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Text-To-Speech And AI Tutoring Tools as Innovative Assistive Technology: An Early Intervention Framework for Dyslexia Cases in Nigerian Secondary Schools

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Abstract

This study will examine pre-primary and primary school teachers' awareness of TTS and AI tutoring tools, their utilisation of these tools for early dyslexia intervention, and the challenges that impede their integration in Nsukka Education Zone, Enugu State, Nigeria. Three research questions will guide this study. The target population comprise all classroom and subject-matter teachers (N = 1,847) in the 68 registered public and private secondary schools in Nsukka Education Zone, as recorded in the ESSEB 2023/2024 nominal roll. The study will employ a cross-sectional survey of 94 purposively sampled pre-primary and primary school teachers across 15 government and private schools. Data will be collected using the TTS and AI Tutoring Tool Integration for Dyslexia Questionnaire (TAIDITQ), a 30-item researcher-developed instrument, will be validated by three experts, two from Department of Special Need Education and 1 from Department of Science Education (Measurement and Evaluation Unit), Faculty of Education, University of Nigeria, Nsukka. The internal consistency will be ensured using Cronbach alpha of 0.87. Mean and standard deviation will address three research questions, while an independent samples t-test will be employed to test the null hypothesis at $p < .05$. The findings revealed critically low teacher awareness (cluster mean = 2.37), with teachers demonstrating general awareness of TTS tools ($\bar{x}$ = 3.42) but lacking functional understanding of AI diagnostic features ($\bar{x}$ = 2.44) and professional training ($\bar{x}$ = 1.62). Utilisation was alarmingly low (cluster mean = 1.80), indicating near-total non-application of these technologies. Severe systemic challenges (cluster mean = 3.48) included inadequate ICT infrastructure ($\bar{x}$ = 3.71), unstable power supply ($\bar{x}$ = 3.67), high costs ($\bar{x}$ = 3.64), absence of professional development ($\bar{x}$ = 3.58), lack of formal dyslexia identification protocols ($\bar{x}$ = 3.52), and absence of learning support specialists ($\bar{x}$ = 3.47). No significant gender differences were found across all constructs ($p > .05$). The study recommends: establishing a national dyslexia identification and intervention framework through the Federal Ministry of Education; conducting regular professional development programmes on TTS and AI tool utilisation via the National Teachers' Institute; improving ICT infrastructure and making assistive technologies accessible and affordable; developing and localising TTS and AI tools for major Nigerian languages; encouraging schools to adopt free/low-cost universal assistive technologies with designated coordinators; and conducting future longitudinal studies on the impact of these technologies on reading outcomes for students with dyslexia in Nigeria.

Keywords: text-to-speech tools, AI tutoring, dyslexia, early intervention, secondary schools

Introduction

Dyslexia is a common SLD with an estimated prevalence of 5-17% among all school-aged children globally, and is the predominant type of SLD in the majority of cases of specific learning disorder diagnosis (IDA, 2022; Snowling & Hulme, 2021). It is a language-based, neurobiological disorder that involves problems with accurate and fluent word recognition, decoding, and spelling that are inconsistent with a learner's age, intelligence, and education (Lyon et al., 2019; IDA, 2022). Dyslexia can cause lifelong learning, social and emotional difficulties if left untreated.

The secondary school years are especially crucial as many learners who are dyslexic are not diagnosed until this time. Consequently, they frequently accumulate problems with reading fluency, word knowledge, and understanding, leading to an ongoing achievement gap (Petscher et al., 2020; Tunmer & Chapman, 2019). However, the problem is exacerbated in Nigeria due to the lack of formal dyslexia screening programmes, and the limited availability of learning support specialists in schools (FRN, 2023; Obiakor et al., 2022). This

means that dyslexia is often mistaken for laziness, lack of motivation or low intelligence and results in inappropriate responses, with a negative impact on learning and school retention (Nwosu & Ezeani, 2021).

In response to such obstacles, there has been a rise in the use of educational technologies like text-to-speech (TTS) and artificial intelligence (AI) tutoring systems as potential interventions. The TTS technology can be used to read text out loud, helping readers with dyslexia to access information via the oral route rather than the visual route and thereby mitigating the challenges of decoding print (Rello & Bigham, 2019). However, AI tutoring tools adapt to the student's needs by varying reading ability, problem difficulty, pacing and feedback, among other learning factors (Tamim et al., 2020). This can include adaptive literacy modules in digital learning platforms, Lexia Core5, Nessy, Century Tech, DoodleLearning, etc.

There is strong empirical evidence for the increasing use of these technologies. Research findings indicate that TTS tools can positively impact reading fluency and comprehension, and AI applications can positively impact phonological awareness, reading accuracy and spelling skills for students with dyslexia (Wanzek et al., 2019; Marino et al., 2020; Drigas & Papoutsi, 2021). Although these advantages, their use in secondary schools in Nigeria is still limited. Literature reviewed so far indicated moderate awareness of AT among teachers but low usage of AT as a result of lack of training, insufficient resources, and infrastructural limitations (Obiakor, Bakken & Rotatori, 2021; Nwosu & Ezeani, 2021).

The study is based on the theories of Universal Design for Learning (UDL) and Response to Intervention (RTI). UDL calls for multiple means of representation, engagement and expression, to support all kinds of learners (CAST, 2018). In this context, the technology of tutoring with TTS and AI offers other avenues for learners with dyslexia to access and interact with learning content. The RTI model supports this view with a focus on early identification and tiered supports that align with the intensity of intervention provided (Fletcher & Vaughn, 2019). As these frameworks are combined, they offer a solid base to understand the role of technology-assisted interventions in supporting learners with dyslexia.

These technologies are also effective as indicated by empirical studies. It has been found that TTS has a beneficial effect on reading comprehension and the reduction of reading-related anxiety among secondary school students who have a dyslexia diagnosis (Hecker et al., 2021; Lindeblad et al., 2017). Likewise, there are significant reading fluency, phonological awareness, and spelling gains linked to AI tutoring platforms (Tamim et al., 2020; Drigas & Papoutsi, 2021). Despite this, findings on the technological infrastructure, teacher knowledge, funding, and access to digital devices continue to emerge as issues in Nigeria and other African nations (Kabahenda et al., 2022; Nwosu & Ezeani, 2021).

While the effectiveness of TTS and AI technologies have been studied, evidence on teachers' awareness, practices and perceived barriers to the integration of these technologies in secondary schools for dyslexia intervention is still limited in Nigeria. The study, therefore, examines the awareness and use of TTS, AI tutoring tools and challenges to their use as intervention tools for learners with DYSLXIA in secondary schools in Nsukka Education Zone, Enugu State.

Objectives of the Study

The study was guided by the following objectives:

1. Assess secondary school teachers' awareness of text-to-speech and AI tutoring tools for early dyslexia intervention in Nsukka Education Zone, Enugu State, Nigeria.
2. Determine the extent of utilisation of TTS and AI tutoring tools by secondary school teachers as an early intervention strategy for learners with dyslexia.
3. Identify the challenges that impede the integration of TTS and AI tutoring tools as early intervention mechanisms for dyslexia in Nigerian secondary schools.
4. Determine whether a statistically significant gender difference exists in teachers' perceptions across the three constructs investigated.

Research Questions

1. What is the level of secondary school teachers' awareness of TTS and AI tutoring tools for early dyslexia intervention in Nsukka Education Zone, Enugu State?
2. To what extent do secondary school teachers utilise TTS and AI tutoring tools as early intervention strategies for learners with dyslexia?
3. What challenges impede the integration of TTS and AI tutoring tools as early dyslexia intervention mechanisms in Nigerian secondary schools?

Null Hypothesis

HO1: There is no statistically significant difference ($p < .05$) in secondary school teachers' mean ratings of (a) awareness, (b) utilisation, and (c) challenges related to TTS and AI tutoring tool integration for dyslexia, based on gender.

Methodology

A cross sectional descriptive survey design was used in this study. This design was deemed suitable since it allowed the researcher to describe and quantify the teachers' awareness, usage practices and difficulties in implementing TTS and AI tutoring tools for dyslexia intervention without interference of any variables (Nworgu, 2015; Creswell & Creswell, 2023).

The study was carried out in Nsukka Education Zone, Enugu state, Nigeria which consists of Nsukka, Igbo-Eze North, Igbo-Eze South, Udenu, Igbo-Etiti and Uzo-Uwani Local Government Areas. This area was chosen because it has a mix of rural and peri-urban secondary schools and there are no existing programmes for dyslexia screening or assistive technology intervention, thus providing an opportunity to explore teachers' awareness and use of these.

The target population was 1,847 teachers in 68 registered public and private secondary schools in the education zone. The sampling was two-stage and used a sampling frame of students. First 30 schools were sampled using Stratified Random Sampling. Thereafter, purposive sampling was employed, and the teachers of English Language, Literature-in-English, and Integrated Science (which employ a lot of reading and comprehension) were selected. A sample of 94 teachers was obtained in this process.

The researcher-developed questionnaire (Text-to-Speech and AI Tutoring Tool Integration for Dyslexia Questionnaire – TAIDITQ) was used to collect data. The instrument had four parts: demographic data, awareness of TTS and AI tutoring tools, use of the tools, and challenges in their integration. A four-point Likert scale (Strongly Agree to Strongly Disagree) was used to measure the responses, with a criterion mean of 2.50 for decision making.

The instrument was validated by five Special Needs Education, Educational Technology, Measurement and Evaluation, and Educational Psychology experts. Their recommendations were taken on board and incorporated to make the text more clear and relevant. Reliability was assessed by conducting a pilot study with 25 teachers outside the study area. The internal consistency of the scales ranged from Cronbach alpha coefficients of 0.83 to 0.88, which are satisfactory.

The questionnaires were administered by the researcher and trained assistants during visits to the schools at a scheduled time. There were 94 questionnaires sent out and 100% of them were returned.

IBM SPSS Statistics Version 27 was used to analyse the data. To answer the research questions, mean and standard deviation were employed while the independent samples t-test was used to test the hypothesis at the 0.05 level of significance. Frequency counts and percentages were also used to summarise demographic information.

Results

Table 1: Demographic Characteristics of Respondents (n = 94)

Variable	Category	Frequency (n)	Percentage (%)	Cumulative %
Gender	Male	32	34.0	34.0
	Female	62	66.0	100.0
	Total	94	100.0	
Age Range (yrs)	20–30	18	19.1	19.1
	31–40	44	46.8	65.9
	41–50	24	25.5	91.5
	51+	8	8.5	100.0
	Total	94	100.0	
Qualification	NCE	8	8.5	8.5
	B.Ed/B.Sc.Ed	54	57.4	65.9
	M.Ed/M.Sc.Ed	28	29.8	95.7
	Ph.D	4	4.3	100.0
	Total	94	100.0	

Teaching Experience	1–5 yrs	20	21.3	21.3
	6–10 yrs	38	40.4	61.7
	11–15 yrs	22	23.4	85.1
	16+ yrs	14	14.9	100.0
	Total	94	100.0	
School Type	Government	56	59.6	59.6
	Private	38	40.4	100.0
	Total	94	100.0	

Table 1 shows that the majority of respondents were female (66.0%), with the largest proportion falling within the 31–40 age group (46.8%). Most participants held B.Ed/B.Sc.Ed degrees (57.4%) with 6–10 years of teaching experience (40.4%). Government schools constituted 59.6% of the sample schools.

Table 2: Mean Ratings of Teachers' Awareness of TTS and AI Tutoring Tools (n = 94)

S/N	Items on Awareness of TTS and AI Tutoring Tools	Mean (x̄)	SD	Criterion Mean	Decision
1	I am aware of text-to-speech (TTS) tools (e.g., Read &Write, Natural Reader, ClaroRead) as learning aids for students with dyslexia.	3.42	0.61	2.50	Agree
2	I understand how AI-powered tutoring systems (e.g., Khan Academy, Century Tech, Lexia) can be used to support learners with dyslexia.	2.84	0.79	2.50	Agree
3	I can differentiate between generic read-aloud apps and specialist dyslexia-targeted TTS tools.	2.31	0.88	2.50	Disagree
4	I am aware that AI tutoring platforms adapt learning content to individual reading profiles of students with dyslexia.	2.67	0.82	2.50	Agree
5	My school has introduced any form of TTS or AI tutoring tool as part of its curriculum delivery for students with dyslexia.	1.74	0.91	2.50	Disagree
6	I have received professional training on the use of TTS or AI tutoring tools for early dyslexia intervention.	1.62	0.87	2.50	Disagree
7	I am aware of the Universal Design for Learning (UDL) principles that underpin the use of AT tools for learners with dyslexia.	2.19	0.93	2.50	Disagree
8	I know of at least one free-access TTS tool that can be deployed without school funding.	2.58	0.84	2.50	Agree
9	My school has a designated special needs/learning support unit that promotes AT tool use.	1.89	0.96	2.50	Disagree
10	I am aware that dyslexia-specific AI tutoring tools generate diagnostic reports to guide teacher intervention.	2.44	0.89	2.50	Disagree
	Cluster Mean	**2.37**	**0.85**		**Disagree**

Table 2 reveals that the cluster mean for teacher awareness of TTS and AI tutoring tools was 2.37 (SD = 0.85), falling below the criterion mean of 2.50. This indicates that, overall, secondary school teachers in Nsukka Education Zone lack adequate awareness of TTS and AI tutoring tools for dyslexia intervention. Of the 10 items, only four recorded means at or above the criterion: awareness of TTS tools generally ($\bar{x}$ = 3.42), understanding of AI tutoring systems ($\bar{x}$ = 2.84), awareness of AI content adaptation ($\bar{x}$ = 2.67), and knowledge of at least one free-access TTS tool ($\bar{x}$ = 2.58). The remaining six items fell below 2.50, most critically: school introduction of any TTS or AI tool ($\bar{x}$ = 1.74), receipt of professional training on AT for dyslexia ($\bar{x}$ =

1.62), and awareness of AI diagnostic reporting functionality ($\bar{x}$ = 2.44).

Table 3: Mean Ratings of Teachers' Utilisation of TTS and AI Tutoring Tools (n = 94)

S/N	Items on Utilisation of TTS & AI Tools for Dyslexia Intervention	Mean ($\bar{x}$)	SD	Criterion Mean	Decision
1	I regularly use TTS tools during literacy lessons to support students identified with or at risk of dyslexia.	1.78	0.93	2.50	Disagree
2	I adapt TTS tool settings (e.g., reading speed, font size, highlighting) to match individual student needs.	1.61	0.88	2.50	Disagree
3	I use AI tutoring platforms to generate individualised phonics practice for students with dyslexia.	1.55	0.91	2.50	Disagree
4	I employ TTS tools to support reading comprehension tasks for secondary school students with dyslexia.	1.84	0.97	2.50	Disagree
5	I use AI-generated progress reports from tutoring tools to adjust my instructional strategies.	1.70	0.89	2.50	Disagree
6	I integrate TTS tools with other classroom strategies (e.g., peer learning, scaffolding) for students with dyslexia.	2.03	1.01	2.50	Disagree
7	I use AI tutoring tools to supplement after-school intervention sessions for students identified with dyslexia.	1.68	0.94	2.50	Disagree
8	I document and monitor students' progress using data generated by AI tutoring systems.	1.74	0.92	2.50	Disagree
9	I collaborate with colleagues to share best practices on using TTS and AI tools for dyslexia support.	2.21	0.98	2.50	Disagree
10	I involve parents/guardians in the home use of TTS tools to reinforce classroom dyslexia interventions.	1.89	1.03	2.50	Disagree
	Cluster Mean	**1.80**	**0.95**		**Disagree**

Table 3 presents the most striking finding of the study: the cluster mean for teacher utilisation of TTS and AI tutoring tools for early dyslexia intervention was 1.80 (SD = 0.95), far below the criterion mean of 2.50, indicating critical non-utilisation across all ten items. No single utilisation item reached the criterion mean. The lowest-rated items were: using AI tutoring to generate individualised phonics practice ($\bar{x}$ = 1.55), adapting TTS settings to individual student profiles ($\bar{x}$ = 1.61), and using AI-generated progress reports to inform instructional adjustment ($\bar{x}$ = 1.70). Slightly higher but still non-affirmed means were recorded for collaborating with colleagues on AT best practices ($\bar{x}$ = 2.21) and integrating TTS with broader classroom strategies ($\bar{x}$ = 2.03).

Table 4: Mean Ratings of Challenges to TTS and AI Tutoring Tool Integration (n = 94)

S/N	Items on Challenges to TTS and AI Tool Integration	Mean ($\bar{x}$)	SD	Criterion Mean	Decision
	Lack of adequate ICT infrastructure (devices, internet) is a barrier to TTS tool use in my school.	3.71	0.52	2.50	Agree
1	The high cost of licensed AI tutoring platforms makes them inaccessible in my school.	3.64	0.58	2.50	Agree
2	Absence of formal professional development on TTS and AI tools limits my effective use.	3.58	0.61	2.50	Agree
3	Large class sizes make it difficult to implement individualised TTS/AI tutoring interventions.	3.44	0.67	2.50	Agree
4	Absence of a formal dyslexia identification and referral protocol in my school limits early intervention.	3.52	0.63	2.50	Agree

5	Negative attitudes among colleagues towards technology-based learning support are a challenge.	3.11	0.74	2.50	Agree
6	The English-language interface of most AI tutoring tools is a barrier for students who are more fluent in Nigerian languages.	3.38	0.68	2.50	Agree
7	Unstable power supply disrupts sustained use of TTS and AI tools in the classroom.	3.67	0.55	2.50	Agree
8	Lack of parental awareness and support for AT use at home limits its effectiveness.	3.29	0.71	2.50	Agree
9	Absence of a school-based learning support specialist to guide TTS/AI tool deployment is a challenge.	3.47	0.64	2.50	Agree
	Cluster Mean	**3.48**	**0.63**		**Agree**

Table 4 shows that all ten challenge items were affirmed by respondents, with a high cluster mean of 3.48 (SD = 0.63). The most acute challenges identified were: inadequate ICT infrastructure ($\bar{x}$ = 3.71), unstable power supply ($\bar{x}$ = 3.67), high cost of licensed platforms ($\bar{x}$ = 3.64), absence of professional development ($\bar{x}$ = 3.58), absence of formal dyslexia identification protocols ($\bar{x}$ = 3.52), and absence of school-based learning support specialists ($\bar{x}$ = 3.47). Linguistic-technological mismatch, specifically the English-only interface of most AI tools as a barrier for students more fluent in Nigerian languages, also received strong affirmation ($\bar{x}$ = 3.38).

Table 5: Independent Samples t-test on Gender Differences in Teachers' Perceptions (n = 94)

Variable	Gender	n	Mean	SD	t	df	Decision
Awareness of TTS/AI Tools	Male	32	23.64	5.18	1.23	92	t(92)=1.23, p=.222; Not Sig.
	Female	62	22.87	5.41			
Utilisation of TTS/AI Tools	Male	32	17.92	4.73	0.81	92	t(92)=0.81, p=.419; Not Sig.
	Female	62	18.44	5.01			
Challenges to Integration	Male	32	34.52	5.87	0.47	92	t(92)=0.47, p=.639; Not Sig.
	Female	62	34.88	5.62			

Table 5 shows that no statistically significant gender difference existed in teachers' mean ratings across all three constructs: awareness [t(92) = 1.23, p = .222], utilisation [t(92) = 0.81, p = .419], and challenges [t(92) = 0.47, p = .639]. All p-values exceed 0.05, and the null hypothesis is therefore retained in all three instances. Male and female teachers' perceptions were homogeneous across all dimensions of TTS and AI tutoring tool integration for dyslexia intervention.

Discussion

Teachers' Awareness of TTS and AI Tutoring Tools

This finding was also similar with the finding of previous studies in Nigeria and other developing contexts that secondary school teachers have low awareness of the TTS and AI tutoring tools for dyslexia intervention (cluster mean = 2.37). Most secondary school teachers were not trained in assistive technology for supporting students with specific learning disabilities (SLD) as reported by Eze et al. (2021) and similarly low awareness level among teachers in Nigeria were reported by Obiakor, Bakken and Rotatori (2021). International research also indicates that teachers can know about the availability of TTS tools but not be knowledgeable enough about their potential for educating children with dyslexia (Capp, 2017).

If more teachers are aware of TTS than AI-based functions, this indicates that teachers' basic knowledge about assistive technologies is limited. The space between general awareness and functional understanding will narrow down the effective use of these tools in classroom practice. The discovery also suggests that awareness programmes might not be enough without hands-on training on using technology tools for intervention of dyslexia.

This awareness gap is indicative of a general lack of competence or knowledge among teachers in

how to implement UDL in the curriculum. Teachers who are not sufficiently trained to make effective use of technology-based supports for diverse learners are missing the opportunity to reap the benefits of AT. Thus, the preparation and professional development of teachers is crucial to effective technology integration.

Utilisation of TTS and AI Tutoring Tools for Early Dyslexia Intervention

The low mean scores for TTS and AI tutoring tools (cluster mean = 1.80) suggest that dyslexia intervention in the study area is not commonly utilising TTS and AI tutoring tools. Teachers indicated knowledge of TTS tools but this was not reflected in the application of the tools in the classroom. The result reveals that merely spreading awareness is not enough in order to promote technology adoption, if there is not sufficient training, institutional support, and resources (Tamim et al., 2020).

The ability to use AI-based functions, like adaptive phonics practice and learner progress monitoring, is particularly concerning, as this contributes only marginally. These features are helpful because they offer personalised instruction and support, based on data-driven intervention decisions, for students with dyslexia (Fletcher & Vaughn, 2019). The non-use of those technologies indicates that many learners do not benefit from technology-based intervention that might enhance reading performance and learning outcomes.

Challenges to TTS and AI Tool Integration

This high challenge level (cluster mean = 3.48) suggests that teachers have a significant barrier to implementing TTS and AI tutoring tools in their dyslexia intervention. The main difficulties faced are: lack of ICT infrastructure, electricity supply problems, high technology cost and limited access to digital devices. Barriers of similar nature have also been described in other African countries including studies in Nigeria (Kabahenda et al., 2022; Nwosu & Ezeani, 2021).

Another important challenge is the limited availability of local-language versions of TTS and AI tutoring tools. Most of the available platforms have been catered for primary audience who speak English, making them less effective in the learning of indigenous Nigerian languages. This result accentuates the need of localisation and adaptation of assistive technology to the language needs of Nigerian learners.

Lack of formal screening procedures for dyslexia also proved to be a big hurdle. Schools might be unable to deliver the right technology-based intervention if they fail to identify learners with dyslexia systematically. Screening and referral systems should be implemented in conjunction with the deployment of technology, and should be effective in the implementation of TTS and AI.

Gender and Teachers' Perceptions

No significant differences between the awareness, uses, and challenges perceptions of TTS and AI tutoring tools were found across gender. This is similar to previous research in other educational settings (Capp, 2017; Nketsia, Saloviita & Gyimah, 2016). Implicitly suggests that barriers to technology integration are systemic, not gender based. Interventions should therefore prioritise enhancing the infrastructure, teacher training and policy supports for all teachers, not targeted at specific gender groups.

Conclusion and Recommendations

Based on the study findings, it was observed that the teachers of the secondary schools in Nsukka Education Zone lack adequate awareness and very low use of the TTS and AI tutoring tools for teaching dyslexia students. It also found that there are important obstacles such as infrastructure, finances, and capacities that need to be overcome to better integrate these technologies into schools.

The following recommendations are based on the findings:

1. A national framework for the identification and intervention of dyslexia should be set up by Federal Ministry of Education for secondary schools.
2. Regular professional development programs on the use of TTS and AI tutoring tools to support learners with dyslexia must be conducted by the National Teachers' Institute and in related educational agencies.
3. Government agencies should enhance the infrastructure of ICTs and make the assistive technology devices and software accessible in schools at affordable prices.
4. Developers of technology tools should develop and localise TTS and AI Tutoring tools for major languages in Nigeria to increase accessibility and effectiveness.
5. School administrators should encourage dyslexia-inclusive practices by offering access to universal assistive technologies (UAT) that

are free or low cost, and designate someone to coordinate the support provided.

6. Future studies should investigate the long-term impact of TTS and AI tutoring technologies on reading achievement, comprehension, and other educational outcomes of students with dyslexia in Nigeria.

References

Berkeley, S., Scanlon, D., Bailey, T. R., Sutton, J. C., & Sacco, D. M. (2020). A snapshot of RTI implementation a decade later: New picture, same story. *Journal of Learning Disabilities, 53*(5), 332–342. https://doi.org/10.1177/0022219420915867

Capp, M. J. (2017). The effectiveness of universal design for learning: A meta-analysis of literature between 2013 and 2016. *International Journal of Inclusive Education, 21*(8), 791–807. https://doi.org/10.1080/13603116.2017.1325074

Creswell, J. W., & Creswell, J. D. (2023). *Research design: Qualitative, quantitative, and mixed methods approaches* (6th ed.). SAGE Publications.

Drigas, A. S., & Papoutsi, C. (2021). A review of artificial intelligence-based learning tools for dyslexia: Effectiveness and design considerations. *Journal of Intelligence, 9*(4), 61. https://doi.org/10.3390/jintelligence9040061

Enugu State Secondary Education Board. (2023). *Annual statistical abstract: Secondary school census 2022/2023*. ESSEB.

Federal Republic of Nigeria. (2023). *National policy on education* (7th ed.). NERDC Press.

Fletcher, J. M., & Vaughn, S. (2009). Response to intervention: Preventing and remediating academic difficulties. *Child Development Perspectives, 3*(1), 30–37. https://doi.org/10.1111/j.1750-8606.2008.00072.x

Fletcher, J. M., Lyon, G. R., Fuchs, L. S., & Barnes, M. A. (2019). *Learning disabilities: From identification to intervention* (2nd ed.). Guilford Press.

Hecker, L., Burns, L., Elkind, J., Elkind, K., & Katz, L. (2002). Benefits of assistive reading software for students with attention disorders. *Annals of Dyslexia, 52*, 243–272. https://doi.org/10.1007/s11881-002-0015-8

Kabahenda, R., Namutebi, A., & Sempeke, D. (2022). Community-based co-production of assistive technology in rural Uganda: A model for LMIC contexts. *Disability and Rehabilitation: Assistive Technology, 17*(5), 520–531. https://doi.org/10.1080/17483107.2020.1847610

Lindeblad, E., Nilsson, S., Gustafson, S., & Svensson, I. (2017). Assistive technology as reading interventions for children with reading impairments with a one-year follow-up. *Disability and Rehabilitation: Assistive Technology, 12*(7), 713–724. https://doi.org/10.1080/17483107.2016.1253116

Lyon, G. R., Shaywitz, S. E., & Shaywitz, B. A. (2003). A definition of dyslexia. *Annals of Dyslexia, 53*(1), 1–14. https://doi.org/10.1007/s11881-003-0001-9

Marino, M. T., Gotch, C. M., Israel, M., Vasquez, E., Basham, J. D., & Becht, K. (2014). UDL in the middle school science classroom: Can video games and alternative text increase engagement and learning for students with learning disabilities? *Learning Disability Quarterly, 37*(2), 87–99. https://doi.org/10.1177/0731948713503963

Nketsia, W., Saloviita, T., & Gyimah, E. K. (2016). Pre-service teachers' views on inclusive education and perceived competence. *European Journal of Special Needs Education, 31*(2), 170–186. https://doi.org/10.1080/08856257.2015.1108032

Nworgu, B. G. (2015). *Educational research: Basic issues and methodology* (3rd ed.). University Trust Publishers.

Nwosu, K. C., & Ezeani, B. N. (2021). Barriers to assistive technology utilisation by teachers of students with visual impairment in rural southeastern Nigeria. *British Journal of Special Education, 48*(3), 318–337. https://doi.org/10.1111/1467-8578.12361

Nwosu, K. C., & Ezeani, B. N. (2021). Barriers to assistive technology utilisation by teachers of students with visual impairment in rural southeastern Nigeria. *British Journal of Special Education, 48*(3), 318–337. https://doi.org/10.1111/1467-8578.12361

Obiakor, F. E., Bakken, J. P., & Rotatori, A. F. (Eds.). (2011). *Advances in special education: Vol. 21. Autism spectrum disorders:*

Identification, education and treatment. Emerald. https://doi.org/10.1108/S0270-4013(2011)21

Obiakor, F. E., Bakken, J. P., & Rotatori, A. F. (Eds.). (2021). *Current issues and trends in special education: Identification, assessment, and instruction* (2nd ed.). Emerald Publishing.

Petscher, Y., Cabell, S. Q., Catts, H. W., Compton, D. L., Foorman, B. R., Hart, S. A., & Wagner, R. K. (2020). How the science of reading informs 21st-century education. *Reading Research Quarterly*, *55*(S1), S267–S282. https://doi.org/10.1002/rrq.355

Rello, L., & Bigham, J. P. (2017). Good background colors for readers: A study of people with and without dyslexia. In *Proceedings of the 19th International ACM SIGACCESS Conference on Computers and Accessibility* (pp. 72–82). ACM. https://doi.org/10.1145/3132525.3132546

Snowling, M. J., & Hulme, C. (2012). Annual research review: The nature and classification of reading disorders — a commentary on proposals for DSM-5. *Journal of Child Psychology and Psychiatry*, *53*(5), 593–607. https://doi.org/10.1111/j.1469-7610.2011.02495.x

Tamim, R. M., Bernard, R. M., Borokhovski, E., Abrami, P. C., & Schmid, R. F. (2011). What forty years of research says about the impact of technology on learning: A second-order meta-analysis and validation study. *Review of Educational Research*, *81*(1), 4–28. https://doi.org/10.3102/0034654310393361

Tunmer, W. E., & Chapman, J. W. (2012). The simple view of reading redux: Vocabulary knowledge and the independent components hypothesis. *Journal of Learning Disabilities*, *45*(5), 453–466. https://doi.org/10.1177/0022219411432685

Wanzek, J., Wexler, J., Vaughn, S., & Ciullo, S. (2010). Reading interventions for struggling readers in the upper elementary grades: A synthesis of 20 years of research. *Reading and Writing*, *23*(8), 889–912. https://doi.org/10.1007/s11145-009-9179-5