenges → Mathematics Understanding	-0.27	0.09	-3.00	0.003	Significant
Language and Comprehension Barriers → Mathematics Understanding	-0.31	0.08	-3.88	< 0.001	Significant
Sensory Sensitivities → Mathematics Understanding	-0.18	0.08	-2.25	0.024	Significant
Neurodivergent Learning Differences → Mathematics Understanding	**-0.59**	**0.07**	**-8.43**	**< 0.001**	**Significant**

Model Fit Indices

$\chi^2 = 7.16$, df = 6, p = 0.306; CFI = 0.989; TLI = 0.976; RMSEA = 0.068; SRMR = 0.041.

Table 5 showed that neurodivergent learning differences significantly predict students' understanding of Mathematics (β = -0.59, S.E. = 0.07, C.R. = -8.43, p < 0.001). The negative coefficient indicates that greater difficulties associated with neurodivergent learning differences are associated with lower levels of Mathematics conceptual understanding. At the dimension level, cognitive processing differences significantly predicted Mathematics understanding (β = -0.38, p < 0.001). Language and comprehension barriers also made a significant contribution (β = -0.31, p < 0.001), followed by attention and focus challenges (β = -0.27, p = 0.003) and sensory sensitivities (β = -0.18, p = 0.024). All four dimensions therefore made statistically significant contributions to students' understanding of Mathematics. The structural path is significant at p < 0.05, hence, the null hypothesis is rejected. Therefore, neurodivergent learning differences significantly predict students' understanding of Mathematics.

Figure 2 illustrated how neurodivergent learning differences affect mathematics understanding. Four dimensions; cognitive processing differences (β = − 0.38), attention and focus challenges (β = − 0.27), language and comprehension barriers (β = − 0.31), and sensory sensitivities (β = − 0.18) feed into the higher-order construct Neurodivergent Learning Differences. This latent variable, in turn, negatively predicts Mathematics Understanding (β = − 0.59 *). Therefore, the model shows that increased neurodivergent learning challenges are associated with reduced understanding of Mathematics.

Hypothesis 3

Gender does not significantly related to neurodivergent students' performance in Mathematics.

Table 6
Independent-Samples t-test of Gender and Neurodivergent Students' Mathematics Performance

Gender	*N*	*Mean*	*SD*	*t*	*df*	*p*
Male	147	63.74	12.86	1.07	267	0.290
Female	122	61.00	14.74			
p > 0.05 (Not Significant)						

The results in Table 6 showed that male neurodivergent students had a mean Mathematics performance score of 63.74 (SD = 12.86), while female students had a mean score of 61.00 (SD = 14.74). Although male students recorded a slightly higher mean score than female students, the difference was not statistically significant, t (48) = 1.07, p = 0.290. Since the obtained p-value of 0.290 is greater than the 0.05 level of significance, the null hypothesis is not rejected. Therefore, gender does not significantly relate to the Mathematics performance of neurodivergent students. This implies that the observed difference in the Mathematics performance of male and female neurodivergent students is not statistically significant.

Discussion

The finding of the study showed that neurodivergent students demonstrated a moderate level of performance in Mathematics. This contradicted to the work of Jones et.al (2009) that arithmetic attainment varied widely with "peaks and dips" rather than a uniform deficit. The study revealed that cognitive processing differences, attention and focus challenges, language and comprehension barriers, and sensory sensitivities were influential factors affecting neurodivergent students' performance in Mathematics. The study was in line with the earlier work of Le Cunff (2024) that neurodivergent students is balancing the acquisition of high-quality data in terms of volume and accuracy. The finding is in consonant with the study of Özkubat & Karabulut, (2021) that students apply cognitive strategies (i.e., reading, computing and controlling) to solve mathematics problems, and these strategy included problem-solving stage in other to implement the strategies is not modeled. The finding equally showed that multi-sensory learning, chunking and task segmentation, flexible representation of mathematical content, and strength-based and interest-led problem contexts were suitable techniques for enhancing the inclusivity of neurodivergent learners in Mathematics. This is in conformity with the study conducted by Nurjana et.al. (2024) that multisensory approach has a positive impact not only on material comprehension but also on students' enthusiasm for learning and positive peer communication. Ashman (2019) corroborated the earlier studies and found out that multisensory method provides a variety of flexible communication channels, allowing students to access information according to the needs and uniqueness of each individual. The study revealed that neurodivergent learning-related characteristics significantly predicted students' academic performance in Mathematics. The finding has similar views with the works of Santoshi et.al. (2024) that understanding strengths and challenges underscore the need for the autistic uniqueness in learning. The study equally posited that

neurodivergent learning differences significantly predicted students' understanding of Mathematics. The finding revealed that gender did not significantly relate to neurodivergent students' performance in Mathematics, leading to the non-rejection of the null hypothesis. This is in line with the work of Fasina (2026) that gender has no significant influence on the accessibility and utilization of assistive technology among students with special needs.

Educational Implications

The findings of this study contributed significantly to inclusive mathematics education by providing evidence-based recommendations for supporting neurodivergent learners. Educational policymakers may utilize the findings to improve inclusive education policies and assessment frameworks.

Teacher education institutions may incorporate neurodiversity-focused training into professional development programmes. Schools may also adopt adaptive instructional strategies to improve mathematical understanding and academic achievement among neurodivergent students

Conclusion and Recommendations

Neurodivergent learners, particularly students with visual and hearing impairments, face unique challenges that affect mathematical understanding and academic performance. Through the lens of the Stimulus-Person-Outcome framework, this study demonstrated the importance of neurodivergent classroom environments and mathematical understanding in predicting students' performance in mathematics. The integration of multisensory instruction, flexible representation, chunking strategies, and strength-based learning approaches significantly enhanced educational outcomes for the neurodivergent students. Addressing dyscalculia, dyslexia, and dygraphia through inclusive assessment and instructional practices is essential for achieving equitable educational opportunities in secondary schools. Based on the finding of this study, it was recommended that inclusive instructional practices should be well equipped with modern facilities that aid learning. Government should from time to time organise specialized training for the neurodivergent mathematics teachers, and adaptive assessment strategies should be intensified to improve learning outcomes among neurodivergent students in Mathematics.

Clinical trial number

not applicable.'

Ethics Approval

and Consent to Publish: - This study, Mathematical Understanding and Neurodivergent Classroom as Predictors of Student Performance in Mathematics in South West, Nigeria, was conducted in accordance with the Declaration of Helsinki and the ethical guidelines of Ekiti State University, Ado-Ekiti, Ekiti State, Nigeria and the National Health Research Ethics Committee (NHREC) of Nigeria. Ethical approval was obtained from ethics committee on Institution Based Research (IBR) of Ekiti State University, Ado-Ekiti

only. Permission to conduct the research was also obtained from the State Ministries of Education and the school authorities in the selected South West states. Managements of special schools were informed and the consent and assent participation was voluntary.

Written informed consent was obtained from school principals, teachers, and the parents or guardians of all student participants. Students gave verbal or written assent in age-appropriate language. Participants were told the purpose of the study and that they could withdraw at any time without penalty or any effect on their academic standing.

Protection of Neurodivergent Participants; - Students identified as neurodivergent (e.g., those with hearing and visual impairments, dyslexia, ADHD, autism spectrum conditions, or dyscalculia) were not singled out, stigmatised, or disadvantaged. Data collection was adapted where needed, such as extra time, clear instructions, and a supportive environment. Neurodivergent status was drawn from existing school records and teacher reports, and no diagnostic or clinical procedures were performed.

Confidentiality and Anonymity: - No names or identifying details of students, teachers, or schools were recorded. Codes were used in place of identities, and data were stored securely, with access limited to the research team. Findings are reported in aggregate only.

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Data Availability: - The datasets generated and analysed during this study are available from the corresponding author on reasonable request, subject to ethical and privacy restrictions.
Conflict of Interest; - The author(s) declare no conflict of interest.

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Ayodele C.J worked on the theorectical framework and literature review. All authors contributed to drafting and revising the manuscript and approved the final version. The authors take full responsibility for the content.

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Figures

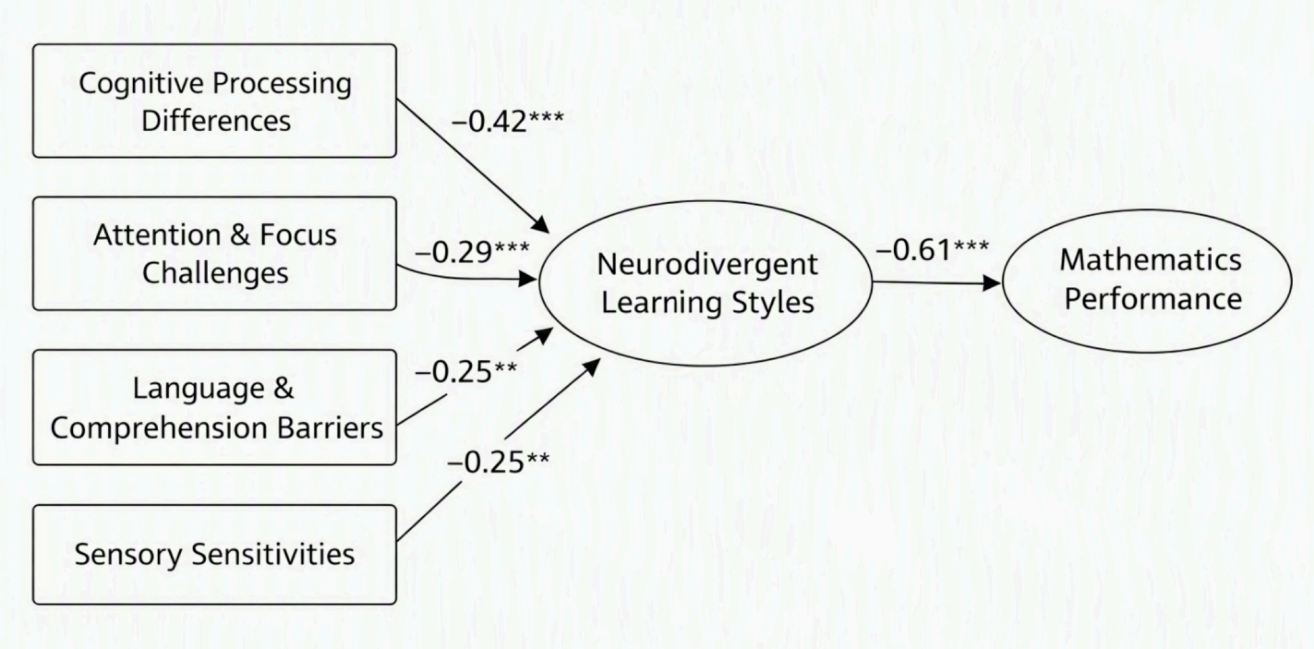

Figure 1

Structural Equation Model (SEM) diagram showing neurodivergent learning-related characteristics prediction of students' academic performance in Mathematics.

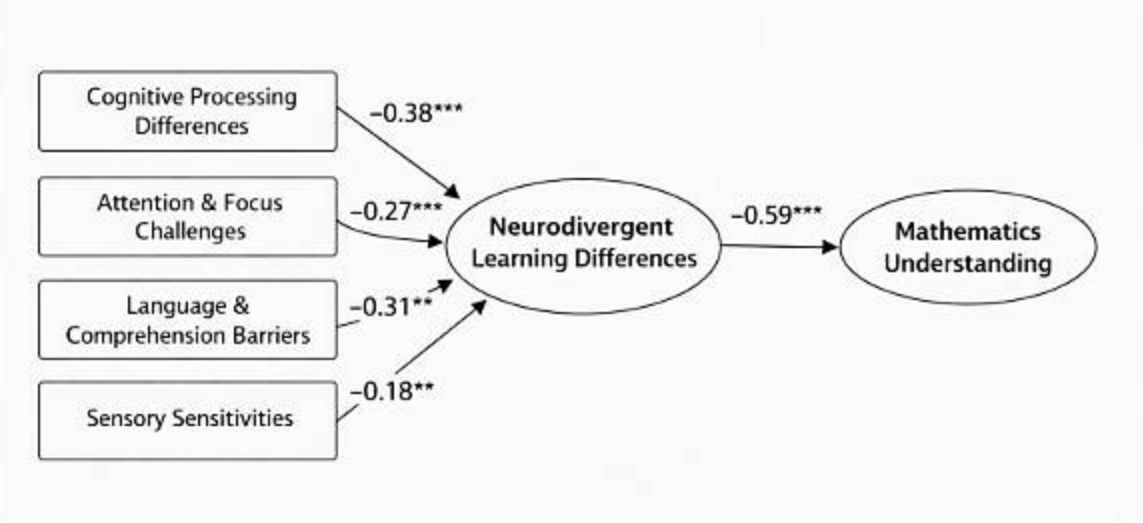

Figure 2

Structural Equation Model (SEM) diagram showing Neurodivergent Learning Differences Prediction of Students' Understanding of Mathematics.