

Virtual Reality Classroom and Inclusive Leadership: Enhancing Access for Students with Disabilities in Secondary Schools in Benue State, Nigeria

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ABSTRACT

This study examined the role of virtual reality (VR) classrooms and inclusive leadership practices in enhancing access to learning for students with disabilities in secondary schools in Benue State, Nigeria. A descriptive survey design was adopted using 120 respondents comprising principals, vice-principals, teachers, and education officers from six public secondary schools. Data were collected using Virtual Reality and Inclusive Leadership in Education Questionnaire (VRILEQ) with a reliability coefficient of 0.84. Descriptive statistics, t-test, Pearson correlation, and regression analysis were used for data analysis. Findings revealed that inclusive leadership practices significantly supported VR integration and improved learning outcomes for students with disabilities. The study recommends improved digital infrastructure, teacher training, and leadership support for inclusive technology integration.

Keywords: Educational technology integration, inclusive education, inclusive leadership, secondary schools, students with disabilities, virtual reality

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INTRODUCTION

Education systems worldwide are increasingly integrating digital technologies to enhance teaching, learning, and educational accessibility (Radianti et al., 2020; Hamilton et al., 2021). Among emerging technologies, virtual reality (VR) has gained considerable attention for its capacity to create immersive and interactive learning environments (Makransky et al., 2019; Ip et al., 2018). VR refers to computer-generated three-dimensional environments that enable users to interact with digital objects and simulated spaces in ways that approximate real-world experiences. In educational contexts, VR technologies allow learners to explore complex concepts through experiential engagement rather than passive observation, thereby supporting deeper understanding and knowledge retention (Radianti et al., 2020).

The growing interest in VR within education is closely linked to the need to address diverse learning needs in contemporary classrooms. Educational institutions increasingly serve learners with varied cognitive, physical, and socio-emotional characteristics. Inclusive education frameworks emphasize the importance of ensuring that all learners, including those with disabilities, have equitable access to meaningful learning opportunities. International initiatives such as the United Nations Sustainable Development Goal 4 advocate inclusive and equitable quality education for all learners regardless of their abilities or backgrounds (UNESCO, 2020). Consequently, educational researchers and practitioners are exploring innovative technologies capable of reducing barriers to learning.

In addition to global policy frameworks supporting inclusive education, Nigeria has also demonstrated national commitment to technology-enabled inclusive learning through several policy initiatives of the Federal Ministry of Education. For example, the National Inclusive Education Policy emphasizes equitable access to quality education for learners with disabilities and other marginalized groups, while the National Digital Learning Policy promotes the integration of technology-supported instructional approaches across school systems to enhance learning participation and outcomes. More recently, the National Educational Technology (EdTech) Strategy further highlights the importance of strengthening digital competencies, expanding access to technology-supported instruction, and improving teacher capacity for inclusive

digital learning environments. These policy developments provide an important institutional foundation for the integration of immersive technologies such as virtual reality within Nigerian secondary school contexts.

Virtual reality technologies offer unique possibilities for supporting inclusive education. Unlike conventional instructional tools, VR environments can simulate real-life situations while allowing learners to interact with educational content in flexible and adaptive ways. Such environments enable students to explore virtual spaces, manipulate objects, and engage with learning materials through multiple sensory channels. These features are particularly beneficial for students with disabilities who may encounter limitations in traditional classroom environments. Studies have shown that immersive technologies can enhance motivation, engagement, conceptual understanding, and learner presence when supported by appropriate instructional design (Makransky et al., 2020; Chalkiadakis et al., 2024; Rahim et al., 2025). Recent meta-analytic evidence further demonstrates that virtual reality-supported instruction improves academic achievement across both school and higher education contexts, particularly when integrated with structured pedagogical strategies (Merchant et al., 2014; Hubbard et al., 2024).

Despite the promising potential of VR technologies, successful implementation within schools depends not only on technological availability but also on organisational and leadership factors (Ertmer & Ottenbreit-Leftwich, 2019). Educational leadership plays a crucial role in shaping school environments that support innovation and inclusive learning practices. School leaders influence decisions regarding resource allocation, teacher training programmes, and institutional policies that determine how educational technologies are adopted and utilised (Jobir, 2025). Leadership approaches that emphasise collaboration, equity, and shared decision-making are particularly important in the context of inclusive education.

Inclusive leadership has therefore emerged as an important concept in contemporary educational administration, particularly within technology-supported learning environments. Recent leadership research increasingly conceptualizes school leadership not as the responsibility of a single administrator but as a collaborative and distributed process involving teachers, school managers, and other stakeholders working collectively to improve learning outcomes. Within this perspective, inclusive leadership overlaps with transformational and distributed leadership approaches that emphasize shared vision building, teacher empowerment, and equitable participation in decision-making processes (Leithwood et al., 2020; Assefa & Mujtaba, 2025). Such leadership practices are especially important when implementing emerging technologies such as virtual reality, where institutional readiness, teacher confidence, and equitable access to digital resources depend strongly on collaborative leadership support structures.

In many developing countries, however, the integration of advanced educational technologies such as VR remains limited. Constraints related to technological infrastructure, funding, and teacher preparedness often hinder the adoption of immersive learning technologies in schools. In Nigeria, national education policy frameworks increasingly recognize the importance of digital technology integration for improving access and learning outcomes. For example, the Federal Republic of Nigeria's National Policy on Education emphasizes the role of educational technology in supporting inclusive and equitable learning opportunities across all levels of schooling.

Similarly, the National Digital Economy Policy and Strategy highlight the importance of digital infrastructure development and technology-enabled learning environments for strengthening educational access and innovation. Despite these policy commitments, implementation gaps remain evident across many secondary schools, particularly in relation to advanced immersive technologies such as virtual reality. These contextual realities make it important to investigate how leadership practices within schools can support the effective adoption of emerging technologies for inclusive education in specific Nigerian states such as Benue.

Furthermore, while previous research has examined the pedagogical benefits of VR technologies and the role of leadership in technology integration, relatively few studies have investigated the intersection between immersive learning technologies and inclusive leadership practices in secondary school contexts. Understanding how leadership practices influence the implementation of VR-based instructional environments is particularly important in settings where technological innovation must be balanced with the goal of ensuring equitable learning opportunities for all students.

This study therefore examines teachers' perceptions of virtual reality-supported learning and the role of inclusive leadership practices in enhancing access for students with disabilities in secondary schools in Benue State, Nigeria. Specifically, the study explores the effectiveness of VR-supported learning environments, identifies barriers to implementation, examines the relationship between inclusive leadership practices and VR integration, and evaluates strategies used by school administrators to support inclusive digital learning environments. Specifically, the study seeks to:

1. Examine the extent to which virtual reality-supported learning is implemented to support students with disabilities in secondary schools.
2. Identify barriers to virtual reality integration and inclusive education in secondary schools.
3. Examine the role of inclusive leadership in enhancing access and participation for students with disabilities.
4. Evaluate strategies used by school administrators to foster the effective use of virtual reality in inclusive classrooms.

Research Hypotheses

The following hypotheses were formulated to guide the study:

1. There is no significant difference in teachers' perceptions of the effectiveness of virtual reality-supported learning based on gender.
2. There is no significant relationship between inclusive leadership practices and the successful integration of virtual reality classrooms.
3. Virtual reality classroom implementation has no significant impact on the learning outcomes of students with disabilities.

LITERATURE REVIEW

Virtual Reality in Education

In recent years immersive virtual reality technologies have gained increasing recognition as powerful instructional tools capable of transforming teaching and learning processes. VR allows learners to explore simulated environments, manipulate objects, and experience complex concepts in ways that traditional instructional methods cannot easily replicate. Previous research also indicates that immersive learning environments enhance student engagement, motivation, and conceptual understanding by providing experiential learning opportunities (Radianti et al., 2020).

A critical review of recent literature also highlights that immersive virtual environments significantly improve student engagement by fostering active participation and sustained attention during instruction (Lin et al., 2024). In educational settings, VR has been applied in various disciplines, including science, engineering, medical training, and teacher education, demonstrating significant potential for improving learning outcomes. Additionally, recent classroom-based studies emphasise that virtual reality serves as an effective instructional tool for enhancing experiential learning and improving students' understanding of abstract concepts in diverse educational contexts (Alali & Wardat, 2024). Recent studies further confirm that virtual reality enhances learning experiences in K–12 education by promoting interactive engagement and improving conceptual understanding across subject areas (Riyami, 2024).

Virtual reality technology provides immersive and interactive learning environments that support experiential learning, spatial visualisation, and learner engagement across multiple subject domains. Recent meta-analytic evidence demonstrates that virtual reality-supported instruction improves conceptual understanding, academic achievement, and learner motivation when integrated with structured pedagogical guidance and appropriate instructional scaffolding (Rahim et al., 2025; Hubbard et al., 2024). In addition, virtual reality learning environments have been shown to improve learner presence and emotional engagement, which contribute to deeper learning experiences compared with

conventional instructional approaches (Makransky et al., 2019). These findings suggest that immersive technologies can play an important role in supporting inclusive instructional strategies when aligned with learner needs and institutional support structures.

Despite these advantages, the adoption of VR technology in schools remains uneven, particularly in developing countries where technological infrastructure and funding are limited. Radianti et al. (2020) observed that many educational institutions face challenges such as high implementation costs, limited teacher training, and inadequate technological infrastructure, which hinder the large-scale integration of immersive technologies into teaching and learning processes. Consequently, while VR has demonstrated substantial potential for transforming education, its effective implementation requires supportive institutional policies, infrastructure development, and teacher capacity building.

Virtual Reality and Inclusive Education

Inclusive education emphasizes the provision of equitable learning opportunities for all learners, including students with disabilities. Contemporary research highlights that inclusive digital technologies play a critical role in promoting social equity by expanding access to learning resources and participation opportunities for learners with diverse needs (Afif & Musyaffa, 2025). Inclusive education seeks to remove barriers that prevent students from fully participating in educational activities and aims to create learning environments that accommodate diverse learning needs (Florian, 2014). Within this context, emerging technologies such as virtual reality present new opportunities for supporting inclusive learning practices by enabling flexible participation, experiential engagement, and alternative access pathways for diverse learners (Dahiya, 2024; Ip et al., 2018). This perspective aligns with recent arguments that digital inclusion is essential for achieving equitable educational outcomes in the digital age, particularly for learners with disabilities who face systemic access barriers (Afif & Musyaffa, 2025).

Virtual reality has also demonstrated considerable potential for supporting inclusive education by enabling learners with disabilities to participate in interactive simulations that might otherwise be inaccessible within conventional classroom environments. Teachers' perspectives further indicate that virtual reality can support inclusive instructional practices by enabling differentiated learning experiences tailored to students with special educational needs, although successful implementation depends on adequate training and institutional support (Dechsling et al., 2024). Studies indicate that immersive environments can support the development of social communication skills among learners with autism spectrum disorder, improve engagement among students with mobility limitations, and enhance access to visual and experiential learning opportunities for learners with diverse cognitive needs (Ip et al., 2018; Abdelwahab et al., 2025).

Furthermore, recent conceptual frameworks emphasise that virtual reality technologies can support inclusive instructional transformation when combined with institutional leadership support and accessibility-focused implementation strategies (Dahiya, 2024).

In addition, VR technologies can support differentiated instruction by allowing teachers to customise learning experiences based on students' needs and abilities (Ip et al., 2018; Di Natale et al., 2020). Recent research further emphasises that inclusive digital education is most effective when immersive technologies are combined with learner-centred pedagogical approaches such as problem-based learning, cooperative learning, and service learning, which enhance participation and engagement among students with special educational needs (D'Elia et al., 2025). Research also indicates that immersive simulations can improve attention, engagement, and comprehension among learners with special educational needs (Jensen & Konradsen, 2017). By providing interactive visualisation and experiential learning opportunities, VR can facilitate deeper understanding of complex concepts and support learners who may struggle with conventional teaching approaches.

Recent research further emphasises that virtual reality can strengthen inclusive learning participation when appropriately adapted to learners' diverse needs. For example, Moreno-Cruz et al. (2025) demonstrated that virtual reality environments designed using STEAM-based instructional approaches can enhance conceptual understanding and engagement among students with disabilities; however, the study also highlights the importance of accessibility-sensitive interface design and teacher support structures to ensure effective participation in immersive learning environments.

Despite these advantages, several accessibility and implementation challenges affect the effective use of virtual reality in inclusive education contexts. Research indicates that head-mounted displays may present usability difficulties for learners with motor impairments, sensory sensitivities, or cognitive processing challenges. Some students may also experience eye strain, dizziness, or sensory overload during immersive interactions, which can limit sustained engagement in virtual environments. In addition, the development of accessible VR instructional content remains a significant challenge, particularly in resource-constrained educational systems where locally adapted inclusive learning simulations are limited.

Ethical considerations related to learner data privacy and device-generated behavioural tracking also require careful institutional attention when deploying immersive technologies in school environments (Mahajan, 2023; Abdelwahab et al., 2025; Navas-Bonilla et al., 2025). These considerations highlight the importance of combining technological innovation with inclusive design principles and supportive leadership practices. However, scholars caution that technology alone cannot guarantee inclusive learning outcomes. Effective inclusive education

requires not only appropriate technological tools but also supportive institutional policies, sustained teacher professional development, and leadership practices that promote accessibility and participation for all learners (DeMatthews et al., 2021; Tondeur et al., 2020). These findings highlight that the effectiveness of virtual reality in inclusive education depends not only on technological availability but also on the integration of appropriate pedagogical strategies that promote active and collaborative learning (D'Elia et al., 2025).

Inclusive Leadership and Technology Integration in Schools

Educational leadership plays a central role in determining the success of technology integration initiatives within schools. Contemporary research increasingly recognises that leadership for technology-supported learning environments is not limited to administrative authority alone but involves collaborative engagement among school leaders, teachers, and institutional stakeholders. Distributed leadership perspectives emphasise shared responsibility for instructional innovation, while transformational leadership supports the development of a shared vision that motivates teachers to adopt emerging instructional technologies (Leithwood et al., 2020; Harris, 2020). Inclusive leadership extends these perspectives by prioritising equitable participation, accessibility, and responsiveness to learner diversity in decision-making processes. Studies within interdisciplinary education contexts further indicate that ethical and inclusive leadership practices significantly influence organisational commitment and staff engagement, which are critical for successful implementation of innovation in educational settings (Kidane et al., 2026).

Within digitally mediated classrooms, inclusive leadership encourages the provision of assistive technologies, supports teacher professional development for inclusive instructional practices, and promotes institutional policies that ensure equitable access to learning resources for students with disabilities (DeMatthews et al., 2021; Shields, 2017). In addition, the integration of digital competence with appropriate instructional strategies has been shown to enhance teachers' capacity to implement technology-supported learning effectively while promoting critical thinking and self-directed learning among students (Inayati et al., 2026). In the context of emerging immersive technologies such as virtual reality, leadership support becomes particularly important because successful implementation depends not only on infrastructure availability but also on teacher readiness, collaborative planning structures, and institutional commitment to inclusive instructional innovation. Therefore, inclusive leadership serves as a practical framework for understanding how school administrators can facilitate equitable adoption of virtual reality-supported learning environments within secondary school contexts.

Recent studies further emphasise that distributed leadership structures improve the sustainability of educational technology initiatives by encouraging

teacher participation in decision-making processes and strengthening institutional ownership of innovation practices. Collaborative leadership approaches have been shown to increase teacher confidence in adopting digital instructional tools and improve the long-term effectiveness of technology-supported learning environments, particularly in inclusive education contexts where coordinated support systems are required (Harris, 2020; Assefa & Mujtaba, 2025).

Virtual Reality, Leadership, and Learning Outcomes

The integration of virtual reality technologies within inclusive educational environments has the potential to improve learning outcomes for students with disabilities. Immersive learning environments allow students to actively engage with instructional content, explore complex ideas, and participate in simulated experiences that enhance understanding and retention of knowledge. Furthermore, the development of metacognitive skills and self-regulated learning has been identified as essential for maximising the benefits of technology-enhanced learning environments, particularly in inclusive educational contexts (M. Ali, 2026).

Empirical studies suggest that immersive learning technologies can positively influence academic achievement, motivation, and learner engagement. This is supported by recent empirical evidence demonstrating that immersive virtual reality environments promote deeper cognitive engagement and active learning compared with traditional instructional methods (Lin et al., 2024). Makransky et al. (2020) reported that VR-based learning environments enhance students' conceptual understanding by providing interactive and experiential learning opportunities. Similarly, Jensen and Konradsen (2017) found that immersive simulations significantly improve learning outcomes in educational settings where practical or experiential learning is required.

However, the successful implementation of VR technologies depends largely on institutional readiness and leadership support. Radianti et al. (2020) emphasised that schools require adequate technological infrastructure, teacher training, and administrative support to effectively integrate immersive learning technologies into teaching practices. Without these conditions, the potential benefits of VR may not be fully realised. Although global research increasingly highlights the instructional benefits of immersive technologies for inclusive education, empirical studies examining leadership-supported implementation of virtual reality learning environments within Nigerian secondary school systems remain limited. Existing Nigerian educational technology research has focused primarily on basic ICT integration challenges rather than advanced immersive learning environments such as virtual reality classrooms. This gap highlights the importance of investigating how inclusive leadership practices can support equitable adoption of emerging instructional technologies within resource-constrained educational contexts such as Benue State secondary schools.

Conceptual Framework

This study is anchored on the principles of inclusive leadership theory and distributed leadership perspectives in educational administration. Inclusive leadership emphasizes equitable participation, collaboration, accessibility, and responsiveness to learner diversity within institutional decision-making processes (Shields, 2017; DeMatthews et al., 2021). The framework assumes that school leaders play a critical role in creating supportive learning environments through resource allocation, teacher empowerment, professional development, and inclusive policy implementation. In addition, distributed leadership perspectives suggest that effective instructional innovation emerges through collaborative engagement among school leaders, teachers, and institutional stakeholders rather than through centralized administrative control alone (Leithwood et al., 2020; Harris, 2020). Within the context of virtual reality-supported learning environments, these leadership approaches provide a useful framework for understanding how schools can support equitable access to immersive technologies for students with disabilities. The study therefore conceptualizes inclusive leadership practices as institutional mechanisms that influence the adoption, accessibility, and effectiveness of virtual reality-supported learning environments in secondary schools.

Research Gap

Although previous studies have examined the educational benefits of virtual reality and the importance of inclusive leadership in schools, limited research has explored the combined influence of VR technology and inclusive leadership practices on the learning outcomes of students with disabilities, particularly in developing country contexts. In Nigeria and other developing nations, the integration of immersive technologies in secondary education remains relatively limited due to infrastructural, financial, and policy constraints. This gap is particularly significant in sub-Saharan African contexts where inclusive digital innovation remains underexplored. Therefore, this study seeks to investigate the implementation of virtual reality classrooms, identify barriers to their integration, and examine the role of inclusive leadership practices in supporting VR-based inclusive learning for students with disabilities in secondary schools in Benue State. By exploring the intersection of technology, leadership, and inclusive education, this study contributes to the growing body of literature on technology-supported inclusive learning environments.

RESEARCH METHOD

Research Design

The study adopted a descriptive survey research design. This design was considered appropriate because it enables the systematic collection of data from a defined population to describe existing conditions, practices, perceptions, and relationships as they occur naturally, without manipulation of variables. Given the limited availability of fully operational VR-supported learning environments within the study area, the investigation focused primarily on respondents' perceptions, institutional readiness, and leadership support for VR-supported inclusive learning environments. The design allowed the researcher to examine the extent of virtual reality classroom implementation, identify barriers to inclusive education, and explore the role of inclusive leadership in enhancing access for students with disabilities in secondary schools in Benue State.

Population and Sample

The population comprised principals, vice-principals, teachers, and education officers in six public secondary schools in Benue State with exposure to digital simulation or emerging VR-supported learning initiatives. A sample of 120 respondents was selected using stratified sampling based on role (principals, teachers, etc.), followed by simple random sampling within each stratum to ensure representation across gender, role, and school type.

Instrument for Data Collection

Data for this study were collected using a structured questionnaire titled *Virtual Reality and Inclusive Leadership in Education Questionnaire* (VRILEQ). The instrument was designed by the researcher to obtain information on the implementation of virtual reality-supported learning, barriers to integration, inclusive leadership practices, and learning outcomes for students with disabilities.

The questionnaire consisted of five sections (A–E) with a total of 40 items. All items in Sections B–E were rated on a 5-point Likert scale: Strongly Disagree (1), Disagree (2), Undecided (3), Agree (4), and Strongly Agree (5).

1. Section A collected demographic information of respondents such as gender, educational qualification, teaching experience, and school type.
2. Section B measured Virtual Reality Classroom Implementation for Students with Disabilities. This section contained 10 items designed to assess the availability, accessibility, and effectiveness of VR tools in supporting inclusive learning. Sample items included: “Virtual reality (VR)-supported learning environments are available for use in my school”

and “VR enhances engagement and participation among students with disabilities.”

3. Section C examined Barriers to VR Integration and Inclusive Education. This subscale consisted of 10 items assessing challenges affecting the adoption of VR technology in schools. Sample items included: “Poor infrastructure limits VR adoption such as electricity and internet” and “VR devices are too few for regular classroom instruction.”
4. Section D assessed inclusive leadership practices Supporting VR Implementation. This section contained 10 items focusing on leadership strategies and administrative support for inclusive technology adoption in schools. Sample items included: “School leaders allocate resources for VR-based learning” and “Inclusive policies guide VR implementation in my school.”
5. Section E measured Learning Outcomes of Students with Disabilities Using VR. This section also consisted of 10 items assessing perceived improvements in academic performance, participation, and skill development as a result of VR-supported learning. Sample items included: “Students with disabilities show improved academic performance when VR is used in lessons.” and “VR helps students with disabilities retain information better.”

Validity and Reliability

Content validity was established via expert review by two professors of Educational Technology and Special Education to ensure clarity, relevance, and adequate coverage of the study variables. Their suggestions were incorporated to improve the quality and appropriateness of the instrument. Cronbach’s alpha of 0.84 indicated a high level of internal consistency and confirmed that the instrument was reliable for the study.

Procedure for Data Collection

The researcher obtained permission from school authorities before administering the questionnaires. The questionnaires were administered in person with the assistance of trained research assistants to ensure proper explanation and completion. Respondents were assured of confidentiality and anonymity, and participation was voluntary. Completed questionnaires were collected immediately to minimize loss and ensure a high response rate.

Ethical Considerations

Ethical approval for the study was obtained from the relevant institutional research committee. Participation was voluntary, and informed consent was obtained from all respondents prior to data collection. Confidentiality and anonymity of participants were maintained throughout the study.

Data Analysis

Descriptive statistics (mean, standard deviation, percentages) were used to analyse the research questions. Inferential statistics (independent t-test, Pearson correlation, regression analysis) tested hypotheses at a significance level of 0.05 using SPSS v26.

RESULTS

Demographic Characteristics of Respondents

The demographic characteristics of the respondents revealed that all the 120 questionnaires distributed were duly completed and returned, representing a 100% response rate. In terms of gender, 68 respondents (56.7%) were male, while 52 respondents (43.3%) were female. Regarding role distribution, 20 respondents (16.7%) were principals, 18 (15.0%) were vice-principals, 72 (60.0%) were teachers, and 10 (8.3%) were education officers. Concerning school location, 65 respondents (54.2%) were from urban schools, while 55 respondents (45.8%) were from rural schools. In terms of VR experience, 49 respondents (40.8%) had used digital simulation programmes without an actual VR laboratory, whereas 71 respondents (59.2%) had not used any digital simulation programmes.

Gender differences are frequently examined in studies investigating technology adoption in educational settings because prior research suggests that demographic variables may influence teachers' perceptions of usefulness, confidence, and readiness to integrate digital instructional tools. Although recent studies indicate that institutional support and professional development are stronger predictors of technology integration than gender alone, examining gender-based differences remains important for understanding whether equitable access to training opportunities and instructional technologies exists within specific school systems (Scherer et al., 2019; Chalkiadakis et al., 2024). Therefore, this study included gender as a contextual variable to determine whether teachers' perceptions of virtual reality-supported learning effectiveness differ across male and female educators.

Table 1: *Descriptive Statistics for Research Variables*

Variable	Mean	SD	Interpretation
VR-supported learning implementation	3.42	0.71	Moderate
Barriers to VR integration	4.01	0.66	High
Inclusive leadership practices	3.88	0.59	High
Accessibility strategies	3.78	0.65	Moderate

Note. Interpretation was based on the criterion mean of 3.00 on the 5-point Likert scale.

The descriptive results indicate that respondents perceived the implementation of VR-supported learning environments as moderate across participating schools. Respondents also identified barriers to VR integration as relatively high, particularly in relation to infrastructure and technological access. Inclusive leadership practices were rated positively, suggesting that school administrators generally demonstrate supportive attitudes toward inclusive digital learning initiatives

Test of Hypotheses

H₀₁: There is no significant difference in perceptions of virtual reality classroom effectiveness between male and female teachers.

Table 2: *Independent Samples t-Test Showing Gender Differences in Perceptions of Virtual Reality Classroom Effectiveness*

Gender	N	Mean	SD	t	p
Male	68	34.48	7.90	0.382	.87
Female	52	33.36	7.20		

Note. No significant difference was found between male and female teachers' perceptions of VR-supported learning environments effectiveness at $p < .05$.

The independent samples t-test revealed that male teachers (Mean = 34.48, SD = 7.90) and female teachers (Mean = 33.36, SD = 7.20) did not differ significantly in their perceptions of the effectiveness of virtual reality-based instructional environments, $t(118) = 0.382$, $p = .87$. Since the p-value was greater than the 0.05 level of significance, the null hypothesis was not rejected. This result suggests that gender does not significantly influence teachers' perceptions of VR-supported learning environments effectiveness. Both male and female teachers demonstrated similar attitudes toward the use of immersive technologies for instructional delivery. This finding supports previous studies indicating that

teachers' acceptance of technology remains a critical predictor of classroom integration practices, with meta-analytic evidence confirming that perceived usefulness, institutional support, and digital competence significantly influence adoption behaviours (Scherer et al., 2019; Radianti et al., 2020).

H₀₂: There is no significant relationship between inclusive leadership practices and the successful integration of virtual reality classrooms.

Table 3: *Pearson Correlation Showing the Relationship between Inclusive Leadership and VR Integration*

Variable	1	2
Inclusive Leadership	-	.627**
VR Integration	.627**	-

Note. **p < .05 (2-tailed).

The Pearson Product-Moment Correlation analysis revealed a strong positive relationship between inclusive leadership practices and the successful integration of virtual reality classrooms ($r = .627, p < .05$). Since the p-value was less than the 0.05 significance level, the null hypothesis was rejected. This finding indicates that inclusive leadership practices significantly contribute to the successful implementation of VR-supported learning environments. Schools where leaders promote collaborative decision-making, equitable access to resources, and skill development opportunities tend to demonstrate higher levels of technology integration. This aligns with research showing that leadership support plays a central role in facilitating educational technology adoption and inclusive instructional practices (Leithwood et al., 2020).

H₀₃: The implementation of virtual reality classroom technology has no significant impact on the learning outcomes of students with disabilities.

Table 4: *Regression Analysis Predicting Learning Outcomes of Students with Disabilities*

Predictor	R	R ²	F	β	t	p
VR classroom implementation	.351	.124	19.451	.351	4.410	< .001

Note. VR classroom implementation significantly predicted learning outcomes among students with disabilities.

Regression analysis was conducted to determine whether virtual reality classroom implementation predicts the learning outcomes of students with disabilities. The analysis revealed that VR-supported learning environments implementation significantly predicted learning outcomes ($\beta = .351, t = 4.410, p <$

.001). The coefficient of determination ($R^2 = .124$) indicates that VR-supported learning implementation accounted for 12.4% of the variance in learning outcomes among students with disabilities. Although this represents a moderate effect size, the result demonstrates that immersive learning technologies can contribute meaningfully to improved engagement, comprehension, and participation among students with diverse learning needs. This finding supports prior research indicating that immersive technologies such as virtual reality can enhance conceptual understanding, experiential learning, and motivation among learners with disabilities (Makransky et al., 2019; Jensen & Konradson, 2017).

DISCUSSION AND CONCLUSIONS

The findings of this study demonstrate that teachers in Benue State secondary schools perceive virtual reality-supported classrooms as having strong potential to enhance inclusive learning access and participation for students with disabilities. These findings align with recent research indicating that immersive learning environments improve engagement, conceptual understanding, and learner presence when supported by appropriate instructional design and institutional leadership structures (Rahim et al., 2025; Hubbard et al., 2024). The results further emphasise the importance of inclusive leadership practices in supporting technology-enabled instructional transformation. Consistent with distributed and transformational leadership perspectives, teachers' perceptions suggest that administrative encouragement, institutional planning support, and access to professional development opportunities influence readiness to adopt immersive instructional technologies. Previous studies have shown that collaborative leadership structures strengthen teacher confidence in integrating emerging digital learning tools and improve the sustainability of school-based technology innovation initiatives (Leithwood et al., 2020; Harris, 2020; Assefa & Mujtaba, 2025). These findings therefore highlight inclusive leadership as a practical institutional mechanism for supporting equitable adoption of virtual reality learning environments within secondary school systems.

From an inclusive education perspective, the findings suggest that virtual reality classrooms may improve participation among learners with mobility, sensory, and cognitive learning challenges when supported by accessible instructional design strategies. Prior research demonstrates that immersive simulations can enhance social communication skills among learners with autism spectrum disorder and increase engagement among students with diverse learning needs when appropriate scaffolding structures are provided (Ip et al., 2018; Abdelwahab et al., 2025; Dahiya, 2024). However, the effectiveness of such environments depends strongly on leadership support for accessibility planning, teacher training, and infrastructure development within school systems. The study also revealed that gender does not significantly influence teachers' perceptions of

virtual reality-supported learning effectiveness. Both male and female teachers demonstrated similar attitudes toward the use of immersive technologies in teaching, suggesting that institutional support, technological infrastructure, and professional development opportunities are stronger predictors of adoption than demographic characteristics. This finding is consistent with previous research indicating that perceived usefulness and organisational support play a more important role in technology adoption than gender differences (Scherer et al., 2019; Radianti et al., 2020).

In addition, the study identified a statistically significant positive relationship between inclusive leadership practices and the successful integration of virtual reality classrooms. Schools where administrators promoted collaboration, equitable resource allocation, and teacher involvement in decision-making were more likely to adopt and utilise immersive technologies effectively. This finding reinforces the central role of leadership as a structural enabler of instructional innovation through its influence on teacher collaboration, institutional readiness, and supportive learning environments (Hallinger, 2011; Nacheva, 2026; Leithwood et al., 2020). Furthermore, the regression analysis revealed that immersive learning environment implementation significantly predicted the learning outcomes of students with disabilities. Although virtual reality accounted for 12.4% of the variance in learning outcomes, the positive relationship suggests that immersive learning environments can improve students' engagement, comprehension, and participation. This supports existing evidence that virtual reality enhances experiential learning by allowing students to interact with complex concepts in simulated environments (Makransky et al., 2019; Jensen & Konradsen, 2017). However, the modest proportion of variance explained indicates that technology alone cannot fully address the challenges of inclusive education. Other factors such as teacher competence, institutional funding, curriculum design, and supportive educational policies remain essential for the development of effective inclusive learning environments (Dexter, 2018; DeMatthews et al., 2021; Florian, 2014; UNESCO, 2021).

Despite the positive perceptions identified in this study, several implementation challenges remain important considerations for policymakers and school administrators. Limited access to immersive learning infrastructure, insufficient teacher training opportunities, and concerns regarding accessibility adaptation for learners with disabilities may affect large-scale adoption of virtual reality classrooms in Nigerian secondary schools. This finding aligns with recent evidence suggesting that while virtual reality environments can improve engagement and conceptual understanding among learners with disabilities, their effectiveness depends on the availability of accessible interface design, appropriate instructional scaffolding, and teacher preparedness to support inclusive participation (Moreno-Cruz et al., 2025). Similar barriers have been reported in other developing-country contexts where institutional readiness plays a critical

role in determining the sustainability of emerging instructional technology initiatives (Mahajan, 2023).

Recent evidence further indicates that sustainable adoption of virtual reality in lower secondary STEAM curricula depends on teacher preparedness, curriculum alignment, infrastructure availability, and leadership-supported implementation planning, all of which function as key enabling conditions for sustainable immersive learning integration in school systems (Nemani, 2025). Related research on augmented reality adoption in developing educational environments further highlights infrastructure limitations, cost constraints, and insufficient technical training as key institutional barriers affecting the implementation of immersive learning technologies across school-based training contexts (Akinradewo, 2025). Collectively, these findings reinforce the importance of coordinated leadership support and strategic institutional planning for sustainable immersive technology integration in secondary education systems.

This study contributes to the growing body of research on immersive learning technologies by providing empirical evidence from a Nigerian secondary school context on teachers' perceptions of virtual reality-supported inclusive classroom practices. Unlike much of the existing literature, which focuses primarily on higher education or developed-country contexts, this study demonstrates how inclusive leadership practices function as a critical enabling factor for the equitable adoption of emerging instructional technologies in resource-constrained educational environments. The findings therefore provide context-specific insights for policymakers, school administrators, and teacher professional development planners seeking to strengthen inclusive digital learning implementation strategies in similar educational systems.

This study examined the implementation of virtual reality classrooms and the role of inclusive leadership practices in enhancing learning access and outcomes for students with disabilities in secondary schools in Benue State, Nigeria. The findings demonstrate that teachers generally perceive virtual reality technologies as valuable instructional tools capable of supporting engagement, participation, and conceptual understanding among learners with diverse needs. Importantly, the results also indicate that inclusive leadership practices play a significant role in facilitating the successful integration of immersive learning technologies within school environments. Beyond confirming the instructional potential of virtual reality, the study highlights that leadership support functions as a critical institutional mechanism for promoting equitable access to emerging educational technologies. The positive relationship identified between inclusive leadership practices and virtual reality implementation suggests that collaborative decision-making structures, professional development support, and equitable resource allocation are essential for sustaining technology-enabled inclusive learning environments.

The study contributes to existing scholarship by providing empirical evidence from a Nigerian secondary school context on the intersection of immersive learning technologies and inclusive leadership practices. While previous research has largely examined virtual reality integration within higher education or technologically advanced educational systems, this study extends current knowledge by demonstrating how leadership practices influence the adoption of innovative instructional technologies in resource-constrained school environments. Although virtual reality implementation significantly predicted learning outcomes among students with disabilities, the findings also indicate that technology alone cannot fully address the challenges associated with inclusive education. Effective integration requires complementary investments in teacher capacity development, infrastructure provision, and supportive policy frameworks. Strengthening these conditions will enhance the sustainability and accessibility of immersive learning initiatives in secondary school systems.

Overall, the study underscores the importance of combining technological innovation with inclusive leadership approaches to improve equitable learning opportunities for students with disabilities. By situating virtual reality integration within leadership-supported institutional practices, the study provides practical guidance for policymakers, school administrators, and educational planners seeking to advance inclusive and technology-supported education in Nigeria and similar contexts. Future research may further explore longitudinal impacts of immersive learning environments on inclusive classroom participation across diverse secondary school settings.

IMPLICATIONS

Policy Implications

The findings of this study have several important implications for educational policymakers, school administrators, and stakeholders involved in educational technology integration. First, educational authorities should prioritise the development of digital infrastructure in secondary schools to facilitate the adoption of immersive learning technologies such as virtual reality. Investments in reliable electricity supply, internet connectivity, and digital learning equipment are essential for effective technology-supported education. Second, professional development programmes should be provided for teachers and school administrators to enhance their capacity to integrate immersive technologies into teaching practices. Training programmes focusing on VR-based instruction, inclusive pedagogy, and digital classroom management can significantly improve teachers' confidence and competence in using educational technologies. Third, policymakers should develop clear national guidelines and policies that support the integration of emerging technologies into inclusive education frameworks. Such policies should ensure that technology-based learning initiatives are aligned

with the broader goals of equitable and accessible education for all learners. Finally, school leaders should adopt inclusive leadership practices that encourage collaboration, shared decision-making, and equitable resource allocation. By creating supportive institutional environments, school leaders can promote innovation and facilitate the successful adoption of immersive technologies in educational settings.

Practical Recommendations

Based on the findings, the study makes the following recommendations:

- 1. Inclusive Leadership:** School administrators should adopt leadership practices that promote equity, collaboration, and participatory decision-making.
- 2. Infrastructure Investment:** Government and education stakeholders should increase funding for VR technology and assistive devices in secondary schools.
- 3. Teacher Training:** Continuous professional development programmes should be provided to enhance teachers' competence in using VR for inclusive instruction.
- 4. Policy Development:** Clear policies and strategic plans should guide VR integration in inclusive education.
- 5. Collaboration:** Schools should partner with technology providers and special education experts to improve accessibility and effective utilization.
- 6. Future Research:** Longitudinal or experimental studies should be conducted to examine the long-term impact of VR-supported learning environments on learning outcomes of students with disabilities.

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