

*Impact of TextVision Application and Raised-Lines Paper on ... Bello, M. M., Et. al. (2026)*

## Impact of TextVision Application and Raised-Lines Paper on Learning Outcomes among Visually Impaired Learners in University of Ilorin, Nigeria

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### Abstract

*This study addresses the critical challenges faced by visually impaired students at the University of Ilorin in accessing printed texts and completing writing tasks independently. Guided by the Social Model of Disability and theories of technology acceptance, self-determination, and inclusive education, the research developed and evaluated two assistive tools: the TextVision App (utilising OCR and text-to-speech) and the Raised Lines Paper. Using a mixed-methods design, the population of the study consists of all visually impaired learners during the 2025/2026 academic session, totaling 62. Purposive sampling techniques were used to sample 21 students. The study implemented a tailored four-week training intervention, assessing usability and impact through surveys, standardised tests, and interviews. Findings revealed significant pre-existing barriers, including dependence on peers and high costs. Post-intervention results demonstrated high usability and effectiveness, with statistically significant improvements in academic performance, reading and writing skills, and self-reported confidence. The study concludes that these affordable, scalable tools empower learners by dismantling social barriers and fostering autonomy. It recommends institutionalizing these technologies, integrating inclusive policies, and establishing structured training programmes to embed sustainable, equitable support systems within the university's educational framework.*

**Keywords:** Inclusive Education, Assistive Technology, Visual Impairment, Academic Empowerment, Accessible Learning

### Introduction

Visually impaired students at the University of Ilorin face significant challenges in accessing printed texts and independently writing, both of which are fundamental to academic success. Writing is not just a means of communication but a critical tool for learning, self-expression, and assessment. The inability to write independently can lead to a cascade



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of difficulties, ranging from reduced academic performance to social isolation. Despite advances in inclusive education, there remains a gap in effective tools that can fully support these students' needs, affecting their overall educational experience and academic outcomes. At the University of Ilorin, visually impaired students often rely on assistive technologies such as screen readers and Braille, or depend on peers or support staff to transcribe their thoughts into written form. While these methods provide some level of support, they are not without limitations. Screen readers, for instance, may struggle with complex layouts and diagrams, while Braille displays can be expensive and cumbersome. Additionally, reliance on others for writing can diminish a student's sense of autonomy and academic integrity, as they must depend on someone else to accurately capture their ideas. This research addresses these critical issues by developing TextVision and introducing Raised Lines Paper as innovative solutions designed to empower visually impaired learners. TextVision aims to enhance access to printed text by utilising cutting-edge technologies such as Optical Character Recognition (OCR) and Text-to-Speech (TTS) systems to convert printed materials into more accessible formats. Meanwhile, Raised Lines Paper, featuring tactile markings, guides the writing process, allowing visually impaired students to write independently. These tools are tailored to the specific needs of visually impaired students, addressing both their challenges in accessing printed texts and their ability to engage in writing activities. The importance of writing extends beyond the academic sphere, influencing various aspects of university life, including taking notes during lectures, completing assignments, and participating in written examinations. The inability to perform these tasks independently can lead to a significant disadvantage, making it difficult for visually impaired students to keep up with their coursework and fully demonstrate their knowledge and capabilities. This, in turn, affects their grades, self-esteem, and overall university experience.

Moreover, writing is closely linked to cognitive processes such as critical thinking, problem-solving, and creativity. When visually impaired students are unable to write independently, they may miss out on the cognitive benefits that writing provides, further widening the academic gap between them and their sighted peers. The lack of adequate support for developing writing skills among visually impaired students at the University of Ilorin is a critical issue that needs to be addressed. The development of TextVision and the use of Raised Lines Paper will be guided by principles of universal design, which advocate for creating products that are accessible to all users, regardless of their abilities. By integrating feedback from visually impaired students and educators at the University of Ilorin, these tools will be optimised for usability and effectiveness. The study will evaluate the impact of these interventions on academic performance, cognitive skill development, and user satisfaction, providing insights into how well they meet the needs of visually impaired learners. This research contributes to the broader field of educational accessibility by demonstrating how specialised tools can improve learning outcomes for visually impaired learners. By focusing on the needs of students at the University of Ilorin, the study aligns with the university's mission to provide a world-class environment for learning, research, and community service, where all students can thrive. It also supports global educational objectives, such as the United Nations Sustainable Development Goals (SDG 4 and SDG 10), which emphasise inclusive and equitable quality education for all and reducing inequalities within and among countries. The success of these interventions could lead to broader implications for educational policy and practice, particularly in how universities and other educational institutions approach the teaching of visually impaired students. If TextVision and Raised Lines Paper prove effective, they could become standard tools in special education, offering practical and cost-effective ways to support visually impaired learners across various educational contexts. This would represent a significant step forward in making education truly inclusive and accessible to all students, regardless of their physical abilities.

### **Statement of the Research Problem**

The necessity for this study is underscored by the increasing population of visually impaired students at the University of Ilorin. Currently, there are 59 visually impaired students across various faculties, a significant number that highlights the growing need for effective support systems within the university. These students face unique challenges, particularly in the area of reading and writing, which are essential for academic success. The difficulties they encounter are further complicated by the fact that many of them lost their sight later in life, some after completing primary education, others after secondary education, and even a few at the postgraduate level due to accidents occurring after their bachelor's degree. Only a small number of these students have been visually impaired from early childhood, meaning that for many, the use of assistive technologies like Braille was introduced too late to be fully effective.



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Compounding these challenges is the fact that many visually impaired students face additional barriers related to the accessibility of assistive tools and economic constraints. For instance, in recent times, issues such as unreliable electricity have hindered the use of laptop computers, which are essential for accessing screen readers for reading and other digital aids. Moreover, the economic status of some parents makes it difficult to provide necessary tools such as typewriters or specialised software, further limiting the students' ability to engage fully in their studies. Given these circumstances, the need for visually impaired students to write independently, like their sighted peers, has become increasingly critical. In response, the University of Ilorin has provided assistants who accompany these students to class, help them read text and take notes, and even assist with reading examination questions and writing during examinations. However, despite this support, many visually impaired students continue to struggle academically. Their results often do not reflect their potential, and a significant number attribute their poor academic performance to their inability to read writing text and write independently. This reliance on others for writing not only affects their academic outcomes but also undermines their confidence and autonomy.

This study is therefore justified in its aim to explore and implement solutions that can empower visually impaired students to read and write text independently. By investigating the use of the Textvision app and Raised lines Paper as an intervention, the research seeks to provide these students with a practical, accessible tool that can bridge the gap between them and their sighted peers. This approach aligns with the university's commitment to inclusivity and excellence, as well as with global educational goals that emphasise the importance of providing equal opportunities for all students. Addressing this gap is not just a matter of academic performance but also of ensuring that visually impaired students can fully participate in the educational experience, thereby enhancing their overall well-being and prospects.

### **Objectives of the Study**

The study evaluated the effectiveness of Textvision and Raised Lines paper as an intervention tool for empowering visually impaired students at the University of Ilorin to read text and write independently, enhancing their academic performance and inclusivity within one academic year. Specifically, the study to:

1. Identify the reading text and writing challenges faced by visually impaired students at the University of Ilorin.
2. Implement the TextVision and Raise line paper intervention tailored to the needs of visually impaired students
3. evaluates the effectiveness of current assistive technologies for reading text and writing tasks by analysing student feedback and usage data over
4. assesses the TextVision App and Raised-line usability and effectiveness
5. Compare the academic performance and self-reported confidence of visually impaired students before and after the intervention of the TextVision and Raiselines paper intervention

### **Research Questions**

The following research questions guided this study.

1. What are the reading and writing challenges faced by visually impaired students at the University of Ilorin?
2. How can the TextVision app and raised line paper be effectively implemented and tailored to meet the specific educational needs of visually impaired students?
3. How effective are current assistive technologies in supporting reading and writing tasks, based on the analysis of student feedback and usage data?
4. What is the usability and effectiveness of the TextVision App and Raised-line paper for visually impaired students?
5. Whether TextVision and Raised-line paper intervention impact the academic performance and self-reported confidence levels of visually impaired students?

### **Hypothesis**

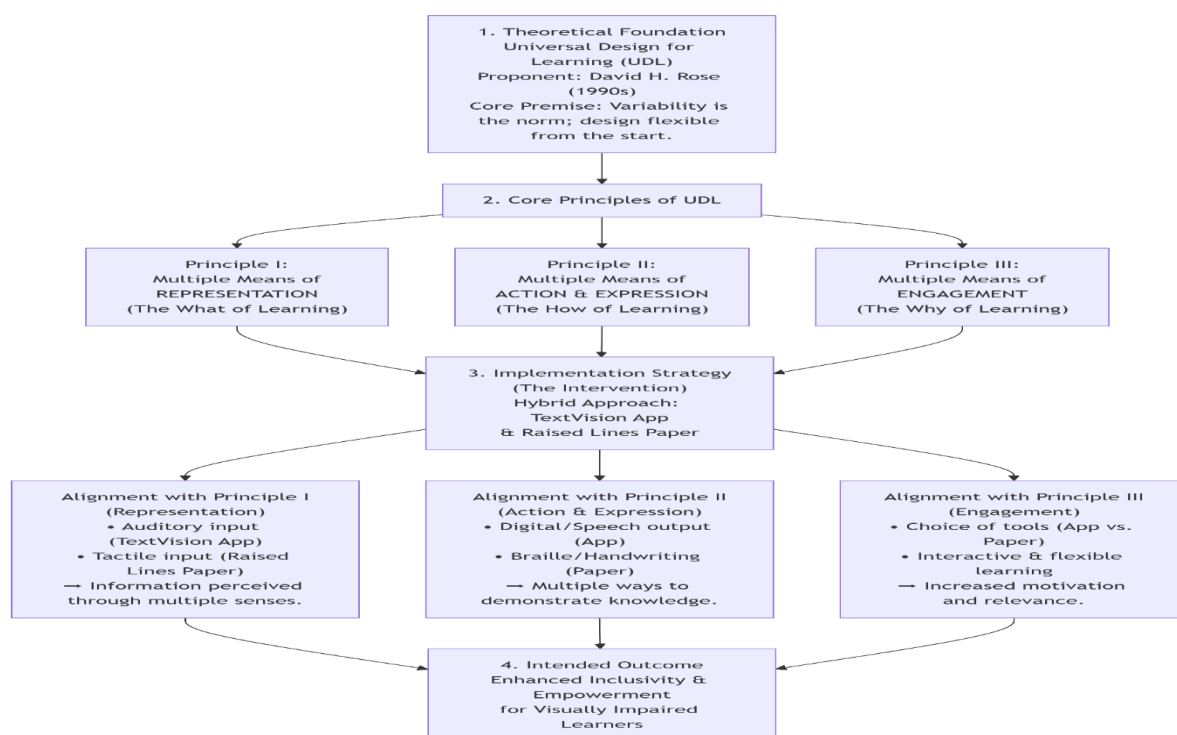
**Ho:** The TextVision app and Raised-line paper intervention have no significant impact on the academic performance and self-reported confidence levels of visually impaired students.

### **Theoretical framework**

This study is grounded in the Universal Design for Learning (UDL) theory, an educational framework developed by David H. Rose in the 1990s that advocates for creating flexible learning environments to accommodate the diverse needs of all students from the outset. UDL is built on three core principles. The first is Multiple Means of Representation, which acknowledges that students perceive and comprehend information differently. To address this, UDL advocates present

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information in various formats. For visually impaired learners, this might include auditory descriptions, tactile graphics, and digital text compatible with screen readers. By offering multiple ways to access content, UDL ensures that all students can engage with the material in a way that suits their individual needs. The second principle, Multiple Means of Action and Expression, recognises that students differ in how they navigate a learning environment and express what they know. UDL encourages providing various options for students to demonstrate their understanding. For instance, visually impaired students might use speech-to-text software, Braille, or oral presentations to express their knowledge. This approach ensures that assessments are not biased towards a single mode of expression, allowing all students to showcase their abilities effectively. The third principle, Multiple Means of Engagement, emphasises the importance of motivation in learning. UDL promotes offering choices in how students engage with the material, such as interactive technology. For visually impaired learners, incorporating tools like the TextVision App and Raised Lines Paper can make learning more interactive and engaging, catering to their unique preferences and needs. The study “Enhancing Inclusivity Using TextVision App and Raised Lines Paper to Empower Visually Impaired Learners in Nigeria” closely aligns with the principles of UDL. The use of the TextVision App and Raised Lines Paper provides visually impaired students with different ways to access and interact with educational content. The TextVision App offers auditory feedback, while the Raised lines paper provides tactile input, ensuring that students can blend both methods, thereby enhancing their comprehension and retention of information. Furthermore, by integrating both technological and traditional tools, the study allows visually impaired students to express their understanding in various ways. They can use the TextVision App for digital assignments or the raised lines paper for handwritten tasks, accommodating different learning styles and abilities. This flexibility ensures that all students can effectively demonstrate their knowledge. Finally, the hybrid approach of combining the TextVision App with the Raised lines paper makes learning more engaging for visually impaired students. It provides them with options to interact with the material in ways that are most motivating and accessible to them. This increased engagement can lead to better learning outcomes and higher levels of student satisfaction, demonstrating the impact and relevance of UDL principles in enhancing inclusivity for visually impaired learners. The theoretical framework of Universal Design for Learning (UDL) provides the structural backbone for the conceptual model illustrated in Figure 1.



**Fig.1: A UDL-Based Conceptual Framework for Enhancing Inclusivity Using TextVision and Raised Lines Paper.**



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As articulated by David H. Rose, the core premise that "variability is the norm" serves as the Theoretical Foundation (Box 1) upon which the entire model is built. This foundation logically expands into the framework's three guiding pillars, Representation, Action & Expression, and Engagement, which are depicted in Box 2 (Core Principles of UDL). These principles do not exist in isolation; they directly inform the design of the Implementation Strategy shown in Box 3. The hybrid use of the TextVision App and Raised Lines Paper is the tangible manifestation of UDL's call for flexibility. The figure then visually demonstrates the alignment between theory and practice by mapping the specific affordances of these tools back to the UDL principles. The auditory and tactile inputs correspond to Principle I (Representation), the diverse output methods correspond to Principle II (Action & Expression), and the element of student choice corresponds to Principle III (Engagement). Ultimately, the figure illustrates that by adhering to the UDL framework, the intervention converges toward the Intended Outcome (Box 4): enhanced inclusivity and empowerment for visually impaired learners.

### **Methodology**

The study adopted a mixed-methods research design, combining quantitative and qualitative approaches to comprehensively examine the impact of the TextVision app and Raised Lines Paper on the writing skills, independence, and academic performance of visually impaired students. The quantitative component measured changes in participants' academic performance, writing proficiency, and independence using surveys and standardised tests, while the qualitative component explored students' lived experiences and perceptions through interviews. The study was conducted at the University of Ilorin, Nigeria, a federal university with a diverse student population, including visually impaired students across various faculties. The institution provides support services for students with special needs, making it an appropriate setting for evaluating assistive learning interventions. The study population comprised all visually impaired students enrolled at the University of Ilorin. According to institutional records, a total of 59 visually impaired students were registered across different faculties at the time of the study. Purposive oversampling was employed to select participants based on the nature of their visual impairment. Only students who lost their sight later in life and had prior experience using conventional writing tools (paper and biro) before vision loss were included. Twenty-one (21) students met these criteria and participated in the study. Data collection began with baseline quantitative assessments using standardised tests to evaluate participants' reading and writing skills, level of independence, and academic performance. In addition, a researcher-designed unstructured questionnaire hosted on Google Forms was administered to gather qualitative information on participants' challenges with reading and writing, use of assistive technologies, and perceived academic difficulties. The intervention involved the introduction of the TextVision app and the Raised Lines Paper. Participants received structured training sessions consisting of demonstrations and hands-on practical exercises to support effective integration of the tools into their academic activities. Continuous support was provided through regular follow-ups to address challenges and ensure proper usage of the assistive technologies. Following the intervention, post-test assessments were conducted using the same surveys and standardised tests administered at the baseline stage. Quantitative data obtained were used to compare pre- and post-intervention performance in writing skills, independence, and academic outcomes. Qualitative data were collected through follow-up interviews and focus group discussions to capture participants' experiences, perceptions, and challenges encountered while using the intervention tools. These narratives provided deeper insight into the usability, effectiveness, and impact of the TextVision app and Raised Lines Paper on students' academic autonomy and confidence. Ethical approval for the study was obtained from the University of Ilorin Ethical Review Committee on 11 September 2025 (UERC/ASN/2025/3322). Informed consent was obtained from all participants after explaining the purpose and procedures of the study, as well as their right to withdraw at any time without penalty. Confidentiality and anonymity were ensured, and all ethical standards governing research involving human participants were strictly observed.

### **Presentation of Results**

The findings of this study were presented as follows:

#### **Research Question One:**

What are the reading and writing challenges faced by visually impaired students at the University of Ilorin?

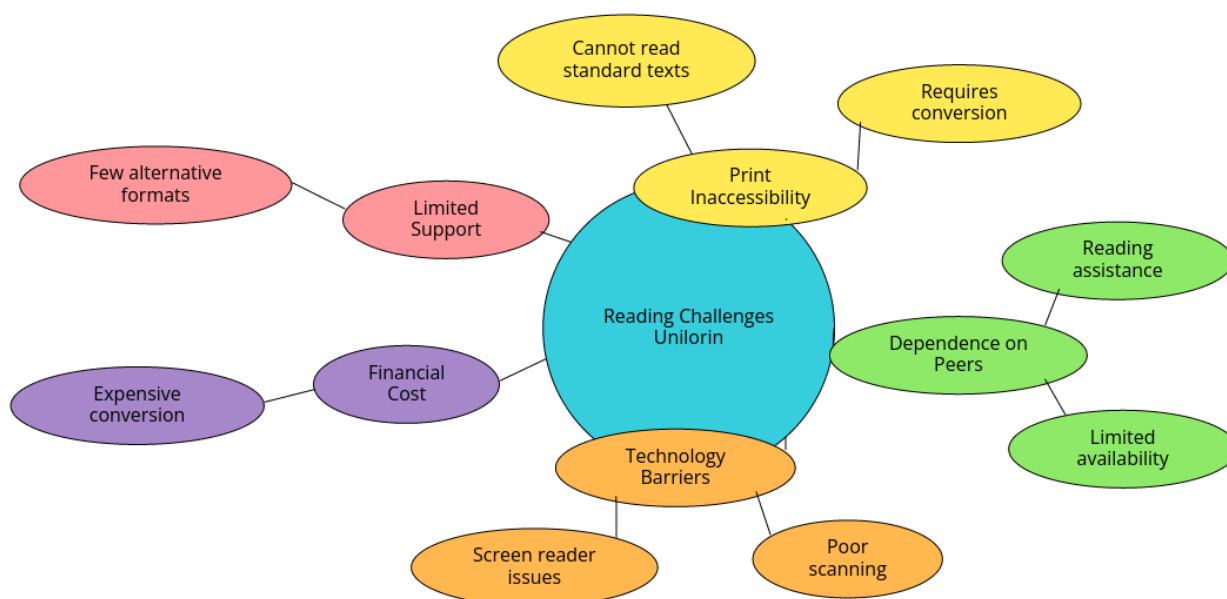
#### **Reading Challenges**

This thematic analysis draws from responses of visually impaired students at the University of Ilorin. The findings reveal that the reading and writing challenges experienced by these students are deeply rooted in accessibility limitations, technological barriers, dependency on sighted assistance, inadequate examination accommodations, financial constraints,

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and institutional support gaps. The data cluster into major themes: inaccessibility of printed materials, overdependence on sighted peers, technological and format-related barriers, financial burden of accessibility, limited institutional provision of alternative formats, time constraints during examinations, inadequate assistive infrastructure, and concerns about academic independence. One dominant theme is the inaccessibility of printed academic materials. Many respondents emphasised that reading standard printed texts is either extremely difficult or completely impossible. Respondent 6 clearly stated, “I cannot read printed materials myself because of my visual impairment,” while Respondents 17, 19, and 20 affirmed that they “can’t see it at all.” Others, such as Respondents 1, 18, and 21, reported experiencing strain and pain when attempting to read printed documents. Respondent 4 further explained that printed materials are not useful unless converted, stressing that there is “no way I can learn from them” without assistance. These responses indicate that conventional print-based instruction significantly restricts independent learning and academic participation.

Closely related is the theme of overdependence on sighted peers and assistants. Several participants disclosed that they rely heavily on friends to read printed materials aloud. Respondent 2 noted that the “lack of sighted guide makes it very difficult,” while Respondent 12 explained that relying on friends is challenging because some are unwilling to help, especially when materials are voluminous. Respondent 6 described situations where friends are unavailable at night or busy with their own studies, making access to materials inconvenient. Although a few respondents (such as 3 and 17) emphasised their desire for independence through assistive applications, the overall pattern suggests that dependency remains a significant academic and emotional burden.



**Figure 2:** A Mindmap Diagram showing the major reading challenges.

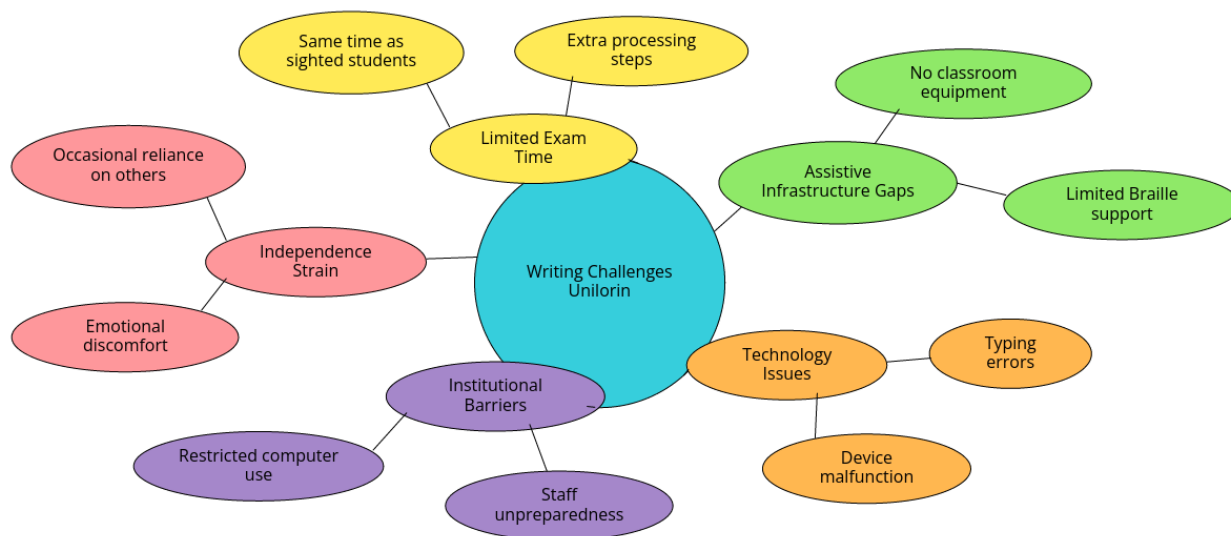
Another major theme emerging from the data is technological and formatting barriers. Most students attempt to convert printed materials into soft copies using scanning applications and screen readers. However, accessibility is often hindered by poorly scanned or improperly formatted documents. Respondent 9 reported that “some academic materials are not accessible for screen readers, especially scanned ones,” while Respondent 16 simply highlighted “inaccurate scanning” as a recurring issue. Respondent 11 also mentioned network failures affecting access to applications, and Respondent 13 pointed to the lack of appropriate devices. In terms of reliability, many students rated their reading methods as “not very reliable,” though a minority (Respondents 17, 18, and 20) described their tools as fully reliable. This variation reflects unequal access to quality assistive technology and digital resources. Financial burden also emerged as a significant theme. Several respondents indicated that converting materials into accessible formats requires additional financial commitment. Respondent 7 stated that he spends “a whole lot of money” converting documents into readable PDFs, while Respondent 12 described taking materials to a café as a “last resort” because it is expensive. These findings suggest that visually

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impaired students incur additional educational costs to access the same materials readily available to their sighted counterparts. Limited institutional provision of alternative formats such as Braille, audio, or properly formatted digital texts was equally evident. While some students access materials through screen readers, Braille, and audio applications, many emphasized that these formats are not consistently available. Respondent 15 noted that reading printed materials is “practically impossible without screen readers or human assistance,” underscoring the need for structured institutional support systems to ensure accessibility.

**Writing Challenges**

Regarding writing challenges, insufficient time during examinations stands out as the most dominant issue. Multiple respondents (3, 4, 6, 7, 12, and 18) emphasized that they are given the same time allocation as sighted students despite requiring additional steps in answering questions. Respondent 6 provided a detailed explanation, noting that blind students must first listen to the question, then comprehend it, and finally write their answer, whereas sighted students read and write simultaneously. Respondent 12 further explained that some supervisors do not understand their situation and expect immediate submission of printed scripts. These responses reveal structural inequities in examination accommodations. The theme of inadequate assistive equipment and institutional preparedness also emerged. Respondent 4 reported that there is “no equipment to write notes in the class,” while Respondent 5 suggested the provision of a Braille embosser to make textbooks and examination questions accessible. Respondent 10 disclosed that some lecturers cannot read Braille and may discourage the use of computers or typewriters during examinations. Respondent 16 summarized this concern as “non-availability of accessible technology.” These findings highlight institutional gaps in supporting inclusive education.



**Figure 2:** Mindmap Diagram Highlighting the illustrating the major writing challenges.

Despite these barriers, many respondents demonstrated resilience through reliance on assistive writing technologies such as typing with screen readers, Braille devices, and dictation software. A significant number described these methods as “very effective” in expressing their ideas clearly (Respondents 4, 5, 6, 7, 10, 16, 18, and 19). However, others reported challenges such as typographical errors, stress, and inefficiency. Respondents 1, 9, 12, and 21 described their methods as “not very effective” or “not really effective,” particularly when technology fails or when dictation assistance is unavailable. Finally, the theme of academic independence and psychological strain emerged. While many students stated that they rarely rely on others to write for them, assistance is sometimes required for filling forms or handling excessive workload (Respondents 1, 7, 8, 15, and 21). Respondent 21 admitted feeling uncomfortable asking for help repeatedly, indicating that dependency can affect self-confidence. Nevertheless, a strong desire for independence was evident across responses, as many participants emphasized that they strive to maximize autonomy through assistive tools. Overall, the thematic analysis reveals that visually impaired students at the University of Ilorin face systemic barriers in reading and writing, particularly in accessing printed materials, securing reliable assistive technology, receiving adequate examination



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accommodations, and obtaining institutional support. Although technological tools offer partial solutions, structural and administrative reforms are necessary to ensure equitable academic experiences.

**Research Question Two:**

How can the Reader App and Raise line paper intervention be implemented in a way that is tailored to the needs of visually impaired students?

**Table 1: Intervention Strategies, Tailoring, and Outcomes for Students with Visual Impairment**

s/no	Intervention	Implementation Strategy	How it was tailored to students' Needs	Outcome of Tailoring
1	TextVision App	InitiA needs an assessment of students' level of visual impairment and digital competence.	App features were customised by adjusting font size, contrast, speech output, reading speed, and navigation commands based on individual learner profiles.	Improved independent reading of learning materials and examination questions
2	Reader App	Progressive training and guided practice	Training moved from basic app navigation to independent reading tasks, allowing students to learn at their own pace.	Increase confidence, autonomy, and effective use of assistive technology.
3	Raised-Line Paper	Orientation to tactile features of raised-line paper	Students were guided on line spacing, margins, and alignment to suit their tactile perception and writing abilities	Better organisation and alignment of written responses
4	Raised-Line Paper	Step-by-step writing practice with facilitator support	Writing tasks progressed from simple exercises to complex responses based on individual learning speeds.	Enhanced handwriting accuracy and structured writing
5	Both Interventions	Continuous monitoring and feedback	Implementation pace and support were adjusted based on students' progress and challenge	Sustained accessibility, learner independence, and inclusive learning

The table indicates that the implementation of the Reader App and raised-line paper interventions was systematic, learner-centred, and responsive to the diverse needs of visually impaired students. The use of an initial needs assessment ensured that individual differences in visual ability and digital competence were identified, allowing each intervention to be appropriately customised rather than uniformly applied. The findings further show that the Reader App was implemented through gradual and structured training, with its features adapted to suit learners' functional requirements. This approach enhanced students' confidence, autonomy, and ability to independently access learning material and examination questions. Similarly, the raised-line paper intervention provided tactile support that was carefully aligned with students' writing abilities, improving spatial organisation, handwriting accuracy, and structured written expression. The combined use of both interventions, supported by continuous monitoring and flexible pacing, promoted accessibility, independence, and inclusive learning. This suggests that tailoring assistive interventions to learners' specific needs is critical for improving academic participation among visually impaired students.

**Research Question three:** Usability and effectiveness of TextVision App

**Table 2: Results Table of usability and effectiveness of TextVision App and Raised-line**

Tool	Variable	Mean ( $\bar{x}$ )	Decision ( $\geq 2.50$ )
Reader App	Ease of Use	3.44	High
	Navigation	3.44	High
	Reading Accuracy	3.11	High
	Independence	3.41	High
	Confidence	3.56	High



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	Grand Mean	3.40	High Usability & Effectiveness
Raised-line Paper	Line Alignment	3.50	High
	Writing Organisation	3.30	High
	Handwriting Accuracy	3.60	High
	Ease of Writing	3.40	High
	Writing Confidence	3.60	High
	Grand Mean	3.48	High Usability & Effectiveness

Both the Reader App and Raised-line Paper showed high usability and effectiveness for visually impaired students, with grand means of 3.40 and 3.48, respectively. The Reader App scored highest in confidence (3.56) and ease of use (3.44), supporting learner autonomy, while reading accuracy (3.11) indicated minor areas for improvement. Raised-line Paper excelled in handwriting accuracy and confidence (3.60) and line alignment (3.50), promoting organised, accurate writing. These tools align well with inclusive education goals (e.g., SDGs 4 on quality education), fostering independence and self-efficacy. The slightly higher mean for the raised-line paper reflects its tactile simplicity, complementing the app's digital strengths. Integrating both tools in blended training is recommended for optimal educational impact.

### Hypothesis

**H<sub>01</sub>:** The TextVision Reader App and Raised-line Paper intervention does not significantly improve academic performance and self-reported confidence in visually impaired students, compared to pre-intervention baselines.

**Table 3: Wilcoxon Signed-Rank Test Summary for Pre- and Post-Intervention**

Variable	Median (Pre)	Median (Post – Week 4)	Z-value	r (Effect Size)	p-value	Decision
<b>Academic Performance</b>	2.01	3.00	-3.82	0.61	< .05	Reject H <sub>01</sub>
<b>Self-Reported Confidence</b>	2.30	3.04	-3.94	0.64	< .05	Reject H <sub>01</sub>
<b>Composite Score</b>	<b>2.04</b>	<b>3.01</b>	<b>-4.01</b>	<b>0.67</b>	<b>&lt; .05</b>	<b>Reject H<sub>01</sub></b>

Table 3 reveals a statistically significant improvement in both academic performance and self-reported confidence among visually impaired students following the TextVision Reader App and Raised-line Paper intervention. Median academic performance scores increased from 2.00 pre-intervention to 3.00 post-intervention ( $Z = -3.82, p < 0.05$ ). Similarly, median confidence scores rose from 2.00 to 3.00 ( $Z = -3.94, p < 0.05$ ). The composite score also showed significant improvement from 2.00 to 3.00 ( $Z = -4.01, p < 0.05$ ), with a large effect size ( $r = 0.67$ ). These effect sizes ( $r > 0.50$ ) across all variables indicate a strong practical impact, confirming that the intervention was both statistically effective and educationally meaningful. Therefore, the null hypothesis was rejected.

**H<sub>02</sub>:** The Reader App and Raised-line Paper intervention do not significantly enhance reading (e.g., accuracy, independence) and writing skills (e.g., organisation, handwriting accuracy) of visually impaired students after two months, compared to pre-intervention baselines.

**Table 4: Summary of Pre-Post Intervention Results for Reading and Writing Skill**

Skill	Pre M (SD)	Post M (SD)	Mdiff	t(df)	p	Cohen's d	Interpretation
<b>Reading</b>	11.4 (0.52)	12.6 (1.43)	1.30	t(9)=3.07	0.013*	0.97	Large effect
<b>Writing</b>	1.38 (0.25)	2.56 (0.17)	1.18	t(9)=11.54	<0.001*	3.64	Very large

The analysis of pre- and post-intervention data reveals significant improvements in both reading and writing skills among visually impaired students following the two-month use of the Reader App and Raised-Line Paper. For reading skills, the mean score increased from 11.4 to 12.6, representing a statistically significant gain ( $t(9) = 3.07, p = 0.013$ ) with a large effect size (Cohen's  $d = 0.97$ ). This indicates that the Reader App contributed meaningfully to the development of reading fluency and comprehension. Even more pronounced improvements were observed in writing skills. The average writing score rose from 1.38 to 2.56 per item, reflecting a highly significant enhancement ( $t(9) = 11.54, p < 0.001$ ) with a very



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large effect size (Cohen's  $d = 3.64$ ). These results demonstrate that the Raised-Line Paper had a substantial and educationally meaningful impact on the students' writing ability, supporting tactile engagement and structural clarity. Thus, both interventions were effective, with writing showing greater relative gains. The findings affirm the value of integrating assistive technology and tactile tools in supporting literacy development for visually impaired learners.

### **Discussion of Findings**

The findings of this study reveal a compelling narrative of challenge and resilience among visually impaired learners at the University of Ilorin. The central challenges identified dependence on others for reading, financial burdens in accessing materials, unreliable assistive technologies, inadequate examination accommodations, and institutional support gaps confirm that the barriers to education are not inherent to the students' impairment. Instead, they are socially constructed through an environment that lacks accessible tools and systemic support. This perspective aligns with the Social Model of Disability, which shifts the focus from individual limitations to the societal structures that create exclusion. The students' voiced frustrations, such as being unable to read independently or facing time constraints during exams, underscore the urgent need for interventions designed to dismantle these disabling barriers rather than accommodate them as inevitable. The inaccessibility of printed materials emerged as a dominant theme, with respondents reporting that standard texts are either impossible to read or physically demanding to read. This forces a heavy reliance on sighted peers, introducing unpredictability and inconvenience into their learning. Technological barriers compound these challenges, as poorly scanned documents and unreliable screen readers hinder access. Financial burden also featured prominently, with students incurring additional costs to convert materials into accessible formats, a cost their sighted counterparts do not bear. Examination practices revealed structural inequities, particularly insufficient time allocations that fail to account for the additional steps visually impaired students require. Inadequate assistive infrastructure and limited institutional preparedness further marginalise these learners. Despite these barriers, students demonstrated resilience through assistive technologies, though effectiveness varied considerably due to inconsistent support. Ultimately, these findings affirm that the barriers visually impaired students face are not inevitable consequences of impairment but products of an environment lacking accessible tools and systemic support. Transforming this environment requires a fundamental shift from viewing accessibility as an accommodation to embedding it as a foundational principle of educational equity.

In direct response to these identified challenges, the intervention introduced two complementary tools: the digital TextVision App and the tactile Raised Lines Paper. Their implementation was not a generic rollout but a carefully tailored process, beginning with a thorough assessment of each student's specific visual needs and digital literacy. This learner-centred approach is fundamental to the principles of Inclusive Education, which advocate for adapting resources and pedagogy to meet diverse needs rather than expecting conformity. For the TextVision App, this meant customising features like speech speed and contrast, while for the Raised Lines Paper, it involved aligning tactile spacing with individual motor skills. This initial customisation was critical, as it ensured the tools were perceived as useful and easy to use from the outset, factors that are central to user acceptance according to the Technology Acceptance Model.

The success of this tailored approach is reflected in the high usability ratings for both tools, which demonstrate their successful integration into the students' academic routines. Students reported that the TextVision App was intuitive to navigate and significantly boosted their confidence in accessing printed materials independently. This perceived ease of use and clear benefit directly fostered a positive attitude toward the technology, a key predictor of sustained adoption. Similarly, the Raised Lines Paper was praised for providing a reliable physical structure for writing, which enhanced handwriting accuracy and organisation. The tactile feedback from the raised lines gave students a sense of control and precision that they previously lacked, reducing the anxiety associated with writing tasks. Together, these tools addressed the core deficits in autonomy and competence that many visually impaired learners experience, as well as the essential psychological needs outlined in Self-Determination Theory.

By satisfying these needs for autonomy and competence, the interventions catalysed a profound shift in the students' academic engagement and self-perception. The quantitative results show statistically significant improvements not only in practical skills but, more importantly, in self-reported confidence. This indicates that the tools did more than facilitate tasks; they restored a sense of agency. Students transitioned from a state of reliance on peers and scribes to becoming



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active, independent agents in their own learning. This empowerment is the cornerstone of intrinsic motivation, where engagement is driven by personal interest and mastery rather than external necessity. The intervention thus moved beyond mere skill development to foster a deeper, more sustainable form of academic participation.

These subjective gains in confidence and agency were matched by substantial improvements in measured academic performance, providing concrete evidence of this transformative impact. The significant gains in both reading and writing skills confirm that the tools are effective pedagogical instruments, not just accessibility aids. The particularly strong effect on writing skills highlights the critical role of tactile guidance in literacy development for visually impaired learners, an area often overlooked in favour of digital solutions alone. These outcomes validate the study's mixed-methods approach, as the qualitative experiences of increased independence and reduced frustration directly correlate with the quantitative metrics of improved scores. This convergence of evidence strengthens the claim that the interventions address the root causes of academic disadvantage.

Importantly, the significance of these findings extends beyond individual achievement to align with broader institutional and global mandates. The University of Ilorin's commitment to an inclusive environment, as enshrined in its disability policy, finds practical expression in this scalable, affordable intervention. By providing a model that enhances autonomy, the study contributes directly to the university's mission of fostering a world-class, equitable learning environment. On a global scale, the intervention resonates with the United Nations Sustainable Development Goals, particularly the aims of ensuring inclusive education and reducing inequality. It demonstrates that with targeted, thoughtful design, educational equity is an attainable goal, even in resource-constrained settings.

## **Conclusion**

This study shows that the barriers facing visually impaired students can be overcome. Using the TextVision App and Raised Lines Paper, the research moved students from dependency to empowerment, removing environmental obstacles, building skills, and restoring confidence. The findings offer a replicable model for other institutions. Future efforts should integrate these tools into standard support systems, provide ongoing training, and involve visually impaired learners in co-designing solutions. True inclusivity, the study concludes, comes from designing education that works for all, not by making exceptions for some.

## **Recommendations**

Based on the findings of this study,

1. The University of Ilorin should institutionalise the provision and sustainable funding of assistive technologies to support visually impaired students.
2. The university should mandate inclusive digital and physical infrastructure to ensure accessibility across learning environments, while implementing structured training and support programmes for both students and staff on the effective use of assistive tools.
3. Inclusive assessment and examination policies should be integrated to promote fairness and independence, alongside the embedding of Universal Design for Learning (UDL) principles in academic practice.
4. In addition, a continuous feedback and review mechanism should be established to assess the effectiveness of support systems, promote awareness, and foster an inclusive campus culture.
5. Finally, the university should develop strategic partnerships with relevant stakeholders to ensure the sustainability and scalability of inclusive education initiatives.

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