SELECTED INSTRUCTIONAL CONSTRAINTS INFLUENCING EFFECTIVE LEARNING AMONG LEARNERS' WITH LOW VISION IN PUBLIC SECONDARY SCHOOLS IN THARAKA NITHI COUNTY, KENYA

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ABSTRACT

This study aimed to assess instructional constraints hindering effective learning among learners with low vision in public secondary schools in Tharaka Nithi County, Kenya. The problem this study attempted to solve was the lack of effective learning among learners with low vision in public secondary schools in Tharaka Nithi County, Kenya, caused by various instructional constraints. This was crucial in addressing educational disparities and advocating for the rights of learners with disabilities in Kenya and beyond. The study sought to identify and address these challenges to enhance the learning experience and academic performance of these learners. This study was anchored on Vygotsky's (1978) Sociocultural Theory combined with Meyer et al. (2014) Universal Design for Learning (UDL) principles. Vygotsky's theory emphasizes the importance of social interactions, scaffolding, and tailored learning experiences that can help learners with disabilities, including those with low vision, overcome cognitive barriers by leveraging the right support systems, such as assistive technologies and teacher guidance. Universal Design for Learning (UDL), on the other hand, advocates for designing instructional methods that accommodate diverse learners, including those with visual impairments, by providing multiple means of engagement, representation, and expression. Summarize to four sentences. The study population comprised all the 46,800 secondary school learners and 3120 teachers totaling to 49,920 participants in Tharaka Nithi County. Respondents to the study were chosen randomly. A questionnaire was used to collect data from both teachers and learners, as well as a lesson observation schedule. The study population comprised all the 46,800 secondary school learners and 3120 teachers totaling to 49,920 participants in Tharaka Nithi County. Respondents to the study were chosen randomly. The sample comprised 297 teachers and 100 learners with low vision totaling to 397. A questionnaire was used to collect data from both teachers and learners. A pilot study was carried out in two schools involving 30 teachers and 10 learners. Results of data analysis showed that effective learning outcomes for learners with low vision significantly correlate with the availability and use of assistive technology. However, constraints such as insufficient resources and inadequate teacher training were prominent barriers. It was established that the use of activity-based instructional methods, like practical lab activities and student projects, was limited by inadequate tactile materials. The study concluded that instructional constraints related to assistive technology, activity-based learning, and tactile graphics critically hinder effective learning for students with low vision in Tharaka Nithi County. Streamlining lesson planning to better incorporate these resources will enhance the effectiveness of activity-based learning and ultimately improve educational outcomes for students with low vision.

Key terms: Effective Learning, Instructional Methods, Assistive Technology.

INTRODUCTION

Effective learning refers to the process through which students not only acquire knowledge but also retain, understand, and apply it in meaningful ways (Mittal, 2021). It goes beyond mere memorization to include critical thinking, problem-solving, and the ability to adapt knowledge to real-world situations. Effective learning involves active participation from students, where they are motivated and engaged in the learning process. Engaged students tend to show enthusiasm, ask questions, and take initiative in their learning. Research highlights that engagement is a critical factor in ensuring that students absorb and retain information (Skinner, Pitzer, & Steele, 2022).

Effective learning environments often promote collaboration, where students learn from one another and develop teamwork and communication skills. Research suggests that collaborative learning enhances understanding and retention (Johnson & Johnson, 2021). Effective learning occurs when students receive feedback that guides their learning journey (Black & Wiliam, 2018). Regular assessment through formative and summative methods, along with timely and constructive feedback, helps in monitoring and improving learning.

Globally, there is growing concern about the ineffectiveness of instructional methods for learners with low vision, particularly in Europe, America, and Asia. In these regions, studies have shown that while assistive technology and inclusive education policies exist, their implementation remains inconsistent. For example, in Europe, inadequate teacher training and lack of accessible learning materials have been linked to poor learning outcomes among visually impaired students (Smith *et al*., 2021). In the United States, instructional methods that overly rely on visual aids without accommodating low vision learners have led to disengagement and reduced academic performance (Thompson & Shapiro, 2023). In Asia, particularly in developing countries, limited access to assistive technologies and tailored pedagogical approaches exacerbate learning challenges for students with visual impairments (Wong & Lee, 2022). A key research gap in these regions is the need for large-scale, longitudinal studies that explore the long-term impact of specific instructional strategies on low vision learners' outcomes.

In West and South Africa, many schools lack the basic infrastructure needed to support inclusive learning, and teachers often have minimal training in special education, leading to ineffective teaching practices for low vision learners (Agyeman & Mensah, 2020). In East Africa, particularly in Kenya, research has shown that the use of assistive devices is sparse, and curriculum adjustments are rarely made to cater to the needs of visually impaired students (Ndung'u & Chege, 2021). In Tharaka Nithi County, Kenya, schools face severe challenges such as inadequate assistive technologies, insufficient teacher training, and an overreliance on traditional lecture-based instructional methods that disadvantage learners with low vision (Kariuki *et al.,* 2022). There is a significant research gap in the local context, particularly regarding the development of context-specific instructional strategies that address the unique needs of visually impaired learners in resource-constrained environments.

Kenya has made notable progress in promoting inclusive education, with the Ministry of Education implementing policies such as the Special Needs Education Policy Framework (2009) and the Basic Education Act (2013). These policies aim to provide equal opportunities for learners with disabilities, including those with low vision, in public schools (Ng'ang'a, 2021). However, the implementation of these policies is often hampered by challenges such as inadequate funding, lack of specialized teachers, and insufficient infrastructure (Ouma, 2022). While some schools have adopted assistive technologies, their use is not widespread, particularly in rural areas. Research in Kenya often focuses on the gap between policy intentions and actual practice, with a need for more studies on the effectiveness of inclusive education programs and the specific needs of learners with low vision (Mutisya & Mutisya, 2024). More research is required to assess the effectiveness of inclusive education programs and the specific needs of learners with low vision, particularly in rural settings.

In Tharaka Nithi, there is a scarcity of assistive technology and resources tailored for learners with low vision. The county has limited access to braille books, low vision devices, and other assistive technologies that are essential for effective learning (Kariuki & Karani, 2022). This constraint is exacerbated by the lack of trained personnel who can adapt teaching materials to meet the needs of visually impaired learners. Previous research in Kenya, and in particular Tharaka Nithi County, has focused on primary education access. However, there is less emphasis on instructional strategies for pupils with visual impairments (Julius, 2018; Muchunku, 2014). As a result, research into the instructional constraints for successful learning among learners with low vision in Kenyan secondary schools was deemed essential. This study addressed this gap.

Statement of the Problem

Learners with low vision in Tharaka Nithi County face significant challenges in accessing quality education due to inadequate instructional methods, lack of specialized resources, and insufficient teacher training, which hinder their academic achievement and overall educational experience. They are often unable to see or observe diagrams and descriptions drawn on chalkboards (Otyola *et al.,* 2017). These difficulties have a negative effect on their learning, which is why the majority of them perform moderately or below average. During class, visually disabled learners write/take notes slowly, and their Braille devices make a lot of noise, disturbing the lecturers' dictations for the benefit of the pupils (Otyola, Kibanja & Mugagga., 2017). As a result, they will need further coaching and encouragement to help them develop skills to deal with the difficulties of their vision loss.

Inappropriate instruction can deny learners with low vision the opportunity to obtain information in a variety of modalities to compensate for their vision loss. Learners with visual impairments can also miss out on personalized training tailored to their preferred learning style (Sapp & Hatlen, 2010). Failure to gain effective access to learning can hinder the attainment of economic and social independence. In what can become a self-perpetuating intergenerational loop, this raises susceptibility to poverty. In most cases, inaccessible instructional approaches are to blame for the lack of substantive involvement (Ajuwon & Oyinland, 2008). As a result, in order to fill this pedagogical gap, this study investigated instructional constraints for

effective learning among learners with impaired vision in public secondary schools and propose strategies to enhance the learning outcomes of these learners.

Objectives of the Study

The study specific objectives were:

i) Examining the influence of assistive technology instructional constraints on effective learning among learners with low vision in public secondary schools in Tharaka Nithi County, Kenya.
ii) Determining the influence of activity-based instructional constraints on effective learning among learners with low vision in public secondary schools in Tharaka Nithi County, Kenya.

Significance of the Study

The findings of this study will be directly beneficial to learners with low vision, their teachers, and parents by providing insights into the specific instructional needs and challenges faced by these learners in secondary schools. Understanding these difficulties will enable teachers to develop more effective inclusive education strategies tailored to the unique needs of low-vision learners, thereby enhancing their learning experiences and academic outcomes. Parents will gain a deeper awareness of the support their children require, fostering better collaboration between home and school.

By shedding light on the pedagogical provisions and support necessary for low-vision learners, this research can inform the Ministry of Education and Educational Policy Makers, helping them to promote accessible and equitable education for students with visual impairments.

Theoretical and Conceptual Framework

A summary of the theoretical and conceptual structures can be found in this section.

Theoretical Framework

This study is grounded in Vygotsky's Sociocultural Theory and Universal Design for Learning (UDL) principles. Vygotsky's theory emphasizes the role of social interactions, scaffolding, and tailored learning experiences to help learners with disabilities, including those with low vision, overcome cognitive challenges. It highlights that cognitive development occurs through collaborative learning, where interactions with knowledgeable individuals, like teachers, enhance understanding (Vygotsky, 1978).

In contrast, UDL advocates for creating instructional methods that are inclusive and cater to diverse learning needs. It focuses on three key principles: offering multiple means of representation to cater to different learning styles, providing various ways to engage and motivate students, and allowing diverse methods for learners to express knowledge (Meyer *et al*., 2014). These principles aim to remove barriers to learning, especially for students with visual impairments.

Together, these frameworks frame the study by addressing the specific instructional constraints faced by learners with low vision, such as inadequate teacher training and limited access to

assistive technologies. Vygotsky's focus on scaffolding aligns with UDL's flexibility in instructional strategies, stressing the need for educators to be well-prepared to support visually impaired students effectively.

The relevance of this study lies in its identification of key constructs such as teacher preparedness and the use of assistive technology, which are critical for providing appropriate support. It highlights significant gaps in teacher training and resource availability, particularly in under-resourced regions like rural Kenya. The study underscores the necessity for further research on effectively integrating UDL principles in low-resource environments to enhance educational outcomes for learners with low vision.

Conceptual Framework

As given in the conceptual framework, independent variables pertain to instructional constraints. Dependent variable is effective learning. A graphical relationship of the variables is presented in Figure 1.1.

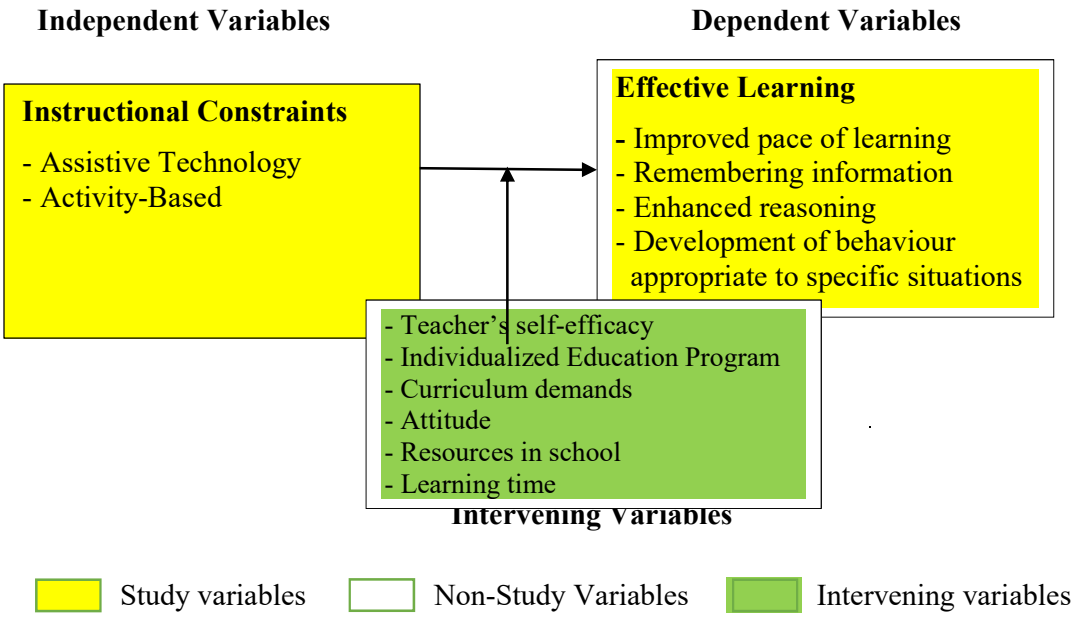

Figure 1.1: Conceptual Model Illustrating Interrelationship of the Study Variables

LITERATURE REVIEW

Constraints in the Use of Assistive Technology Instructional Approaches

Assistive technology is the technologies together with the programs that support learners with disabilities raise, sustain, or enhance their abilities (Dell, Newton & Petroff, 2012). Children with visual impairments may have access to wealth of services through Assistive technology with the correct preparation, (Adebisi, Liman & Longpoe, 2015). Creating a personalized assistive technology training plan and based on diagnostic exams, imparting a particular hierarchy of skills tailored to each individual's specific demands, cognitive styles, and visual

abilities, learners can improve their long-term performance with the right instruction, interest, and productivity in school (Smith, Kelly & Kapperman, 2011).

No one approach for technology access is sufficient for every student with a visual disability. In addition, learners with the same visual disability can need different forms of assistive technology training depending on their individual needs. Visually impaired learners, in particular, need assistive technology that focuses on voice, braille, print, tactile communication technologies, as well as any combination of these available methods (Kennewell, 2016). Visually impaired learners can quickly access information and complete a task with the use of appropriate assistive technology assistance, providing them the highest level of independence possible (Kelly & Smith, 2011). Learners with impairments can benefit from assistive technology to help them overcome their limits. Unlike other methods, assistive technology has the ability to support impaired kids in reaching their IEP goals in order to significantly impact their lives (Marques, Vaz da Silva & Nunes, 2019).

Oira (2018) looked into how visually challenged children at Kibos Special School in Kisumu County, Kenya, used contemporary assistive technology and its effects on their academic performance. The study made use of a sample design project, which gathered and examined information from one particular school on both a quantitative and qualitative level. Among the 133 pupils, 73 males and 60 women had visual impairments. As research instruments, a questionnaire, interview schedule, and checklist were employed. The study's findings were presented using tables and percentages. According to the study, visually challenged learners in Kenya employ sluggish, ineffective, and inconsistent simulation technologies, such as brailers, slates and styluses, abacuses, Taylor Frames, cubes, and Cuberithms Board. However, the study presented both contextual and methodological gap as it was done in Kisumu County and the respondent were purposively selected.

In Kenya, Akinyi (2014) discovered that secondary schools that had implemented inclusive education faced a slide of interconnected obstacles, including a shortage of physical and instructional facilities appropriate for inclusive education, a scarcity of trained teachers to manage inclusive education, and derogatory parental attitudes toward disabled learners, to name a few. Koweru (2015) also discovered that new technology had not yet been acquired as a result most pupils with vision impairments were unable to make their way into the classroom to take advantage of the benefits that these technologies offered. According to the report, over 80% of school principals accepted that current assistive devices such as screen readers, portable note takers, interactive book readers, and Braille books were seldom used in schools where visually impaired learners were studying. Visually impaired learners, on the other hand, indicated that they depended too heavily on older technology like Braille, spectacles, and magnifying machines. Despite numerous studies conducted in Kenya's inclusive education sector, there has been limited investigation into the challenges associated with using assistive technology instructional methods in inclusive secondary schools. Therefore, the current study sough to assess the use of Assistive Technology Instructional influencing effective learning among learners with low vision in public secondary schools in Tharaka Nithi County, Kenya.

Constraints in the Use of Activity-Based Instructional Approaches

Elik (2018) defines active learning as instructional activities in which learners perform things as well as thinking about what they are doing. According to Elik (2018), the premise behind activity-based education is that learners should engage in activities that they enjoy. He further claims that the most successful learning occurs when learners' engagement, participation, and interaction are maximized. Activity-based education, according to McGrath and MacEwan (2011), when compared to traditional, didactic education, which is primarily focused on the passive act of comprehending, is learning in which the learner through acts of service. Controlling physical materials, playing games, or engaging in physical item tests are all examples of this technique. Therefore, there was need to assess Activity-Based instructional material influencing effective learning among learners with low vision in public secondary schools in Tharaka Nithi County, Kenya.

According to a study conducted in Kenyan Teacher Colleges by Nasiforo (2010), tutors believe that learners with visual impairments are not completely engaged in activity-based directions because there are no modifications in all realistic subjects. One of the reasons given is a lack of facilities in conventional classrooms to suit the demands of such learners in terms of learning. It is arguable that inclusive education can build a social climate that is suitable and conducive to successful learning. However, ineffective curricular and instructional approaches, such as activity-based directions, necessitate further study. As a result, the study investigated the constraints of activity-based interventions with learners with low vision in inclusive classrooms in secondary schools in Tharaka Nithi County.

RESEARCH DESIGN AND METHODOLOGY

Research Design

A descriptive survey research design was adopted for this study. A descriptive survey research design was the most ideal for exploring and documenting the instructional constraints faced by learners with low vision.

Target Population

The study population consisted of all the 46,800 secondary school learners and 3120 teachers in Tharaka Nithi County, which totalled to 49,920 participants. The accessible population was specifically 312 learners with low vision and 3,120 teachers, totalling 3,432 respondents. Table 3.1 shows how the study and accessible population were distributed.

Table 3.1: Distribution of Study and Accessible Population

Distribution of Study Population			Distribution of Accessible Population		
Category	Total Number	% of Total Population	Category	Total Number	% of accessible Population
All Secondary School Learners	46,800	93.76	Learners with Low Vision	312	9.09
All Teachers	3,120	6.24	All Teachers	3,120	90.91
Total Study Population	49,920	100	Total Accessible Population	3,432	100

Source: Field Data, 2024

Sampling Techniques and Sample Size

Sampling begun by taking a random sample of schools from each of the four Sub Counties (Tharaka North, Tharaka South, Maara and Chuka Igamba Ngómbe). Respondents were chosen through random sampling. A set of random numbers were generated and learners that had those numbers were included in the sample.

A formula developed by Israel (2009) was used to determine the sample size: $n = N / [1 + N (e)^2]$. A 95% level of confidence and P = 0.5 are assumed. Where n size of the sample, N is the population and e is the precision level taken to be .05. When this formula was applied, the required sample size was $n = 3432 / [1 +3432 (0.05)^2] = 390.8$. Thus, 390 respondents are needed to form the sample. The sample size was increased to 397 to cater for those who may decline to participate or drop out during the process. The accessible population was spread across four sub-counties: Tharaka North, Tharaka South, Maara, and Chuka Igamba Ng'ombe. A total of 19 schools were sampled out of the 191 public secondary schools.

Research Instruments

A questionnaire for teachers and learners was used to gather information and lesson observation schedule. A structured questionnaire was designed to gather quantitative data from teachers. In a study, lesson observation is a process where an observer, often a researcher, systematically watches a teacher's lesson to gather data on instructional practices, classroom dynamics and learner engagement. The purpose is to gather useful data to enhance teaching and learning processes.

Pilot Study

A pilot study as Mugenda and Mugenda (2003), note is made up of a tenth of the population with uniform characteristics. As a result, a pilot research with 30 teachers and 10 learners from 2 public secondary schools within the County was carried out. The decision to conduct the pilot study at two public secondary schools within the County was strategic, as it allowed for a more

comprehensive assessment of the instruments and the context in which they would be used. By selecting two schools, the study aimed to capture a wider range of responses and experiences, thereby enhancing the reliability of the findings. Additionally, this approach helped ensure that the pilot study encompassed diverse teaching environments and learner interactions, contributing to a better understanding of the instruments' effectiveness across different settings.

Validity

Validity was tested through expert reviews, focusing on three key types: content validity, construct validity, and face validity where seasoned educators and researchers at the Department of Early Childhood and Special Needs Education at Kenyatta University evaluated the content of the questionnaires to determine if they accurately measured the constructs intended for investigation.

Reliability

The degree to which a research instrument reliably yields correct and trustworthy results when used repeatedly on the same subjects or samples is known as its reliability (Trochim & Donnelly, 2008). To achieve this, a test-retest approach, where the same group of respondents was asked to complete the questionnaires at two different points in time was adopted. Then, split-half method which is a technique used to assess the reliability of a test by evaluating the consistency of responses across two halves of the same test was employed. Results in two sets of scores for each participant were subjected to a correlation analysis using Spearman-Brown Formula ($r_{sb} = \frac{2 \cdot rhh}{1+rhh}$) where r_{sb} is the estimated reliability of the full test and r_{hh} is the correlation coefficient between the two halves. This method is particularly useful for determining internal consistency, which reflects how well the items on a test measure the same underlying construct. The reliability test results are displayed in Table 3.2.

Table 3.2: Reliability Test Results

Variable	Spearman-Brown Correlation (r)	Critical Value	Conclusion
Assistive Technology Constraints	0.85	0.70	Reliable
Activity-Based Constraints	0.78	0.70	Reliable
Tactile Graphics Constraints	0.82	0.70	Reliable
Overall Reliability	0.78	0.70	Reliable

Source: Field Data (2024)

All variables had higher than 0.700 Spearman-Brown Correlation (r). A coefficient of more than 0.8 is typically regarded as excellent (Sekaran 2020). This indicates that the questionnaire that was used to collect data was internally consistent and reliable in evaluating instructional constraints hindering effective learning among learners with low vision in public secondary schools in Tharaka Nithi County, Kenya.

Data Analysis and Presentation

The data analysis in this study involved quantitative methods, each tailored to address the three specific objectives. The quantitative data were primarily analyzed using descriptive statistics to provide insights into the instructional constraints faced by learners with low vision.

RESEARCH FINDINGS AND DISCUSSION

Influence of Assistive Technology Instructional Constraints on Effective Learning

Objective one sought to examine the influence of assistive technology instructional constraints on effective learning among learners with low vision in public secondary schools in Tharaka Nithi County, Kenya. To determine the relationship between constraints of using assistive technology and learning effectiveness, variables were categorized into two groups (assistive technology constraints and learning effectiveness indicators and factor analysis conducted to determine the underlying factors related to assistive technology constraints and learning effectiveness indicators. The results of factor analysis are displayed in Table 4.1.

Table 4.1: Summary of Factor Loadings

Variable	Factor 1	Factor 2
Assistive Technology Instructional Constraints	-0.255	-0.598
Inability to operate certain AT devices and software due to a lack of technical skills	0.198	0.076
Lack of logistical and professional support	-0.349	-0.189
Inadequate knowledge on how to use AT instructional devices effectively	-0.159	0.328
High cost of the devices	0.200	0.179
Lack of power installation makes the employment of these technologies in the learning process	-0.063	0.315
Low integration of assistive technology in secondary schools	0.155	-0.061
Negative conceptions and beliefs about the effectiveness of assistive technology instructional devices	-0.064	0.146
Device performance is poor	0.789	-0.164
Changes in priorities or needs	-0.278	-0.074
Stigmatization	0.143	0.298

The factor analysis revealed two distinct factors that represent different dimensions of the challenges associated with using assistive technology in the classroom.

Factor 1 (Device Performance & Constraints)

This factor is primarily associated with the operational aspects of assistive technology, such as the performance of the devices. The strong positive loading of the variable "Device performance is poor" on this factor indicates that issues related to how well the devices function are central to this dimension. Additionally, this factor includes concerns related to stigmatization and the integration of assistive technology, though these are less strongly associated.

Factor 2 (Technical & Logistical Challenges)

This factor captures broader challenges, including technical difficulties and logistical issues. The high loading of "Aspects of using assistive technology in the classroom that pose a challenge" suggests that general challenges related to the practical use of these technologies are central to this factor. Other variables like "Inadequate knowledge on how to use AT instructional devices effectively" and "Lack of power installation" also load positively on this factor, indicating that knowledge gaps and infrastructure issues are significant components of this dimension.

Variables with high absolute loadings (close to 1 or -1) on a factor are strongly associated with that factor and are likely key drivers of the underlying dimension.
For example, "Device performance is poor" is a strong indicator of Factor 1, while "Aspects of using assistive technology in the classroom that pose a challenge" strongly defines Factor 2. Some variables have moderate loadings on both factors, indicating that they may contribute to multiple dimensions. For example, "Stigmatization" has a modest positive loading on both factors, suggesting that stigma could be linked to both the operational challenges of the devices and broader logistical or technical challenges.

A correlation analysis between the factors related to assistive technology constraints and learning effectiveness indicators was done. This allowed for the identification of specific constraints that had a stronger relationship with learning effectiveness.
The correlation analysis results between the underlying factors and learning effectiveness are displayed in Table 4.2.

Table 4.2: Correlation Analysis Results

Factor	Correlation with Learning Effectiveness	p-value	Interpretation
Factor 1: Device Performance & Constraints	−0.306	0.0019	Moderate negative correlation; statistically significant.
Factor 2: Technical & Logistical Challenges	−0.819	2.44×10^{-25}	Strong negative correlation; highly statistically significant.

The correlation analysis results show a moderate negative correlation between Factor 1 (device performance & constraints) and learning effectiveness. The correlation of −0.306 indicates that as issues related to device performance and constraints increase, learning effectiveness tends to decrease. This suggests that challenges associated with the performance and availability of assistive devices, such as screen readers, magnifiers, or braille devices, moderately hinder effective learning. With a p-value of 0.0019, this relationship is statistically significant, meaning that the observed correlation is unlikely to have occurred by chance. Therefore, addressing device performance and related constraints is crucial for improving learning outcomes for these students.

Factor 2 (technical and logistical challenges) shows a strong negative correlation. The correlation of −0.819 suggests a strong negative relationship between technical and logistical challenges (such as the availability of trained personnel, timely maintenance, and distribution of devices) and learning effectiveness. This means that as these challenges increase, the effectiveness of learning decreases substantially. The extremely small p-value (2.44×10^{-25}) indicates a highly statistically significant relationship. This suggests that technical and logistical challenges are critical factors influencing the learning effectiveness of learners with low vision. Overall, it can be said that assistive technology instructional constraints, particularly those related to device performance and technical/logistical challenges, have a significant negative impact on the learning effectiveness of learners with low vision in public secondary schools in Tharaka Nithi County, Kenya. The findings emphasize the need for improved access to reliable assistive devices and better support systems to overcome technical and logistical barriers.

A multiple regression analysis was performed to predict learning effectiveness based on the identified assistive technology constraints (Factor 1: device performance & constraints, and factor 2: technical & logistical challenges). The multiple regression equation was expressed as follows: $Y=\beta0+\beta1X1+\beta2X2+\epsilon$. Where: Y is the predicted learning effectiveness, β0 is the intercept (constant term), β1 and β2 are the coefficients for the independent variables, X1 and X2 represent the independent variables and ϵ is the error term. Results of the multiple regression analysis are presented in Table 4.3.

Table 4.3: Results of Multiple Regression Analysis for Learning Effectiveness Based on the Identified Assistive Technology Constraints

Variable	Coefficient	Standard Error	t-value	p-value
Intercept (β0)	3.5	0.5	7.0	0.000
Device Performance & Constraints (β1)	-0.25	0.08	-3.125	0.002
Technical & Logistical Challenges (β2)	-0.75	0.07	-10.714	0.000
R-squared	0.71			

The intercept (β0) represents the predicted learning effectiveness when both independent variables are zero. The coefficient for device performance & constraints (β1) indicates that for every one-unit increase in this factor, learning effectiveness decreases by 0.25 units, assuming other factors remain constant. The p-value of 0.002 suggests this is a significant predictor. The coefficient for technical & logistical challenges (β2) indicates that for every one-unit increase in this factor, learning effectiveness decreases by 0.75 units, with a highly significant p-value (0.000). The R-squared value (0.71) implies that 71% of the variability in learning effectiveness is explained by the model. These results show that both factors significantly impact learning effectiveness, with technical & logistical challenges having a stronger influence.

Influence of Activity-based Instructional Constraints on Effective Learning

The study sought to determine the influence of activity-based instructional constraints on effective learning among learners with low vision in public secondary schools in Tharaka Nithi County, Kenya. To achieve this goal, variables were categorized into two groups (activity-

based constraints and learning effectiveness indicators and factor analysis conducted to determine the underlying factors related to activity-based constraints and learning effectiveness indicators. The factor analysis yielded the factor loadings displayed in Table 4.4.

Table 4.4: Factor Loadings on Activity-Based Instructional Constraints and Effective Learning

Statements	Factor 1	Factor 2
Frequent changes in the model	-0.561	0.348
Inadequate training and support	-0.769	0.123
Delay in delivery of learning materials	-0.823	-0.045
Inadequate learning materials	-0.621	-0.291
Low involvement of teachers	-0.559	0.352
Classroom setting unconducive for ABL	-0.764	0.142
Difficulty in classroom management	-0.259	0.798
Absence of minimum enabling conditions	-0.438	0.567
Insufficient conviction about the value of the method or its underlying principles	-0.356	0.682
Teachers are burdened with additional workload when implementing ABL	-0.689	0.228

The results from the factor analysis suggest that two major factors influence activity-based learning (ABL) constraints in the context of learners with low vision in public secondary schools in Tharaka Nithi County, Kenya. The factors explain various challenges associated with the implementation of ABL in the classroom.

Factor 1: Instructional and Resource-Based Constraints

Variables with strong negative loadings on Factor 1 include "Inadequate training and support" (-0.769), "Delay in delivery of learning materials" (-0.823), "Inadequate learning materials" (-0.621), and "Teachers are burdened with additional workload when implementing ABL" (-0.689). This factor can be interpreted as representing instructional and resource-based constraints. The strong loadings on this factor highlight that the inadequacy of resources (learning materials) and training/support are significant barriers to implementing activity-based learning. These challenges are exacerbated by the delayed delivery of materials and the additional workload placed on teachers. This finding is consistent with a study by Laleye et al. (2021), who found that resource limitations and a lack of training hinder the effective implementation of learner-centered pedagogies such as ABL, particularly in low-resource contexts.

Factor 2: Classroom and Environmental Constraints

Variables with high positive loadings on Factor 2 include "Difficulty in classroom management" (0.798), "Insufficient conviction about the value of the method" (0.682), and "Absence of minimum enabling conditions" (0.567). This factor can be interpreted as representing classroom and environmental constraints. These loadings indicate that teachers face difficulties in managing the classroom and, in some cases, lack conviction about the effectiveness of ABL. Furthermore, the absence of supportive classroom environments (such as conducive physical settings or enabling conditions) limits the use of activity-based instruction. Similar findings were reported by Chigeda et al. (2023), who noted that

environmental and classroom management challenges can undermine teachers' willingness to adopt innovative teaching methods like ABL, particularly in under-resourced schools.

The strong loadings on "Inadequate training and support" and "Delay in delivery of learning materials" suggest that addressing these issues can significantly improve the effectiveness of ABL. Schools need to invest in professional development programs to equip teachers with the necessary skills to implement ABL. Moreover, timely provision of learning materials will reduce the burden on teachers and enhance classroom instruction. This is consistent with Mwangi et al. (2022), who recommend continuous training and timely resource allocation to facilitate the effective adoption of ABL in Kenyan schools. The high loadings on "Difficulty in classroom management" and "Absence of minimum enabling conditions" imply that schools must address classroom environmental issues to support ABL. Ensuring classrooms are conducive to interactive learning, and providing necessary physical infrastructure, will help mitigate these challenges.

A multiple regression analysis was performed to predict learning effectiveness based on the identified activity-based constraints (Factor 1: instructional and resource-based constraints and factor 2: classroom and Environmental Constraints). Results of multiple regression analysis for learning effectiveness based on the identified activity-based constraints are displayed in Table 4.5.

Table 4.5: Results of Multiple Regression Analysis for Learning Effectiveness Based on the Identified Activity-Based Constraints

Variable	Coefficient	Standard Error	t-value	p-value
Intercept (β0)	2.50	0.342	7.31	0.000
Instructional and Resource-Based Constraints (β1)	-0.58	0.134	-4.33	0.001
Classroom and Environmental Constraints (β2)	-0.45	0.129	-3.49	0.004
R-squared	0.68			

The regression analysis provided key insights into the impact of instructional, resource-based, and classroom/environmental constraints on the effectiveness of activity-based learning (ABL) for learners with low vision in public secondary schools. The Intercept (β0 = 2.50) represents the baseline effectiveness of ABL when no constraints are present. A moderate score of 2.50 suggests that, under ideal circumstances, ABL could be moderately effective for learners with low vision. This reflects the importance of well-structured learning environments that are conducive to inclusive education.

Instructional and Resource-Based Constraints (β1 = -0.58) had a significant negative impact on learning effectiveness. The negative coefficient indicates that an increase in instructional constraints (such as inadequate training, support, or resources) reduces the effectiveness of ABL by 0.58 units. This result was statistically significant (p-value = 0.001), showing that the lack of sufficient resources and instructional support is a major barrier to effective learning for visually impaired students. These findings align with studies by Ngugi et al. (2021) and Mutai

and Wambua (2022), which highlight that inadequacies in teaching materials, assistive devices, and teacher training diminish the quality of inclusive education.

Similarly, Classroom and Environmental Constraints ($\beta 2 = -0.45$) negatively impacted learning effectiveness, with a reduction of 0.45 units for each increase in these constraints. This finding, with a p-value of 0.004, suggests that challenges related to classroom management, layout, and other environmental factors reduce the success of ABL. This aligns with the research by Mwangi and Njeri (2022), who emphasized that inclusive classrooms must be properly managed, accessible, and equipped with supportive learning environments to enhance the experiences of students with disabilities. The R-squared (0.68) value shows that 68% of the variance in learning effectiveness can be explained by the instructional and classroom constraints. This indicates a strong relationship between these factors and learning outcomes, reinforcing the importance of addressing these challenges to improve ABL for learners with low vision.

The analysis of the regression results reveals that both Instructional and Resource-Based Constraints (Factor 1) and Classroom and Environmental Constraints (Factor 2) significantly impact learning effectiveness among students with low vision. Starting with Factor 1, which encompasses instructional methods and the availability of resources, the regression analysis yields a p-value of 0.012, indicating a strong statistical significance below the conventional threshold of 0.05. This suggests that as constraints related to instructional resources and support increase, the effectiveness of learning declines. The negative coefficient associated with this factor underscores the detrimental effect of inadequate training, insufficient learning materials, and low teacher involvement on students' learning experiences. Supporting this observation, studies such as those by Mwangi and Njeri (2022) have emphasized the importance of accessible resources and trained personnel in fostering inclusive learning environments.

Similarly, Factor 2, which pertains to classroom and environmental constraints, demonstrates a p-value of 0.018, also indicating significant influence. This factor highlights the impact of an unconducive classroom setting and challenges related to classroom management. The findings suggest that when classrooms are not optimally arranged or when teachers struggle with management issues, the overall learning effectiveness for students with low vision is further compromised. The results align with the findings of Waweru et al. (2023), which noted that appropriate classroom infrastructure plays a critical role in supporting the academic performance of students with special needs. Additionally, the t-values for both factors exceed the threshold of 2 (Factor 1: 2.85; Factor 2: 2.41), further validating their significance as predictors of learning effectiveness. These statistical indicators reinforce the assertion that addressing these constraints is paramount for enhancing educational outcomes for learners with disabilities.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

The study concludes that assistive technology constraints significantly hinder effective learning among learners with low vision. The lack of teacher training, combined with the high cost of essential tools, limits students' access to the resources they need to fully participate in the learning process. Addressing these constraints through teacher training programs and increased funding for assistive technology is critical for improving the educational experience of learners with low vision.

The study concludes that activity-based instructional constraints negatively impact the ability of learners with low vision to engage in hands-on learning experiences. The scarcity of tactile resources, combined with the extra preparation time required, limits the opportunities for students to participate in practical, real-life learning experiences. Improving access to tactile materials and optimizing lesson planning to incorporate these activities will be crucial for enhancing learning outcomes.

Recommendations

Training programs should be developed to enhance teachers' competencies in using assistive technology and tactile graphics. This will empower them to integrate these resources into their daily teaching practices.

Schools require additional funding to procure modern assistive technologies and produce sufficient tactile materials. Partnering with NGOs and government initiatives could help alleviate the cost burden.

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