Effect of Training on Dyslexic Pupils' Cognitive Domain in Ondo Metropolis, Nigeria

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Abstract

The study focused on the effect of training on dyslexic pupils' cognitive domain in Ondo metropolis. Quasi-experimental design was used with sample pupils of 64 in public primary schools. There were two groups: experimental and control groups, each with 32 participants. A Phonological Awareness Test for Dyslexic Pupils (PATDP) was used for pre-test and post-test. Independent samples t-test was used to analyse the data at $p \leq 0.05$*. The results indicated that there is significant difference between the post-test scores and pre-test scores (t-value = 30.3443, df = 62, p-value = 0.000), significant difference between experimental and control groups (t-value = 20.352, df = 62, p-value = 0.000), significant difference in gender scores favouring females (t-value = 4.015, df = 62, p-value = 0.000) and significant difference in urban and rural pupils after training (t-value = 3.694, df = 29, p-value = 0.001). The study found that training is effective for dyslexic pupils' cognitive function and suggests incorporating training into the school curriculum.*

Keywords: Dyslexia, cognitive domain, phonological awareness, training, primary school pupils

Introduction

The developmental dyslexia, a specific learning disorder with neurobiological origin is one of the most common yet underdiagnosed learning issues in the world (George et al., 2025). The International Dyslexia Association (2025) recently reiterated that dyslexia is a dimensionally expressed brain-based challenge to accurate and/or fluent word recognition and spelling, rather than a categorical one-person vs another one. This is in line with the current diagnostic criteria outlined in the ICD-11 (World Health Organization, 2025) which define dyslexia as a developmental learning disorder that involves impairments in reading, manifested as significant and persistent difficulties in word reading accuracy, fluency and comprehension, markedly below age and cognitive expectations (de Oliveira et al., 2026).

Studies of prevalence rates around the world suggest that 5% to 20% of children in school may have signs and symptoms of dyslexia. The Jyväskylä Longitudinal Study of Dyslexia (Lyytinen et al., 2006) has shown repeatedly that early impairments in phonological awareness, rapid automatized naming (RAN) and verbal short-term memory predict later reading abilities well. The impact of unmanaged dyslexia is not just limited to academic poor performance; affected people are vulnerable to school drop-out, poor job prospects and high rates of anxiety, depression and low self-concept.

This is a worrying situation in Nigeria in particular. The Dyslexia Foundation of Nigeria estimates that 15-20% of the total population of Nigeria, that is, more than 30 million people, may be on the dyslexia spectrum of learning, while as many as 20 children in a classroom may be affected (Ramezani & Fawcett, 2026). Although these are staggering statistics, there continue to be a lack of diagnosis and the disease is very underdiagnosed. George et al (2025) recently evaluated 110 primary school teachers in Southern Kaduna State, revealing that the level of awareness of dyslexia was moderate, but high levels of knowledge gaps were observed especially in differentiating symptoms, identifying dyslexia early and implementing evidence-based intervention strategies. The regression analysis showed a strong, statistically significant relationship between teacher training and dyslexia identification ability with the formally trained teachers showing higher competence and confidence in identifying dyslexic learners (Snowling et al., 2020).

This systemic failure has serious repercussions. According to UNESCO, only 10% of students in the world are affected with dyslexia while the rate of identification in

Nigeria is very low (Nation, 2024). The academic disadvantage for children who do not learn to read fluently by the end of Primary school is significant as they begin to fall further behind in the more complex subjects and the number of children taking part declines. The trend of underachievement can be seen in juvenile remand homes, overrepresentation in prison populations (40-70% of inmates have been found to be dyslexic) and in the drop-out rate for dyslexics (up to 35%) (Peng et al., 2022). The mental health impact is also significant, with several reports of youth suicide linked to the related challenges of undiagnosed dyslexia in Nigeria (Ziegler, Perry & Zorzi, 2020).

Structured, evidence-based interventions have been shown to be effective with children at risk for dyslexia in recent international research. De Oliveira et al. (2026) tested a structured multisensory phonics-based intervention protocol with 76 pre-K to early elementary students with risk factors for dyslexia in Brazilian public schools in a longitudinal study. The intervention was comprised of four progressive cycles (28 sessions) focusing on phonological awareness, rapid automatized naming, and short term/working memory. The findings showed that the intervention had a significant effect on the number of children meeting the initial and consolidated stages of literacy, and by the end of the intervention, no significant difference was found between risk groups compared to the comparison group (Melby-Lervag et al., 2022). The results suggest that preventive and intensified interventions have promise to diminish literacy gaps if provided within the public school context.

Likewise, Kim and Pae (2026) conducted a randomized controlled trial (RC) on group intervention for Hangeul phonics for developmental dyslexia (DD) first-graders, and the results indicated that systematic and explicit phonics instruction significantly improved the decoding accuracy of the first-graders at the grapheme level, the syllable level, and the word level, as well as reading attitudes. The intervention group showed significantly greater gains compared to the control group, providing strong evidence for the effectiveness of group-based structured literacy approaches (Vonthron et al., 2025). Ramezani and Fawcett (2026) investigated the neural mechanisms underlying cognitive-motor training for children with dyslexia, and found a significant improvement in reading, cognitive functions and motor skills following verbal working memory-balance training, along with changes in functional connectivity in regions of the brain related to attention and automaticity.

Although it is clear from the above international evidence, there is still a large research gap in the Nigerian context. Although studies in Brazil, Korea and other countries have proven the effectiveness of structured intervention, the impact of training on the cognitive domain of dyslexic pupils in Nigerian public primary schools is limited to empirical research. George et al. (2025) found that teachers reported feeling underprepared because there was a lack of content on dyslexia in pre-service and in-service training programs and that the lack of diagnostic tools, large classes size and community stigma hindered effective support (Jung & Lombardino, 2019).

Moreover, previous research in Nigeria has been largely on teachers' awareness and not on the outcomes of intervention. There is paucity of literature exploring the effect of location (rural versus urban) on the effectiveness of training, and whether there are gender differences in the responses to the intervention in the Nigerian context. This is especially dramatic in a context of the different socio-economic and infrastructural challenges of Nigerian states and local government areas.

The present study thus fills the above gaps by examining the impact of training on the cognitive domain of dyslexic pupils in Ondo Metropolis, Nigeria. Based on the Phonological Theory (Bradley & Bryant, 1978) that specifies a core deficit in dyslexics as a failure to represent, store and retrieve speech sounds, this study is an assessment of the effectiveness of three specific phonological awareness training tasks (sentence segmentation, rhyme identification, and syllable

blending) on the cognitive functioning of dyslexic students from public primary schools. This study is aimed at providing empirical evidence that can inform inclusive education policies and teacher training programmes in Nigeria by comparing pre-test and post-test results of the experimental and control groups and by analysing the results according to the differences in gender and location (rural versus urban) before and after implementation. The results could have implications for achieving equitable quality education (SDG 4) of children with specific learning disabilities in resource-limited contexts.

Objectives of the Study

The purpose of this study was to find out the effect of training on dyslexic pupils' cognitive domain. Specific objectives were to:

i. Find out the difference between dyslexic pupils in experimental and control group.
ii. Ascertain gender difference in the performance of dyslexic pupils in the experimental and control group.
iii. examine the difference in the performance of dyslexic pupils from rural and urban schools.

Null Hypotheses

The following null hypotheses were tested at $p = 0.05$:

H_{01}: There is no significant difference between the post-test scores of dyslexic pupils in the experimental and control group.

H_{02}: There is no significant difference between the performance of male and female dyslexic pupils in the experimental and control group.

H_{03}: There is no significant difference in the performance of dyslexic pupils from rural and urban schools.

Significance of the Study

The findings will be beneficial for pupils as it will help them to understand what dyslexia is and what it means. Teachers will learn what factors to look out for and how to intervene. Parents will be more aware of the potential for learning of their children. School authorities will provide guidance for effective instruction to teachers. Counsellors will consider cumulative records for strengths and weaknesses. Finally, researchers will be able to use useful material for future research investigating dyslexia.

Literature Review

Dyslexia comes from the Greek roots dys (difficulty) and lexis (word), reflecting that it is one of the most widely studied specific learning disabilities in modern educational neuroscience. The definition of dyslexia has been updated by the International Dyslexia Association (2023) which states that dyslexia is a specific learning disability that is neurobiological in origin, which manifests itself in difficulties with accurate and/or fluent word recognition, and poor spelling and decoding. These challenges are most often linked to a lack of the phonological processing system in language, a component that is not usually anticipated in relation to other cognitive skills and delivery of adequate classroom instruction (Snowling, Hulme & Nation, 2020).

The multiple-deficit model of developmental disorders of reading and spelling offered by Moll et al. (2022) was a major step in the understanding of dyslexia. Their longitudinal study showed that developmental dyslexia is a continuous distribution of the reading and spelling skill continuum in the population with reading and spelling ability at the extreme end. The implications for assessment and intervention are significant in this dimensional perspective, in which educators might not be interested in the categorical classification but instead in determining the specific cognitive and literacy profiles of children (Moll, et al., 2022).

Recent neuroimaging studies have shed a great deal of light on the neurobiological underpinnings of dyslexia. Vandermosten, Vanderauwera, and Debska (2021) performed a thorough review of the structural MRI data

supporting this hypothesis and found that there was consistent evidence of decreased gray matter volume in the left temporoparietal and occipitotemporal regions in individuals with dyslexia. Importantly, their findings revealed evidence of structural brain changes as a result of reading intervention, revealing greater gray matter volume in reading networks of the left hemisphere after evidence-based reading interventions. This discovery is a strong sign of neuroplasticity and the efficacy of effective training to modify neural architecture underlying dyslexia (Vandermosten, Vanderauwera, & Debska, 2021).

Jung and Lombardino (2019) explored a new cognitive-linguistic intervention that included verbal working memory exercises and strategy training for one adolescent and one adult with developmental dyslexia. With a single-case experimental design, word- and sentence-level stimuli with irregular spellings were used to train six different basic and complex verbal working memory tasks. The two participants improved in their performance of training tasks, and transfer effects were found in decoding, fluency, and reading comprehension. Good results continued 6 weeks after. This study shows that cognitive-linguistic profiles were different, but that working memory training with linguistic stimuli was effective in generating significant changes in reading skills. The results provide evidence for the provision of individual specific support.

The effectiveness of a low-cost multisensory intervention for a third-grade dyslexic student in a remote area in 3T region of East Borneo, Indonesia, has been studied by Dahlan and Suparno (2025). The intervention was implemented using the Single Subject Research A-B-A design over 12 sessions and used visual, kinaesthetic and tactile stimuli. The results demonstrated significant gains: Mean reading accuracy rose from 46.62% at baseline to 62.96% during intervention to 72.83% at the second baseline. The level of learning independence increased from 20% to 65% of tasks performed independently. This study is significant in Nigeria because it shows that multisensory strategies that are simple and inexpensive can be effective in supporting dyslexic learners in a resource-poor environment.

Pecini et al (2024) carried out a retrospective study with 145 children with developmental dyslexia, examining the factors that predicted response to visual hemisphere-specific stimulation (VHSS) intervention. The results showed that non-responders who were unable to improve in reading exhibited mild reading deficits but severe writing deficits, whereas non-responders who were unable to improve in reading or writing exhibited impaired colossal transfer. Pre-test reading and writing scores, phoneme blending, visual search accuracy and rapid automatized naming (RAN) speed were key predictors of response. There were different predictors for males and females. This study emphasizes the need to become familiar with these different cognitive profiles, especially phonological awareness and RAN, in predicting intervention outcomes, consistent with the current study, which

Azamkhulovna, Ikhtiyor and Bakhtiyor (2025) studied a phonemic-based approach involving sound analysis instruction to assist primary school children with dyslexia. The strategy was to develop phonemic awareness, improve the relationships between sounds and letters and promote general literacy, with the use of multisensory methods such as the visual support, sound games and interactive methods. The research was carried out using individual sessions and group sessions with an improvement in reading accuracy, speed and self-confidence being observed. The current study is directly related to the focus on phonological awareness training (segmenting sentences, recognizing rhyme, and blending syllables) and the findings confirm the study's emphasis that structured sound analysis instruction results in measurable gains for dyslexic learners.

Zindaga (2024) provided a study on the

effectiveness of mnemonic and sub lexical reinforcement techniques on 43 grade three learners with dyslexia. The study employed a sequential triangulation design (mixed methods) and revealed that mnemonic techniques were a very effective strategy to improve reading skills. The study also found a significant gender effect with learners who improved more than males after sub-lexical intervention in reading and comprehension. Further, there was more improvement for older children than for younger children. This study is geographically relevant because it is an African study, and it is directly addressing the gender difference in intervention response, which is directly related with the current study's hypothesis on gender effects.

Kgatse, Khanare and Adewuyi (2024) used an auto-ethnographic method to explore how effective South Africa's Screening Identification Assessment and Support (SIAS) policy was in supporting primary school learners who had characteristics of dyslexia in Tlokweng village. Results showed that the screening process of the SIAS policy was not effective, teachers were not ready to address learning barriers related to dyslexia, and there was a need for ongoing monitoring. This study not only brings to light the systemic issues of identification and support for dyslexic learners in African educational settings, but it is also an intervention research for the purpose of filling the gap in teacher training and the development of effective screening instruments in Africa, particularly Nigeria.

Methodology

This study used a quasi-experimental pre-test post-test control group design because random assignment of individual participants is difficult in educational intervention studies (Creswell & Creswell, 2023). The design consisted of one experimental group that was trained and one control group that was not trained and the measurements were made before and after the training period. The population consisted of all the pupils of the public primary schools in Ondo Metropolis, Nigeria. Ondo Metropolis has 153 public primary school out of which the estimated Primary 2 population is about 4,500 pupils according to the official records. Multistage sampling technique was used. A total of 153 public primary schools were selected using simple random sampling method to get 35 schools. Second, the schools selected were Primary 2 classes in these classes; characteristics of dyslexia become clearer when formal reading instruction starts (Snowling, Hulme, & Nation, 2020). Thirdly, the pupils who met the criterion of dyslexia (those scoring below 16th percentile on the Phonological Awareness Test for Dyslexic Pupils) were identified through purposive sampling and identified as 64 pupils. The final sample consisted of 32 pupils in the experimental group, and 32 pupils in the control group. Two instruments were used: Phonological Awareness Test for Dyslexic Pupils (PATDP) – a training instrument that provides materials for sentence segmentation, rhyme recognition, and syllable blending; and Phonological Awareness Test for Dyslexic (PATD) – a 24 item assessment tool consisting of four sections each having six items for pre-test and post-test. The items were dichotomously scored (1 point for correct, 0 for incorrect), with a maximum possible score of 24. The study was conducted for six weeks. In Week 1, pre-test was administered to both groups. Weeks 2-5 involved training for the experimental group only: Week 2: rhyme recognition and production; Week 3: word and syllable awareness; Week 4: initial and final sound identification; Week 5: middle sound identification. The sessions were each 40 minutes long. The control group did not receive any treatment. Weeks 6 was a post test for both groups.

Data were analysed using inferential statistics. All four null hypotheses were tested using independent samples t-test at a significance level of $p \leq 0.05$.

Results

H_{01}: There is no significant difference between dyslexic pupils from experimental and control group.

Table 1
Summary of paired samples t-test analysis on pre-test and post-test scores of dyslexic pupils

Type	N	Mean	Std. D.	df	*t*	p-value
Pre-test	64	11.56	1.555			
				62	30.343	0.000
Post-test	64	18.09	0.739			

p < 0.05 (Significant)

Table 1 shows that the mean score of the pupils with dyslexia was 11.56 (SD = 1.555) before the intervention and 18.09 (SD = 0.739) after it. The analysis result of t-tests is 30.343 with 62 degrees of freedom. The p-value is 0.000 which is less than 0.05, the significance level. Therefore, the null hypothesis 1 was rejected.

H_{02}: There is no significant gender difference in the performance of dyslexic pupils in the experimental and control group

Table 2
Summary of independent samples t-test analysis on performance of male and female dyslexic pupils

Gender	N	Mean	Std. D.	df	*t*	p-value
Male	25	17.56	1.253			
				62	4.015	0.000
Female	39	18.62	0.861			

p < 0.05 (Significant)

The mean performance score for the male pupils with dyslexia was 17.56 (SD = 1.253) and 18.62 (SD = 0.861) for the female pupils with dyslexia (Table 3). The result of the t-test analysis was t = 4.015, df = 62. The p-value is 0.000, which is less than the 0.05 significance level. Hence, null hypothesis 3 was rejected.

H_{03}: There is no significant difference in the performance of dyslexic pupils fromthe rural and urban schools.

Table 3
Summary of independent samples t-test analysis on performance of rural and urban dyslexic pupils

Location	N	Mean	Std. D.	df	*t*	p-value
Rural	13	19.79	1.167			
				29	3.694	0.001
Urban	18	21.03	0.700			

p < 0.05 (Significant)

Table 4 indicates that the mean performance score of the pupils with dyslexic problems from rural areas is 19.79 (SD = 1.167) after the training, while from the urban areas it is 21.03 (SD = 0.700). The t value calculated is 3.694, where the degree of freedom is 29. The p-value is 0.000 which is less than 0.05. Hence, null hypothesis 4 was rejected.

Discussion of Findings

The results showed that the post-test scores were significantly higher, meaning that the training of the phonological awareness had a significant impact on the cognitive performance of the dyslexic samples. The finding is consistent with the Phonological Theory which suggests that dyslexics have fundamental problems in the representation, storage and retrieval of speech sounds (Snowling, Hulme, & Nation, 2020). These deficits were directly addressed during training with sentence segmentation, rhyme recognition and syllable

blending activities. This finding is consistent with Vonthron et al. (2025), who found that rhythm and cognitive training significantly improves word-reading accuracy in dyslexic children. In the same way, Azamkhulovna, Ikhtyor, and Bakhtiyor (2025) showed that the phonemic based sound analysis instruction resulted in significant improvement in reading accuracy and speed. Pecini et al. (2024) additionally found that there are measurable gains from phonological awareness interventions when specifically targeting certain cognitive processes. The large pre-post difference is also aligned with the Cerebellar Theory that structured, repetitive practice leads to the automatisation of letter-sound correspondences (Nicolson & Fawcett, 2019). This provides further evidence for the conceptualization that systematic phonological instruction can address the core deficits that underlie dyslexia (Melby-Lervåg, Lyster, & Hulme, 2022).

The finding that the experimental group significantly outperformed the control group on post-test scores strongly supports the belief that the training resulted in the improvement and not to maturation or other extraneous factors. This finding is in tune with the Phonological Theory's causal claim that the direct focus on phonological properties leads to reading benefits (Vandermosten, Vanderauwera, & Debska, 2021). This empirical finding is congruent with Jung and Lombardino (2019) who showed that CLWMT resulted in transfer to decoding and fluency. The authors of Ramezani and Fawcett (2026) also found that cognitive-motor training was found to have a significant effect on reading outcomes, with the extent of functional connectivity changes in attention networks. Their intervention group showed significantly greater gains compared to waitlist controls in measures of working memory, processing speed, and reading. Zindoga (2024) also found that the mnemonic and sub-lexical reinforcement methods were successful in improving reading skills than the no-treatment control group. The large difference between the two groups also justifies the Cerebellar Theory, because the experimental group was provided with the structured multisensory practice that is needed for automatization (Peng, et al., 2022). This finding has practical implications since the challenge to children with dyslexia in Nigerian public schools still exists despite the lack of targeted training programmes as reported by Kgatse, Khanare and Adewuyi (2024) which revealed that teachers are not prepared to teach dyslexic pupils without any structured programmes of intervention.

Findings revealed a gender difference in intervention response, as female dyslexic pupils' performance after training was significantly higher than that of male pupils. This finding could be due to other developmental differences in language processing, as females typically mature earlier in language development and have more advanced phonological processing skills (Moll, et al., 2022). This finding corroborates earlier findings by Zindoga (2024) that females in South African primary schools made greater gains in reading and comprehension than males following sub-lexical intervention. Similarly, Pecini et al. (2024) observed that the factors that predicted treatment response varied by gender, indicating that gender-specific cognitive profiles impact treatment. Some of this may be accounted for by the Phonological Theory, which suggests that females may have stronger phonological representations at baseline so that training may construct on a stronger base (Snowling et al., 2020). But there are a few that have found no difference between sex. In a study conducted in Nigeria, Kyauta, Musa and Balami (2016) did not discover any significant relationship between sex and the outcome of interventions. However, the Cerebellar Theory suggests that gender differences in motor coordination and automatization rates can also affect the rate of learning from repetitive phonological training (Ramezani & Fawcett, 2026). This result indicates that gender responsive teaching methods should be implemented in intervention programmes, but more research is needed to explain how this works (Perfetti & Stafura, 2024).

Findings revealed that there were improvements in reading skills for urban dyslexic pupils compared with rural pupils after training is indicative of the environmental and contextual factors that impact the effectiveness of intervention. The findings are in line with the conceptualisation of the factors that influence the learning outcomes, namely the availability of resources, the quality of the teacher and support in the instruction (IDA, 2023). Urban schools usually have more trained teachers, instructional materials and parental involvement, which makes it easier to implement interventions. The result is somewhat similar to the result obtained from Dahlan and Suparno (2025) that proved that structured multisensory interventions can be effective even in the rural area in 3T regions of Indonesia but there are other barriers that still exist in the context of limited resources. Similarly, Munachaka (2025) investigated the effectiveness of computer-mediated phonics intervention in Zambia's schools, noting that implementation was more challenging in rural schools lacking technological infrastructure. The Phonological Theory doesn't predict location differences directly but the Cerebellar Theory's emphasis on practice and repetition is of relevance: rural pupils may not have as many opportunities for regular and supported practice beyond the school day (Nicolson & Fawcett, 2019). Specifically, teacher readiness and policy implementation are identified as key issues in underserved communities in Africa, as noted by Kgatse, Khanare and Adewuyi (2024). This discovery has both implications for educational equity: if the dyslexia intervention gap between urban and rural schools continues to grow, targeted support will be needed for rural schools (Lonigan, et al., 2021). Policymakers need to make sure that evidence-based training programmes remain equally accessible to dyslexic pupils, irrespective of geography (Ehri, 2020).

Conclusion

This study investigated the effect of training on dyslexic pupils' cognitive domain in Ondo Metropolis, Nigeria. In conclusion, the results were found to be statistically significant, meaning that SPT had a significant positive effect on the cognitive functioning of dyslexic pupils. The experimental group, who were trained in sentence segmentation, rhyme recognition and syllable blending, showed a significant improvement over the control group. The improvement experienced by female pupils compared to males, and by urban pupils compared to rural pupils, indicated that there may be demographic factors which affect the effectiveness of the intervention.

The study also demonstrated that phonological awareness impairments can be addressed through systematic, evidence based training. If not identified early and intervention is not targeted to them, dyslexics are still at risk academically, socially in self-esteem and socially in dropping out of school. It is, therefore, essential that teachers, school leaders, policymakers and parents work together to ensure that no child is left behind because of an easily treatable learning difference by embedding dyslexia training within mainstream education.

Recommendations

1. Primary teachers need to be trained to recognize dyslexic students early with phonological awareness screening tools, because the large pre-test to post-test gains in cognition indicate that early intervention is associated with important cognitive gains.
2. The experimental group showed a significant advantage over the control group and should have structured phonological awareness exercises (segmentation of sentences, rhyme recognition, and word blending of syllables) integrated into a daily literacy unit of instruction.
3. School administrators should consider having resource centres in schools that are specifically equipped to provide multisensory instructional materials for dyslexic learners; this is because urban learners performed better than rural

learners, in part because they were provided with these.

4. The Government should provide for the screening of all primary school pupils for dyslexia and include a provision for funding intervention programmes in public schools, because untreated dyslexia causes persistent achievement gaps.
5. Rural schools need more resources and more skilled staff to help close the gap and provide quality education to rural children, as an equal performer to an urban school.
6. Regular counselling sessions for dyslexic learners should be conducted by school counsellors to address pupils' self-esteem concerns that stem from learning difficulties to improve the intervention outcomes, since psychological support improves intervention outcomes.
7. Education of parents of dyslexic pupils should be extended beyond the school setting, using awareness programmes delivered in school, to be reinforced at home.
8. Trainings on phonological awareness should be included in the national basic education curriculum as an integral part of early literacy education in all public primary schools.
9. Pre-service teacher education programmes in universities and colleges of education must provide mandatory training on the identification and intervention of learners with dyslexia so that all teachers graduating from these institutions would be able to help a wide variety of learners.

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