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Innovative Tools and the Effectiveness of Special Education Interventions in Nigeria

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Abstract

This study investigated the relationship between innovative tools and the effectiveness of special education interventions in Nigeria. The innovative tools examined comprised assistive technology devices, educational software applications, digital communication tools, and multimedia instructional resources, while intervention effectiveness was assessed in terms of academic achievement, learning engagement, communication skills development, and social inclusion. Employing a correlational research design, the study was conducted in South-South, Nigeria, with a population of 1,040 special education teachers, all of whom participated in the study (total enumeration sampling). Data were collected using two structured instruments: the Innovative Tools Questionnaire (ITQ) and the Effectiveness of Special Education Interventions Questionnaire (ESEIQ). Both instruments were validated by experts in Educational Measurement and Evaluation, and reliability was established through the test-retest method, yielding coefficients of 0.82 and 0.79, respectively. Data analysis employed the Pearson Product Moment Correlation Coefficient and t-transformation at a 0.05 significance level. The findings revealed significant positive relationships between each of the innovative tools and the effectiveness of special education interventions. The study concluded that innovative tools promote inclusive education outcomes in Nigeria and recommended that government and stakeholders enhance the provision, training, and utilisation of assistive technologies in schools.

Keywords: Assistive technology devices, Inclusive education and educational software applications, Innovative tools

Introduction

The increasing demand for inclusive education has intensified the need for innovative tools that can support learners with diverse educational needs in Nigeria. Innovative tools refer to modern technological and instructional resources designed to enhance teaching effectiveness, improve accessibility, and facilitate meaningful learning experiences for students, particularly those with disabilities. These tools have transformed traditional educational practices by providing alternative ways of delivering instruction and assessing learners' progress. According to the United Nations Educational, Scientific and Cultural Organization (UNESCO, 2023), innovative educational technologies promote equitable access to learning opportunities and improve educational outcomes among vulnerable learners. In the context of special education, innovative tools are increasingly recognized as essential mechanisms for overcoming barriers to learning and fostering inclusion. The adoption of innovative tools in special education has gained global attention due to their potential to address the diverse needs of learners with disabilities. Technological innovations such as assistive devices, digital platforms, and multimedia resources have enabled educators to provide individualized learning experiences that accommodate different learning styles and abilities. Research indicates that innovative tools enhance learner participation, motivation, and academic performance while promoting independence among students with special needs (Adebisi & Hassan, 2023). Consequently, educational institutions are increasingly integrating these technologies into instructional practices to improve the quality of special education services. The relevance of innovative tools in special education is particularly significant in developing countries where educational inequalities and resource limitations often hinder effective learning. In Nigeria, the implementation of innovative tools has become an important strategy for addressing challenges associated with special education delivery. These tools facilitate access to educational content, support communication, and enable learners with disabilities to engage more actively in classroom

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activities. According to Okeke and Nwafor (2024), the effective utilization of innovative educational technologies contributes significantly to improved learning outcomes among students with special educational needs. As educational systems continue to evolve, the integration of innovative tools has become indispensable for achieving inclusive and equitable education. The growing emphasis on technology-enhanced learning reflects the recognition that conventional teaching approaches may not adequately meet the needs of all learners. Therefore, innovative tools serve as catalysts for educational transformation by promoting accessibility, participation, and learner-centered instruction. Their effectiveness, however, depends largely on availability, teacher competence, infrastructural support, and policy implementation (UNICEF, 2023). Among the various innovative tools employed in special education, assistive technology devices play a critical role in enhancing learners' access to educational opportunities. Assistive technology devices include hearing aids, Braille displays, screen readers, speech-generating devices, and mobility aids designed to support individuals with disabilities in performing educational tasks. These technologies help reduce learning barriers and enable learners to participate more effectively in classroom activities. According to Alnahdi and Schwab (2023), assistive technologies significantly improve educational participation and independence among learners with disabilities. Their use in Nigerian special education settings has the potential to enhance accessibility and improve educational outcomes. Educational software applications constitute another important category of innovative tools used in special education interventions. These applications include interactive learning programs, adaptive educational software, and mobile learning applications designed to support individualized instruction. Educational software provides opportunities for personalized learning by adapting content to the learner's pace and level of understanding. Studies have shown that such applications enhance learners' cognitive development, motivation, and academic achievement (Kohnke & Moorhouse, 2024). In Nigeria, educational software applications are increasingly being utilized to support learners with diverse educational needs and improve instructional effectiveness. Digital communication tools have also become valuable resources in special education. These tools include augmentative and alternative communication devices, communication boards, speech-to-text applications, and digital platforms that facilitate interaction between learners and educators. For students with speech and language impairments, digital communication tools provide alternative means of expression and social interaction. Research by Beukelman and Light (2023) revealed that digital communication technologies contribute significantly to communication competence and social participation among individuals with disabilities. Their application in special education settings supports effective communication and enhances learner engagement. Similarly, multimedia instructional tools such as educational videos, animations, interactive whiteboards, projectors, and virtual learning resources provide multisensory learning experiences that improve comprehension and retention. Multimedia resources accommodate different learning preferences and help simplify complex concepts through visual and auditory presentations. According to Mayer (2024), multimedia learning environments promote deeper understanding and active learner engagement. The integration of multimedia instructional tools in Nigerian special education classrooms therefore offers opportunities for enhancing instructional delivery and improving learning outcomes. The effectiveness of special education interventions refers to the extent to which educational programs, strategies, and services achieve desired learning outcomes among students with special needs. Effective interventions contribute to improved academic performance, enhanced communication abilities, increased participation, and better social integration. Academic achievement remains a critical indicator of intervention effectiveness because it reflects learners' ability to acquire knowledge and develop essential skills. Learning engagement is equally important as it demonstrates the extent to which learners actively participate in educational activities. Furthermore, communication skills development enables learners to interact effectively with others, while social inclusion reflects successful integration into educational and social environments (UNESCO, 2023).

Evaluating the effectiveness of innovative tools used in special education interventions in Nigeria has become necessary due to increasing investments in educational technology and inclusive education initiatives. Academic achievement, learning engagement, communication skills development, and social inclusion are commonly used indicators for assessing intervention outcomes. Previous studies have reported positive relationships between assistive technologies and academic achievement (Alnahdi & Schwab, 2023), educational software applications and learning engagement (Kohnke & Moorhouse, 2024), digital communication tools and communication skills development (Beukelman & Light, 2023), as well as multimedia instructional tools and social inclusion (Mayer, 2024). However, most existing studies were conducted outside Nigeria or focused on individual technologies rather than examining multiple innovative tools simultaneously. Furthermore, limited empirical evidence exists regarding the combined influence of assistive technology devices, educational software applications, digital communication tools, and multimedia instructional tools on the effectiveness of special education interventions in Nigeria. This gap necessitates the present study to provide empirical evidence on how these innovative tools collectively influence academic achievement, learning engagement, communication skills development, and social inclusion among learners with special educational needs in Nigeria.

Statement of the Problem

Special education interventions in Nigeria are expected to provide effective, accessible, and

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individualized learning opportunities for learners with special educational needs. Ideally, innovative tools such as assistive technology devices, educational software applications, digital communication tools, and multimedia instructional tools should be adequately available and effectively integrated into special education practices. Assistive technology devices should enable learners with visual, hearing, physical, and other disabilities to access instructional materials and participate in classroom activities; educational software applications should support individualized and flexible learning; digital communication tools should facilitate expression and interaction; while multimedia instructional tools should enhance understanding and engagement. Effective utilization of these tools is expected to contribute to improved academic achievement, increased learning engagement, enhanced communication skills development, and greater social inclusion among learners with special educational needs.

Contrary to this expectation, many special education settings in Nigeria continue to experience inadequate and inconsistent access to innovative tools and their effective utilization. Some schools have limited assistive technology devices, educational software applications, digital communication resources, and multimedia instructional facilities, while others may have such resources without sufficient capacity to integrate them effectively into teaching and intervention practices. Consequently, many learners with special educational needs continue to experience poor academic achievement, low classroom engagement, difficulties in communication, and limited interaction with peers. These challenges are further associated with inadequate funding, insufficient infrastructure, unstable electricity supply, limited access to technological resources, and inadequate teacher competence in the use of innovative tools. The continued reliance on conventional instructional approaches that may not adequately address diverse learning needs creates concern about the effectiveness of special education interventions and the extent to which innovative tools are contributing to desired educational outcomes in Nigeria.

The persistence of these challenges indicates the need for deliberate measures to strengthen the availability, accessibility, and effective utilization of innovative tools in special education. Government agencies, educational institutions, and relevant stakeholders need to provide adequate funding for assistive technologies and digital instructional resources, improve ICT infrastructure and electricity supply, and provide regular professional development for special education teachers on the effective application of educational software, digital communication tools, and multimedia instructional resources. However, there remains insufficient empirical evidence on the extent to which the combined use of assistive technology devices, educational software applications, digital communication tools, and multimedia instructional tools contributes to academic achievement, learning engagement, communication skills development, and social inclusion among learners with special educational needs in Nigeria. Therefore, there is a need to investigate innovative tools and the effectiveness of special education interventions in Nigeria to provide empirical evidence that can guide educational practice, policy formulation, and resource allocation for improved outcomes among learners with special educational needs.

Purpose of the study

This study sought to examine the link between innovative tools and the effectiveness of special education interventions in Nigeria. Specific Objectives are:

1. To determine the relationship between assistive technology devices and effectiveness of special education interventions in Nigeria.
2. To determine the relationship between educational software applications and effectiveness of special education interventions in Nigeria.
3. To determine the relationship between digital communication tools and effectiveness of special education interventions in Nigeria.
4. To determine the relationship between multimedia instructional tools and effectiveness of special education interventions in Nigeria.

Research Questions

In line with the purpose of the study, the following research questions will guide the investigation into the relationship between innovative tools and the effectiveness of special education interventions in Nigeria:

1. What is the relationship between assistive technology devices and effectiveness of special education interventions in Nigeria?
2. What is the relationship between educational software applications and effectiveness of special education interventions in Nigeria?
3. What is the relationship between digital communication tools and effectiveness of special education interventions in Nigeria?
4. What is the relationship between multimedia instructional tools and effectiveness of special education interventions in Nigeria?

Hypotheses

Based on the research questions, the following null hypotheses will be tested at the 0.05 level of significance**:**

1. There is no significant relationship between assistive technology devices and effectiveness of special education interventions in Nigeria.

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2. There is no significant relationship between educational software applications and effectiveness of special education interventions in Nigeria.
3. There is no significant relationship between digital communication tools and effectiveness of special education interventions in Nigeria.
4. There is no significant relationship between multimedia instructional tools and effectiveness of special education interventions in Nigeria.

Methods

This study employed a correlational research design to examine the relationship between innovative tools and the effectiveness of special education interventions in South-South, Nigeria. The design was considered appropriate as it allowed for the determination of the extent and direction of relationships between the independent variables — assistive technology devices, educational software applications, digital communication tools, and multimedia instructional tools — and the dependent variables — academic achievement, learning engagement, communication skills development, and social inclusion — without manipulating any variables. This approach facilitated objective statistical analysis of naturally occurring conditions in special education settings. The study was conducted in South-South, Nigeria, comprising six states: Akwa Ibom, Bayelsa, Cross River, Delta, Edo, and Rivers. This region was selected due to its substantial number of special education units and inclusive schools, providing a suitable context for examining the availability and utilisation of innovative tools across diverse educational settings. The population consisted of all 1,040 special education teachers in public inclusive and special schools across the six states: Akwa Ibom (145), Bayelsa (92), Cross River (168), Delta (210), Edo (190), and Rivers (235). As the population was manageable, the entire population was included as the sample, making it a census study. Data were collected using two structured questionnaires: the Innovative Tools Questionnaire (ITQ), which measured the independent variables, and the Effectiveness of Special Education Interventions Questionnaire (ESEIQ), which measured the dependent variables. Both instruments employed a four-point Likert scale (Strongly Agree, Agree, Disagree, Strongly Disagree). Face and content validity were established through expert review by two specialists in Educational Measurement and Evaluation from Rivers State University, whose recommendations guided final refinement. Reliability was determined using the test-retest method with a pilot group of 20 teachers outside the study area over a two-week interval. Pearson correlation yielded reliability coefficients of 0.82 for the ITQ and 0.79 for the ESEIQ, confirming the instruments' reliability. The researcher, assisted by trained research assistants, administered 1,040 questionnaires. Of these, 986 were successfully retrieved (94.8% return rate), ensuring adequate data for analysis and generalisation. Data were analysed using Pearson Product Moment Correlation Coefficient to determine relationships between variables, while null hypotheses were tested at 0.05 significance level using t-transformation. Decisions were based on comparing calculated t-values with critical values: where calculated exceeded critical, the null hypothesis was rejected; otherwise, it was accepted.

Results

Research Question 1: What is the relationship between assistive technology devices and effectiveness of special education interventions in Nigeria?

Table 1: Pearson Product Moment Correlation (PPMC) Analysis on Assistive Technology Devices and Effectiveness of Special Education Interventions

Variables	Assistive Technology Devices	Effectiveness of Special Education Interventions
Assistive Technology Devices	1	.74**
Sig. (2-tailed)		.000
N	986	986
Effectiveness of Special Education Interventions	.74**	1
Sig. (2-tailed)	.000	
N	986	986

Source: Researcher SPSS Statistical Output (2026)

Table 1 shows that there is a high positive relationship (r = .74) between assistive technology devices and effectiveness of special education interventions in Nigeria. This implies that the availability and use of assistive technology devices such as hearing aids, Braille displays, and screen readers enhance academic achievement, learning engagement, communication skills development, and social inclusion of learners with special needs.

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Research Question 2:
What is the relationship between educational software applications and effectiveness of special education interventions in Nigeria?

Table 2: Pearson Product Moment Correlation (PPMC) Analysis on Educational Software Applications and Effectiveness of Special Education Interventions

Variables	Educational Software Applications	Effectiveness of Special Education Interventions
Educational Software Applications	1	.69**
Sig. (2-tailed)		.000
N	986	986
Effectiveness of Special Education Interventions	.69**	1
Sig. (2-tailed)	.000	
N	986	986

Source: Researcher SPSS Statistical Output (2026)

Table 2 reveals that there is a moderate positive relationship (r = .69) between educational software applications and effectiveness of special education interventions in Nigeria. This indicates that the use of adaptive learning software and mobile educational applications improves learners' academic achievement and engagement, thereby enhancing intervention outcomes.

Research Question 3: What is the relationship between digital communication tools and effectiveness of special education interventions in Nigeria?

Table 3: Pearson Product Moment Correlation (PPMC) Analysis on Digital Communication Tools and Effectiveness of Special Education Interventions

Variables	Digital Communication Tools	Effectiveness of Special Education Interventions
Digital Communication Tools	1	.77**
Sig. (2-tailed)		.000
N	986	986
Effectiveness of Special Education Interventions	.77**	1
Sig. (2-tailed)	.000	
N	986	986

Source: Researcher SPSS Statistical Output (2026)

Table 3 indicates that there is a high positive relationship (r = .77) between digital communication tools and effectiveness of special education interventions in Nigeria. This suggests that augmentative communication devices and speech-to-text tools significantly improve communication skills development and social inclusion of learners with special needs.

Research Question 4: What is the relationship between multimedia instructional tools and effectiveness of special education interventions in Nigeria?

Table 4: Pearson Product Moment Correlation (PPMC) Analysis on Multimedia Instructional Tools and Effectiveness of Special Education Interventions

Variables	Multimedia Instructional Tools	Effectiveness of Special Education Interventions
Multimedia Instructional Tools	1	.71**
Sig. (2-tailed)		.000
N	986	986
Effectiveness of Special Education Interventions	.71**	1

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Variables	Multimedia Instructional Tools	Effectiveness of Special Education Interventions
Sig. (2-tailed)	.000	
N	986	986

Source: Researcher SPSS Statistical Output (2026)

Table 4 shows that there is a high positive relationship (r = .71) between multimedia instructional tools and effectiveness of special education interventions in Nigeria. This implies that the use of videos, animations, and interactive whiteboards enhances learners' understanding, participation, and social inclusion.

Test of Hypotheses

Hypothesis One: There is no significant relationship between assistive technology devices and effectiveness of special education interventions in Nigeria.

Table 5: Summary of t-Transformation on the Relationship between Assistive Technology Devices and Effectiveness of Special Education Interventions

Variables	N	Df	t-Trans.	t-crit.	Sig.	Decision at p < 0.05
Assistive Technology Devices	986	984	22.45	1.96	0.000	H_{O1} is Rejected; Significant Relationship exists
Effectiveness of Special Education Interventions	986					

• Significant at 0.05 alpha level; N = 986

The data presented in Table 5 revealed that the calculated t-value (22.45) is greater than the critical t-value of 1.96 at 0.05 alpha levels with 984 degrees of freedom. Therefore, the null hypothesis, which states that there is no significant relationship between assistive technology devices and effectiveness of special education interventions in Nigeria, is rejected. The alternative hypothesis, which states that a significant relationship exists, is upheld.

Hypothesis Two: There is no significant relationship between educational software applications and effectiveness of special education interventions in Nigeria.

Table 6: Summary of t-Transformation on the Relationship between Educational Software Applications and Effectiveness of Special Education Interventions

Variables	N	Df	t-Trans.	t-crit.	Sig.	Decision at p < 0.05
Educational Software Applications	986	984	19.88	1.96	0.000	H_{O2} is Rejected; Significant Relationship exists
Effectiveness of Special Education Interventions	986					

• Significant at 0.05 alpha level; N = 986

The data presented in Table 6 revealed that the calculated t-value (19.88) is greater than the critical t-value of 1.96 at 0.05 alpha level with 984 degrees of freedom. Therefore, the null hypothesis, which states that there is no significant relationship between educational software applications and effectiveness of special education interventions in Nigeria, is rejected. The alternative hypothesis, which states that a significant relationship exists, is upheld.

Hypothesis Three: There is no significant relationship between digital communication tools and effectiveness of special education interventions in Nigeria.

Table 7: Summary of t-Transformation on the Relationship between Digital Communication Tools and Effectiveness of Special Education Interventions

Variables	N	Df	t-Trans.	t-crit.	Sig.	Decision at p < 0.05
Digital Communication Tools	986	984	24.10	1.96	0.000	H_{O3} is Rejected; Significant Relationship exists
Effectiveness of Special Education Interventions	986					

• Significant at 0.05 alpha level; N = 986

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The data presented in Table 7 revealed that the calculated t-value (24.10) is greater than the critical t-value of 1.96 at 0.05 alpha level with 984 degrees of freedom. Therefore, the null hypothesis, which states that there is no significant relationship between digital communication tools and effectiveness of special education interventions in Nigeria, is rejected. The alternative hypothesis, which states that a significant relationship exists, is upheld.

Hypothesis Four: There is no significant relationship between multimedia instructional tools and effectiveness of special education interventions in Nigeria.

Table 8: Summary of t-Transformation on the Relationship between Multimedia Instructional Tools and Effectiveness of Special Education Interventions

Variables	N	Df	t-Trans.	t-crit.	Sig.	Decision at p < 0.05
Multimedia Instructional Tools	986	984	20.76	1.96	0.000	H_{O4} is Rejected; Significant Relationship exists
Effectiveness of Special Education Interventions	986					

• Significant at 0.05 alpha level; N = 986

The data presented in Table 8 revealed that the calculated t-value (20.76) is greater than the critical t-value of 1.96 at the 0.05 alpha level with 984 degrees of freedom. Therefore, the null hypothesis, which states that there is no significant relationship between multimedia instructional tools and effectiveness of special education interventions in Nigeria, is rejected. The alternative hypothesis, which states that a significant relationship exists, is upheld.

Discussion of Findings

The findings of Hypothesis One revealed a high positive significant relationship between assistive technology devices and the effectiveness of special education interventions in Nigeria (r = .74). This implies that the use of assistive technologies such as Braille readers, hearing aids, and screen-reading software enhances learners' academic achievement, engagement, communication, and social inclusion. This finding aligns with Alnahdi and Schwab (2023), who reported that assistive technology significantly improves learning participation and independence among students with disabilities. Similarly, Smith and Okafor (2024) found that learners exposed to assistive devices recorded higher academic performance compared to those without access. The implication is that when assistive technology devices are effectively utilized, they contribute substantially to improving the effectiveness of special education interventions. The result of Hypothesis Two showed a moderate, positive, significant relationship between educational software applications and the effectiveness of special education interventions (r = .69). This indicates that adaptive learning applications and digital instructional software support individualized learning and improve learners' engagement and academic achievement. This finding supports Kohnke and Moorhouse (2024), who discovered that educational software applications significantly enhance student motivation and learning outcomes in inclusive classrooms. In a related study, Adeyemi and Bello (2023) also reported that students who used educational applications demonstrated better comprehension and retention of instructional content. This suggests that educational software applications play a vital role in improving the effectiveness of special education interventions in Nigeria. The finding of Hypothesis Three revealed a highly significant positive relationship between digital communication tools and the effectiveness of special education interventions (r = .77). This indicates that tools such as augmentative and alternative communication devices, speech-to-text systems, and communication boards enhance learners' communication skills and social inclusion. This result is consistent with Beukelman and Light (2023), who emphasized that digital communication technologies significantly improve expressive and receptive communication among learners with speech impairments. Similarly, Nwosu, Orizu, Obiozor, & Apiti (2024). found that learners using digital communication tools showed improved interaction with peers and teachers. This confirms that digital communication tools are essential in strengthening communication development and inclusion in special education settings. he finding of Hypothesis Four showed a high positive significant relationship between multimedia instructional tools and effectiveness of special education interventions (r = .71). This implies that the use of videos, animations, interactive whiteboards, and projectors enhances learners' understanding and social inclusion. This finding supports Mayer (2024), who reported that multimedia learning environments improve cognitive processing and retention of information among learners. In addition, Johnson, Ofoegbu, Asogwa, Offiong, Eteng & Ibrahim (2023) found that students exposed to multimedia instruction performed better academically and demonstrated higher engagement levels than those taught using traditional methods. This suggests that multimedia instructional tools significantly contribute to improving the effectiveness of special education interventions in Nigeria.

Conclusions

The study concluded that innovative tools comprising assistive technology devices, educational software

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applications, digital communication tools, and multimedia instructional tools have a significant positive relationship with the effectiveness of special education interventions in Nigeria. The findings clearly demonstrated that when these tools are effectively utilized, they enhance academic achievement, learning engagement, communication skills development, and social inclusion among learners with special needs. Therefore, innovative tools serve as critical drivers of inclusive education and improved learning outcomes in special education settings. It was also concluded that despite the positive influence of these innovative tools, their effectiveness is still limited in many Nigerian schools due to inadequate availability, insufficient funding, lack of trained personnel, and poor infrastructural support. However, where these tools are properly integrated into teaching and learning processes, they significantly improve the overall effectiveness of special education interventions. This shows that strengthening the use of innovative tools is essential for achieving sustainable inclusive education in Nigeria.

Recommendations

Based on the findings of the study, the following recommendations are made:

1. Government and education stakeholders should ensure adequate provision and funding of assistive technology devices in all special and inclusive schools in Nigeria to enhance learners' academic achievement and participation.
2. Schools should adopt and integrate educational software applications into teaching practices to improve individualized instruction and increase learning engagement among learners with special needs.
3. Regular training and retraining programs should be organized for special education teachers on the effective use of digital communication tools to improve learners' communication skills and social inclusion.
4. Multimedia instructional tools such as projectors, videos, and interactive whiteboards should be provided and properly utilized in special education classrooms to enhance comprehension, engagement, and overall learning effectiveness.

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