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Effectiveness of Synchronous and Asynchronous Learning among Trainees with Visual Impairment in Public Technical and Vocational Education and Training Institutions in Kenya.

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Abstract

Education is a fundamental right for all individuals, including those with disabilities. Trainees with disabilities, like all other learners, are entitled to quality education and should be included in all forms of learning, including synchronous and asynchronous. In the 21st century, technology plays a critical role in education, and these learning models are designed to offer unique educational opportunities for every learner, including those with visual impairments. While synchronous and asynchronous learning hold the promise of flexible and accessible learning experiences, they can also present barriers for trainees with visual impairments. Supporting these learners effectively has become a vital responsibility for educational institutions. This study, therefore, focused on assessing the effectiveness of synchronous and asynchronous learning among trainees with visual impairments in public Technical and Vocational Education and Training (TVET) institutions in Kenya. The study specifically examined the accessibility of digital resources for synchronous learning, evaluated the accessibility of digital resources for asynchronous learning, and explored trainers' preparedness to support trainees with visual impairments in both learning modes. A mixed-methods research design was adopted, combining both quantitative and qualitative approaches. The findings revealed varying levels of effectiveness in digital learning platforms for visually impaired trainees. While some trainees reported improved comprehension and access, others encountered significant challenges, including limited platform availability, inaccessible content formats, and feelings of social isolation. Peer interaction was moderate, indicating some engagement but leaving room for improvement. Despite these challenges, the study provides meaningful insights particularly the need for screen reader compatibility, accessible content formats, and clearer instructional design. The findings underscore both the potential and current limitations of digital tools in fostering inclusive education and point to actionable areas for improvement in public TVET institutions.

Key words: Asynchronous learning, effectiveness, trainees with visual impairment, synchronous learning.

Introduction

The COVID-19 pandemic, which emerged in 2020, caused widespread disruptions to education systems globally. In the United States, 96% of schools had closed by April 2020 (MCH Strategic Data, 2020), prompting a rapid shift from traditional face-to-face learning to online modalities. Online learning, which delivers at least 80% of instructional content digitally (Shelton & Saltsman, 2005; Allen & Seaman, 2011), became the primary mode of education delivery. Two dominant models emerged: synchronous learning, involving real-time virtual sessions via platforms like

Zoom, and asynchronous learning, which allows learners to access pre-recorded materials at their convenience (Mahoney & Hall, 2020).

While these models helped maintain learning continuity, they also exposed significant disparities, particularly for learners with disabilities. For trainees with visual impairments, access to digital resources and assistive technologies became critical. Although online learning offers benefits such as flexible pacing and reduced social anxiety (Martenev & Bernadowski, 2016), limited research has explored its accessibility for visually impaired learners in Technical and Vocational Education and Training (TVET) institutions in Kenya.

In Africa, the shift to online learning was further complicated by the digital divide—unequal access to internet, devices, and ICT infrastructure (Awuor, 2021). Urban institutions adopted synchronous platforms, while rural ones faced challenges like unreliable electricity and high data costs. These issues disproportionately affected trainees with visual impairments, who rely on screen readers and adapted platforms. As the pandemic continued, many institutions transitioned to asynchronous learning, which offered flexibility but raised concerns about the accessibility of materials lacking features like text-to-speech compatibility.

In Kenya, public TVET institutions such as the Kenya School of TVET (KSTVET) and the Rift Valley Institute of Science and Technology (RVIST) initially adopted synchronous delivery before shifting to asynchronous formats. They developed digital content including recorded lectures and e-books, but accessibility for visually impaired trainees remained largely unaddressed. Despite national efforts to subsidize internet access (Ministry of Education, Kenya, 2021), gaps in inclusive digital learning persist.

Trainer preparedness also emerged as a critical factor. Many lacked training in digital pedagogy and inclusive teaching methods, further marginalizing visually impaired trainees. Although distance learning introduced flexibility and innovation, there is limited empirical evidence on the experiences of visually impaired trainees in Kenya's public TVET sector. Specifically, the accessibility of digital resources and the readiness of trainers to support inclusive learning remain underexplored. This gap strongly justifies the need for this study.

Problem Statement

The outbreak of COVID-19 prompted a rapid transition from traditional classroom learning to online platforms in public TVET institutions across Kenya. While this shift enabled continuity in education through synchronous and asynchronous modes, it also exposed significant gaps in accessibility and inclusivity, particularly for trainees with visual impairments. Despite efforts to develop digital learning resources and deliver content via platforms like Zoom, Google Classroom, and pre-recorded materials, the accessibility of these resources for visually impaired trainees remains largely undocumented and questionable.

Furthermore, the effectiveness of online learning for trainees with visual impairments is heavily influenced by the accessibility of digital content and the capacity of trainers to deliver inclusive instruction. Yet, many trainers lack the necessary skills, training, or tools to support visually impaired learners effectively in digital environments. This raises concerns about the quality and equity of education delivered through these modes. Existing studies on digital learning in Kenya and Sub-Saharan Africa have focused broadly on technological challenges and general student experiences but have paid limited attention to the unique needs of learners with visual impairments in the TVET sector. There is a noticeable gap in empirical evidence regarding the accessibility of digital learning resources and the preparedness of trainers to support inclusive online education for this group. This study sought to address this gap by examining the accessibility of digital resources for synchronous and asynchronous learning and evaluating the preparedness of trainers to meet the learning needs of visually impaired trainees in public TVET institutions in Kenya.

Objectives

The objectives of the study were to:

- i) Examine the accessibility of digital resources for synchronous learning among trainees with visual impairments in public TVET institutions in Kenya.
- ii) Evaluate the accessibility of digital resources for asynchronous learning among trainees with visual impairments in public TVET institutions in Kenya.
- iii) Examine trainers' preparedness to deliver synchronous and asynchronous learning to trainees with visual impairments in public TVET institutions in Kenya.

Rationale of the Study

The rationale for this study stems from the urgent need to evaluate the effectiveness of synchronous and asynchronous learning for trainees with visual impairments in public TVET institutions in Kenya, an issue that gained prominence during the COVID-19 pandemic. The abrupt shift to online and self-paced learning revealed both opportunities and significant challenges in delivering inclusive education, especially in the context of TVET, where practical, hands-on training is essential. Trainees with visual impairments often face unique barriers in accessing digital content, participating in real-time sessions, and engaging with instructional materials that are not designed with accessibility in mind. As TVET institutions in Kenya continue to adopt blended and fully online learning models, it is critical to understand how these modalities are supporting or failing trainees with visual impairments. This study is therefore significant as it aims to explore the accessibility of digital resources used in both synchronous and asynchronous learning and assess the preparedness of trainers to accommodate learners with visual impairments. The findings will offer valuable insights for policymakers, educators, and technology developers seeking to improve inclusivity, ensure equal learning opportunities, and strengthen the resilience of TVET institutions in the face of current and future educational disruptions.

Methodology

This study employed a mixed-methods research design, combining both quantitative and qualitative approaches to thoroughly investigate the effectiveness of synchronous and asynchronous learning among trainees with visual impairments in public TVET institutions in Kenya. Data collection involved multiple instruments tailored to different respondent groups. Questionnaires were administered to administrators, trainers, and Heads of Department (HODs) from Open, Distance, and E-Learning (ODEL) departments to gather quantitative data regarding accessibility of digital resources and trainers' preparedness. Semi-structured interviews were conducted with trainees with visual impairments to capture rich qualitative insights into their experiences, challenges, and perceptions of both learning modes. Additionally, an observation checklist was utilized to assess the availability and usability of physical and digital accessibility features within the institutions, such as adaptive technologies and learning platforms. Institutional reports and policy documents were also reviewed to provide a broader context of existing accessibility frameworks, implementation strategies, and support mechanisms for inclusive learning.

The development of the research instruments was informed by a comprehensive review of existing literature, relevant policy guidelines, and established best practices in inclusive education and digital learning. To ensure content validity, the instruments were subjected to expert review by specialists in special needs education, educational technology, and TVET curriculum design. Feedback from these experts was incorporated to refine the clarity, relevance, and structure of the tools. A pilot study was then conducted with a small group of respondents from institutions outside the main sample to test the instruments' clarity and reliability. Based on the pilot results, necessary revisions were made to improve the instruments. The reliability of the quantitative tools was

assessed using Cronbach’s Alpha coefficient, with values exceeding the acceptable threshold of 0.7, confirming internal consistency.

Quantitative data collected through questionnaires were analysed using descriptive statistics, including frequencies and percentages, to summarize participant responses. Comparative analysis using the Chi-square test was performed to examine differences in accessibility between synchronous and asynchronous learning modes. The results were presented using frequency distribution tables, pie charts, and bar graphs. Qualitative data from interviews and document analysis were organized thematically and analysed narratively to identify patterns and provide in-depth understanding of trainees’ experiences and institutional contexts.

The target population was drawn from 14 TVET institutions offering common units through both synchronous and asynchronous modes of instruction. It consisted of 118 participants, including 14 principals, 14 Heads of Open, Distance, and e-Learning (ODEL) departments, 10 Heads of other academic departments, 50 trainers involved in delivering blended instruction, and 30 trainees with visual impairments. A sample size of 68 respondents was determined from a target population of 118 using Yamane’s formula (1967) at a margin of error of 8% and a confidence level of 95%. This sample was deemed sufficient to ensure valid representation across the different categories of participants. A mixed sampling approach was applied: stratified random sampling to capture institutional diversity, and purposive sampling to include individuals with expertise in digital learning and disability inclusion. Of the 68 respondents sampled, 56 responded, yielding a response rate of 82.4%. Out of these, 53 responses were received, yielding a response rate of 77.9%.

To ensure a balanced and representative sample, a combination of stratified random sampling and purposive sampling techniques was employed. Stratified random sampling facilitated inclusion of respondents from diverse regions and various TVET institutions, while purposive sampling was used to select key informants with relevant experience and expertise in digital learning and disability inclusion.

Results

The findings were based on the study objectives hence areas of concern were;

- Accessibility of digital resources among trainees with visual impairment for synchronous learning
- Accessibility of digital resources among trainees with visual impairment for asynchronous learning
- Trainers’ preparedness on synchronous and asynchronous learning for trainees with visual disabilities

Discussion of Findings

Objective 1: Accessibility of digital resources among trainees with visual impairment for synchronous learning in public TVET institutions in Kenya. The analysis looked into:

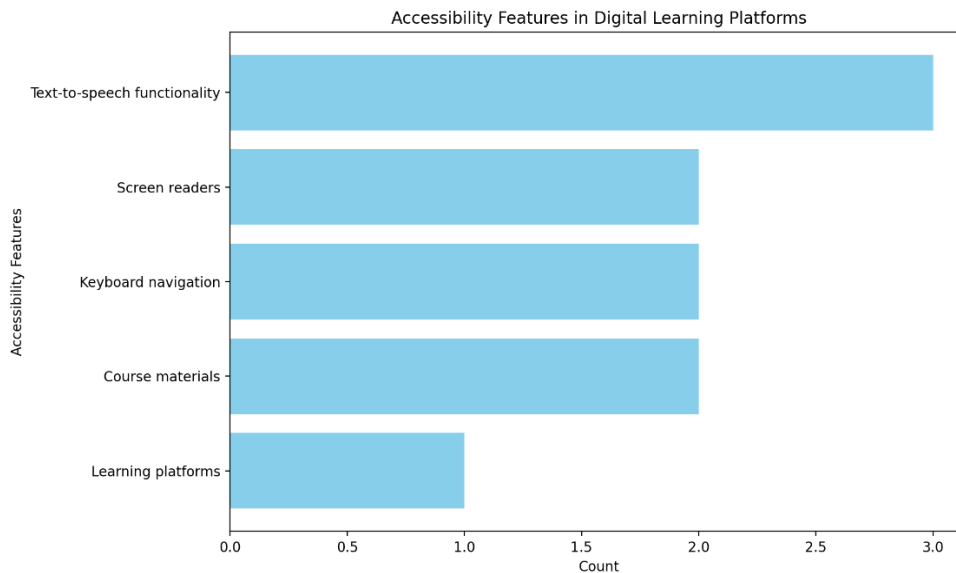
- Availability of Digital Learning Platforms
- Accessibility Features Present
- Independent Access by Trainees
- Difficulties in Navigation
- Institutional Incorporation of Accessibility Features

Availability of Digital Learning Platforms

Category	Count	Percentage
Accessible platforms available (Yes)	17	33.3%
Accessible platforms NOT available (No)	34	66.7%
Rarely (25%) can independently access	13	25.5%
Rarely (25%) report navigation difficulty	11	21.6%

As shown above, 34 respondents (66.7%) indicated that such platforms are not available, while 17 respondents (33.3%) reported that they are available. While only about a third of trainers report having accessible digital learning platforms, a significant portion (about a quarter) indicate that visually impaired trainees can "rarely" access digital resources independently or "rarely" face navigation difficulties. This suggests that even where platforms exist, accessibility and usability remain substantial challenges for many trainees.

Accessibility Features Present



The chart above shows that "Text-to-speech functionality" is the most commonly included feature, followed by "Screen readers," "Keyboard navigation," and "Course materials." "Learning platforms" as a feature is mentioned less frequently. This suggests that while some key accessibility features are present, their overall inclusion is still limited, highlighting areas for improvement in supporting visually impaired trainees.

Independent Access by Trainees

Response	Count	Percentage
Sometimes (50%)	24	47.1
Rarely (25%)	13	25.5
Often (75%)	5	9.8
None	3	5.9
Never (0%)	3	5.9
Not Applicable	2	3.9
Always (100%)	1	2
Total	51	100.1

Most visually impaired trainees can only sometimes or rarely access and use digital resources for real-time learning independently, with very few able to do so always or often.

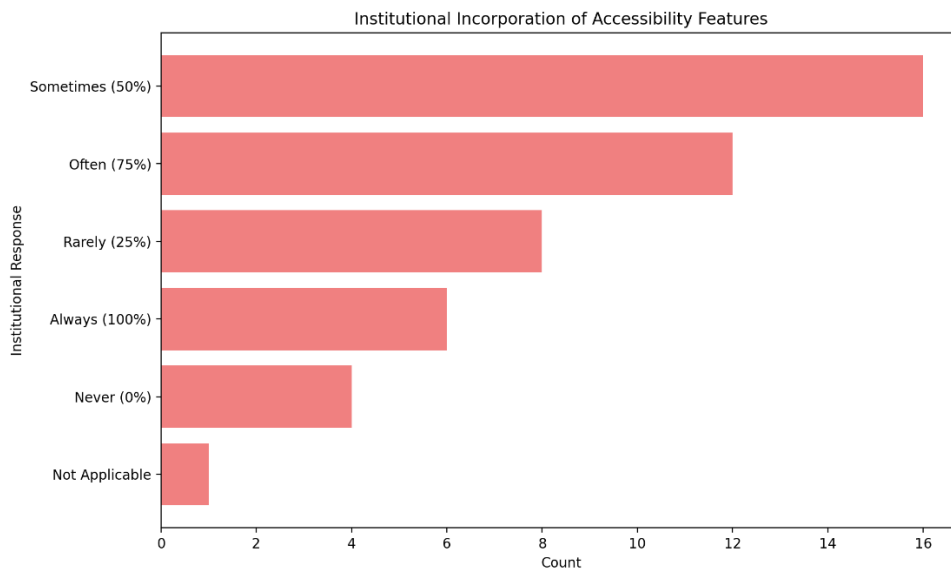
Difficulties in Navigation

Response	Count	Percentage
Sometimes (50%)	16	31.4
Rarely (25%)	11	21.6
Often (75%)	10	19.6
None	5	9.8
Never (0%)	5	9.8

Not Applicable	3	5.9
Always (100%)	1	2
Total	51	100.1

A significant proportion of visually impaired trainees report experiencing difficulties navigating digital platforms for live classes, with most indicating these challenges occur sometimes or rarely, and only a small minority never facing such issues.

Institutional Incorporation of Accessibility Features



The analysis shows that most institutions (31.4%) only sometimes incorporate accessibility features, while 23.5% do so often and 11.8% always. About 23.5% rarely or never incorporate such features.

The standard deviation to measure accessibility factors and ease of use of the digital platforms are explained as follows:

Are there digital learning platforms designed to accommodate the specific needs of visually impaired trainees in your institution? - A high standard deviation (12.02) indicates significant variability in how institutions responded—some have platforms, others don't, and the responses were not evenly distributed.

Accessibility features are readily available - Standard Deviation: 1.07. This was a moderate standard deviation, suggesting that while many respondents may agree on the availability of accessibility features, there is still some disagreement or variability in perception.

Respondents rated the level of real-time assistance they provide to visually impaired trainees. A standard deviation of 1.23 suggests that while many responses cluster around a central value (likely "Moderate Support"), there is noticeable variation, with some institutions offering significantly more or less support.

The standard deviation calculations for the synchronous learning indicators reveal the degree of variability in how institutions support visually impaired trainees. The standard deviation for the availability of accessibility features (1.07) indicates a moderate spread in responses, suggesting that while many institutions agree on their availability, there are still differing experiences. The real-time assistance rating had a standard deviation of 1.23, showing slightly more variability,

which implies that the level of support provided varies more significantly across institutions. Meanwhile, the platform availability question, though categorical, showed a high standard deviation (12.02) based on response frequencies, highlighting a wide disparity in whether institutions have digital platforms tailored for visually impaired learners. Overall, these values suggest that while some institutions are well-equipped and supportive, others lag behind, leading to inconsistent learning experiences for visually impaired trainees.

A Mann-Whitney U Test was carried out to compare accessibility and navigation difficulties and the results were:

U Statistic: 1565.0

P-Value: 1.42×10^{-8}

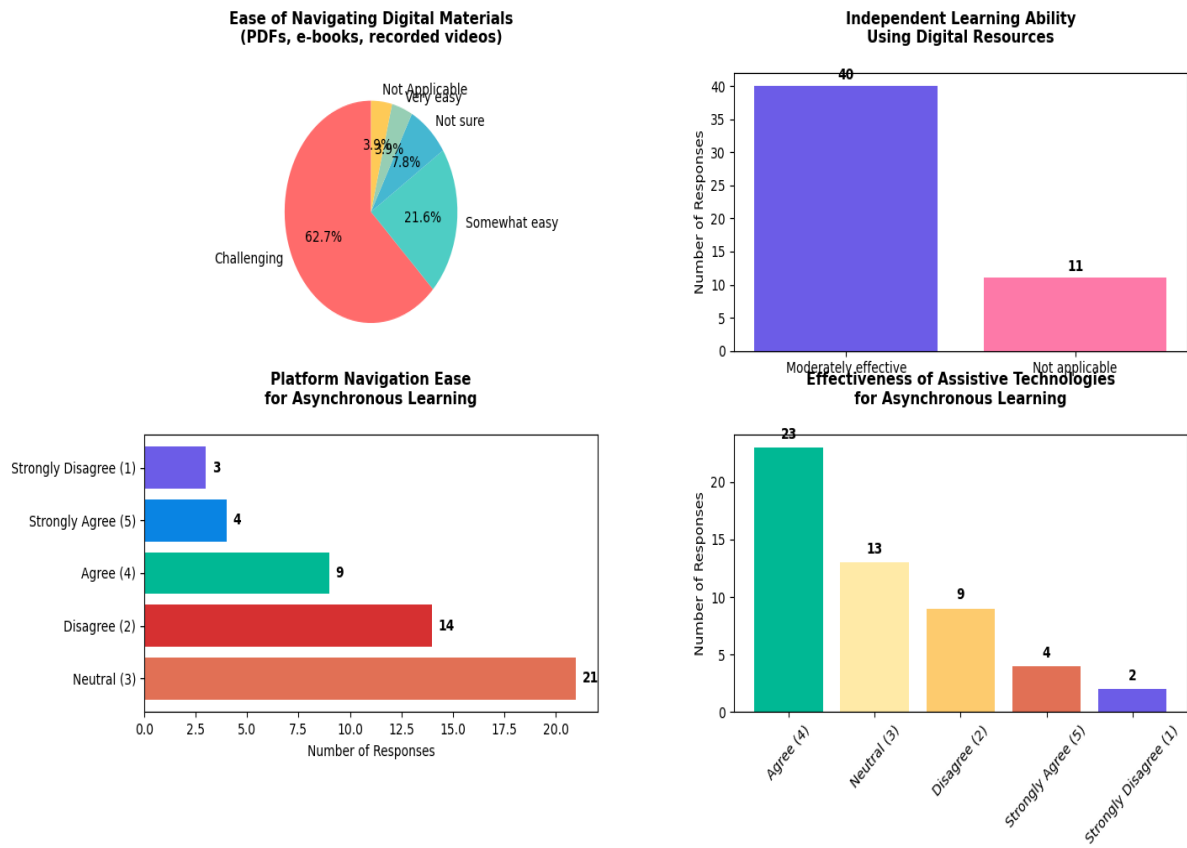
This shows that there is a statistically significant difference between how respondents rated the availability of accessibility features and the difficulty trainees face navigating digital platforms.

This suggests that even when accessibility features are perceived as available, trainees may still experience significant challenges navigating platforms—highlighting a potential gap between feature availability and practical usability.

Objective 2: Accessibility of digital resources among trainees with visual impairment for asynchronous learning in public TVET institutions in Kenya. The analysis evaluated:

- The ease of navigating digital materials
- The independent learning ability
- The asynchronous learning experiences of the trainees

Accessibility of Asynchronous Learning for Visually Impaired Trainees in Kenyan TVET Institutions



The data revealed the following about accessibility of digital resources for asynchronous learning among visually impaired trainees in Kenyan public TVET institutions:

- Most respondents (62.7%) say it is “Challenging” for visually impaired trainees to navigate digital materials like PDFs, e-books, and recorded videos. Only a small fraction (3.9%) find it “Very easy.”
- When describing their ability to learn independently using digital resources, the majority (78.4%) rate it as “Moderately effective.”
- Ratings for asynchronous learning experiences show that most respondents are neutral or agree that trainees have positive experiences, but strong agreement is low.
- Ease of navigating online platforms is a challenge: 41.2% are neutral, and 27.5% disagree that platforms are easy to navigate.
- Assistive technologies and adaptations are generally seen as somewhat effective, but strong positive ratings are limited.
- Implementation of recommendations for improving accessibility is mostly neutral or positive, but only 15.7% “Strongly Agree.”

While there are some positive experiences, significant barriers remain for visually impaired trainees in accessing and navigating asynchronous digital resources. Most respondents see room for improvement, especially in navigation and the effectiveness of assistive technologies.

A Chi-Square Test was performed to compare the differences between Synchronous vs Asynchronous Accessibility as below:

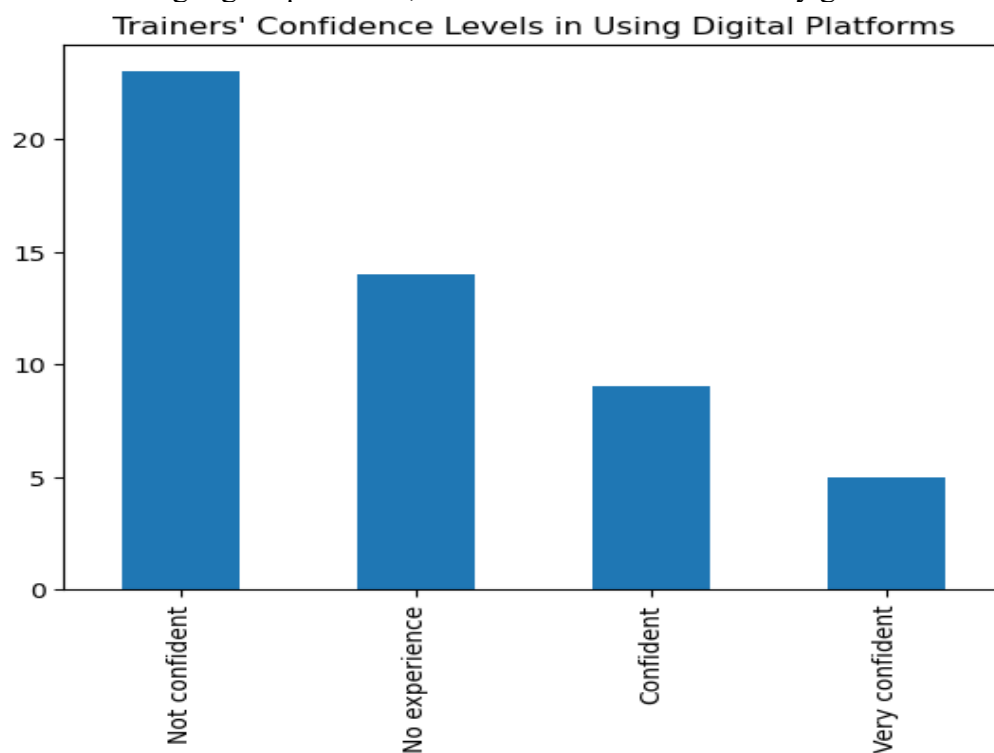
Chi-Square Statistic: 1.54

Degrees of Freedom: 4

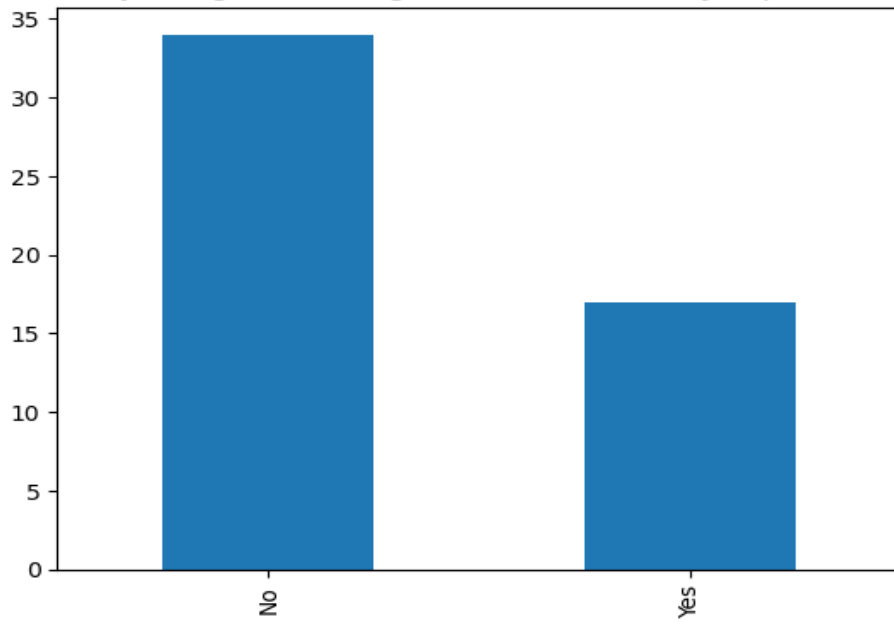
P-Value: 0.819

The p-value (0.819) is much greater than the common significance level of 0.05 indicating that there is no statistically significant difference in how respondents rated accessibility features between synchronous and asynchronous learning modes. In other words, the distribution of accessibility ratings is similar across both learning formats, suggesting that institutions perceive accessibility availability to be relatively consistent regardless of whether learning is real-time or self-paced.

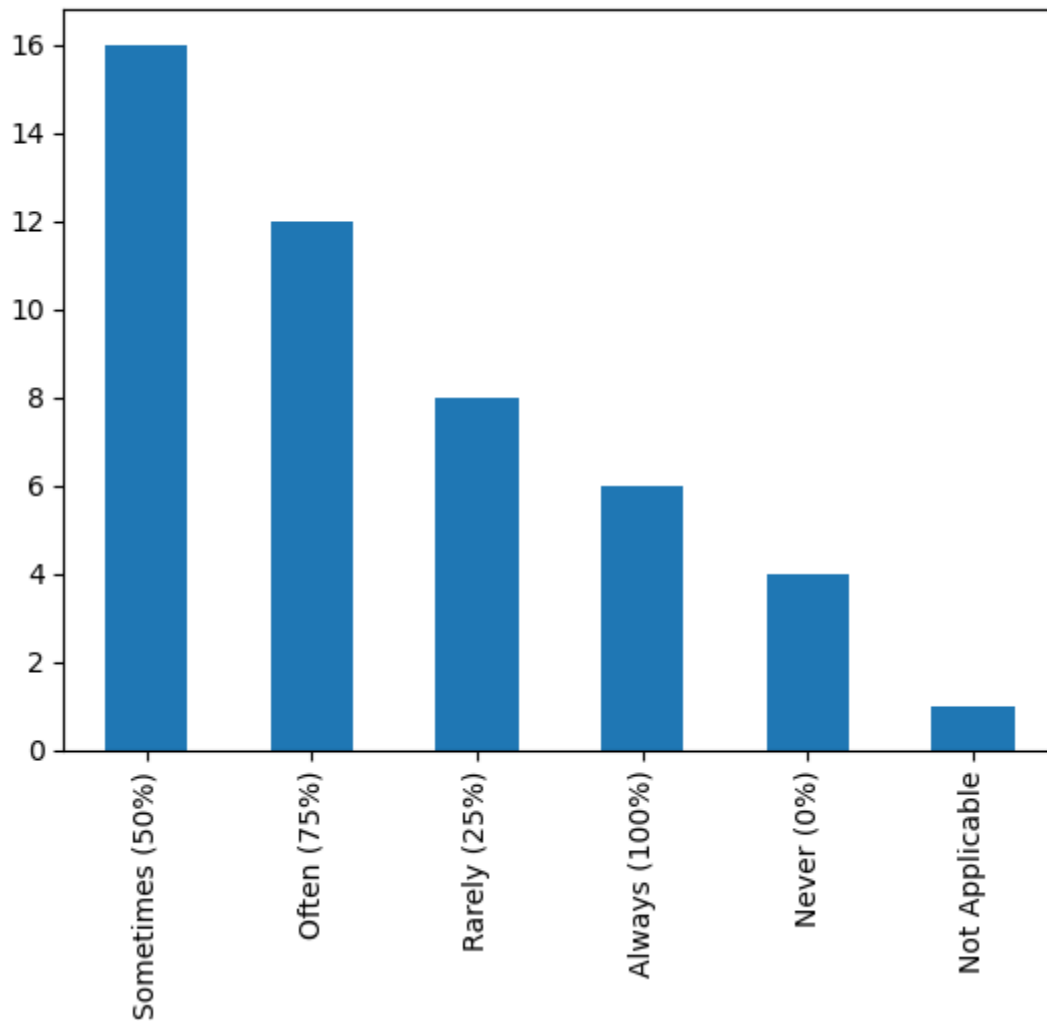
Objective 3: Trainers' preparedness on synchronous and asynchronous learning for trainees with visual disabilities in public TVET institutions in Kenya. Data was analyzed to examine trainer preparedness in regard to teaching experience, prior training received, the length of training, confidence in using digital platforms, and awareness of accessibility guidelines.



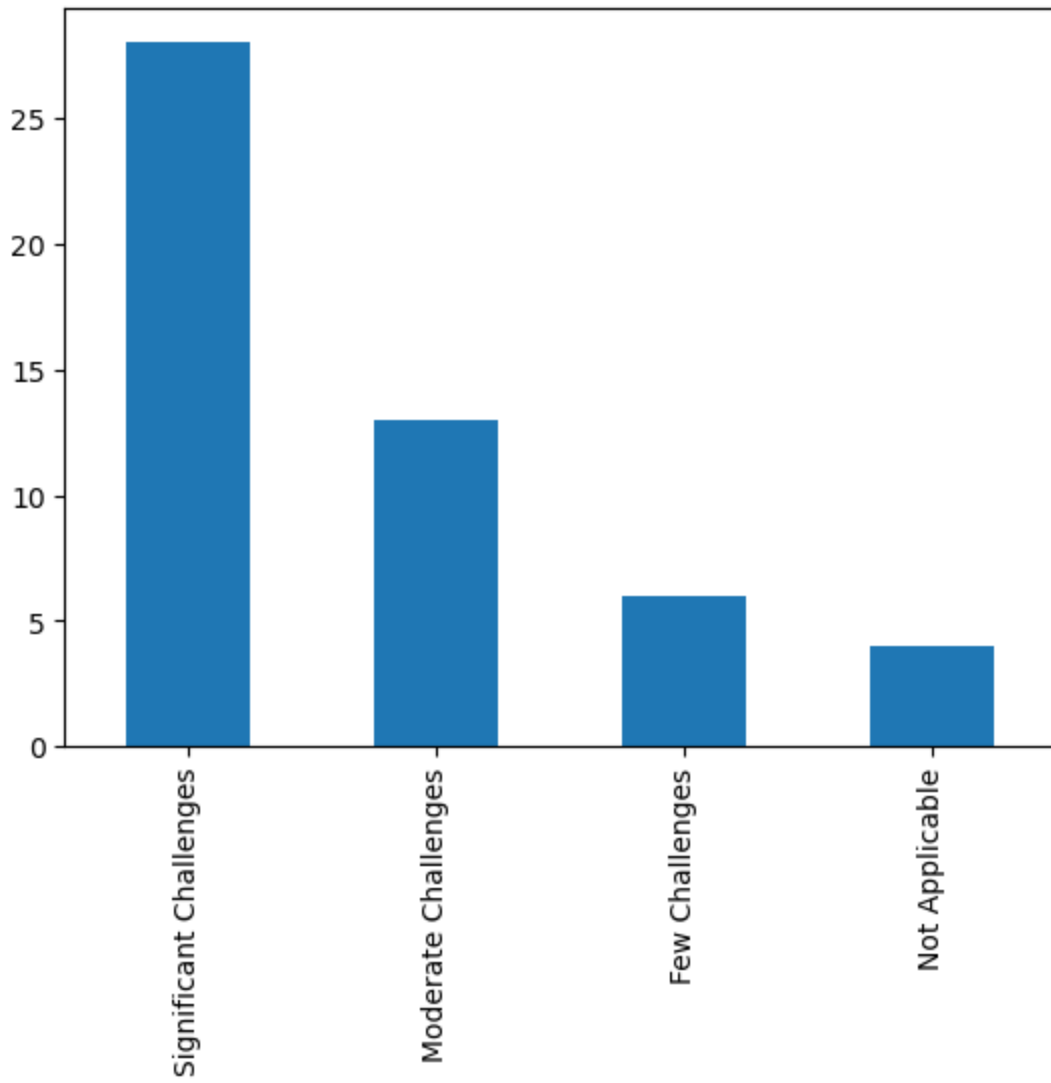
Availability of Digital Learning Platforms for Visually Impaired Trainees

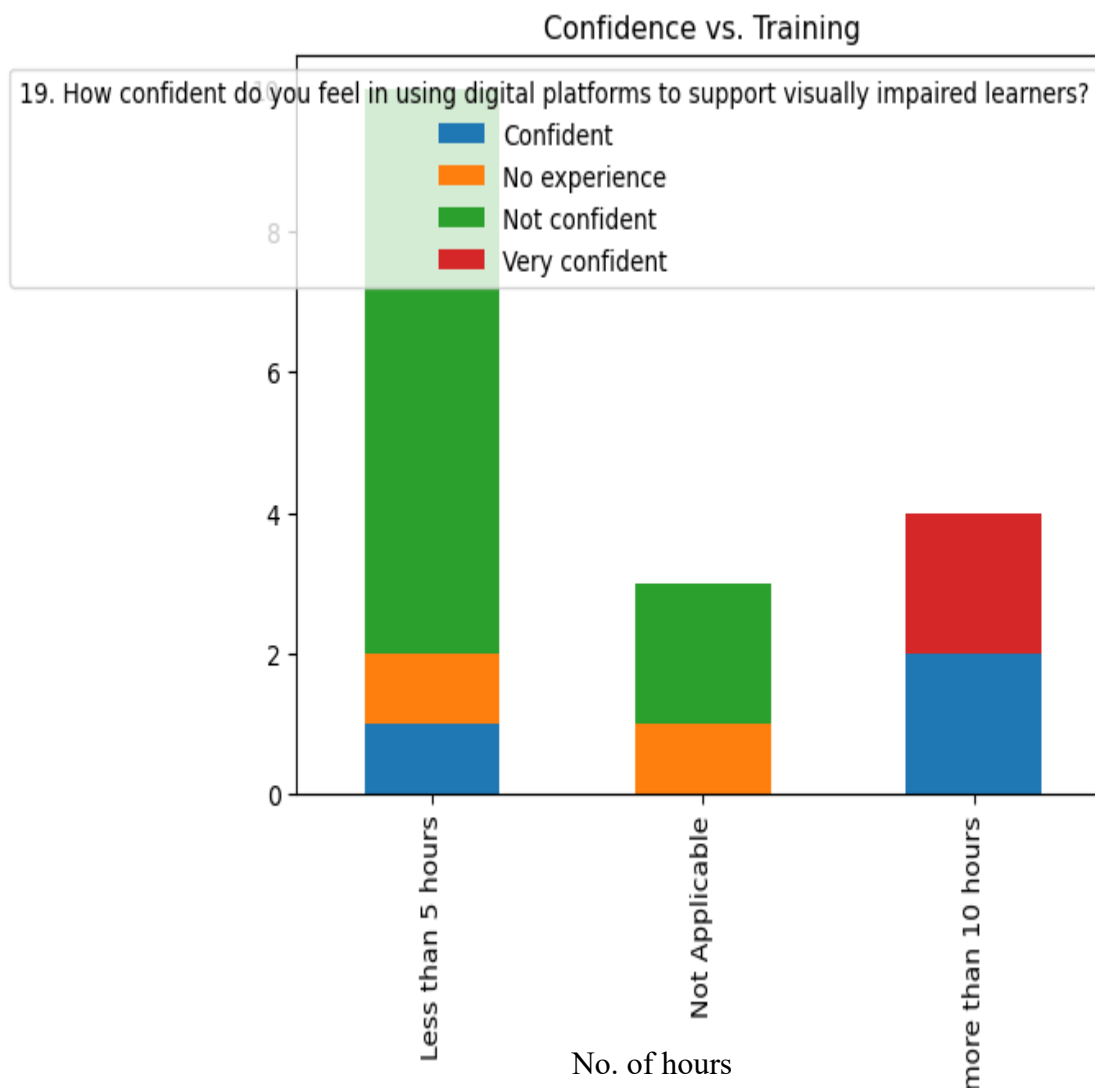


Frequency of Accessibility Features Used



Challenges in Engaging Visually Impaired Trainees





The findings show significant preparedness gaps: 64% of trainers have no prior training in digital learning for visually impaired students, 72% lack confidence in using digital platforms, and 66% have limited or no awareness of accessibility guidelines.

VI Trainee interview

Of the 14 TVET institutions targeted, only two had experienced a trainee with Visual Impairment and they were interviewed. The interview results were summarized as below:

Synchronous Learning

Responses were mixed regarding platform availability for visually impaired learners, with some trainees confirming access while others reported none. The impact on comprehension varied, as one trainee experienced enhanced understanding and access, while another felt digital tools somewhat hindered their learning. All respondents reported moderate participation in real-time group discussions. Key challenges included limited access to learning materials, feelings of social isolation, and non-user-friendly content formats. To address these issues, trainees recommended adopting platforms compatible with screen readers and ensuring all materials are provided in accessible formats.

Asynchronous Learning

All respondents confirmed the availability of platforms designed for visually impaired trainees, which positively impacted comprehension—one trainee reported significant improvement, while

another noted moderate gains. However, peer interaction remained limited, with minimal engagement from some trainees. Common challenges included poor color contrast, difficult navigation, and unclear or inconsistent instructions. To enhance the learning experience, trainees suggested improvements such as better visual contrast, more descriptive cues for visual elements, and clearer, standardized instructions tailored specifically for visually impaired users.

Conclusion

The assessment of digital resources available for synchronous and asynchronous learning for trainees with disabilities in TVET institutions and examination of trainers' preparedness on synchronous and asynchronous training for trainees with disabilities in TVET institutions ought to be scrutinized so as to ensure the right to education of these trainees is not compromised.

The research reveals mixed effectiveness of digital learning platforms for visually impaired trainees. While some trainees experienced improved comprehension and access, others faced significant barriers such as limited platform availability, inaccessible content formats, and social isolation. Peer interaction was generally moderate, suggesting some level of engagement but room for improvement. Despite these challenges, the study offers meaningful insights—notably, the importance of screen reader compatibility, accessible content formats, and clearer instructional design. These findings highlight both the potential and the current limitations of digital tools in supporting inclusive education, pointing to actionable areas for enhancement.

Recommendations

Based on the analysis of the data comparing synchronous and asynchronous learning accessibility for visually impaired trainees in Kenyan TVET institutions, the following recommendations can be drawn:

1. Strengthen Real-Time Support Systems

The standard deviation for real-time assistance (1.23) indicates variability in support levels across institutions. This suggests a need to standardize and enhance real-time support, such as through trained assistants, live chat help, or dedicated accessibility officers during synchronous sessions.

2. Bridge the Gap between Feature availability and Usability

Although accessibility features are reportedly available, the Mann-Whitney U Test revealed a significant difference between perceived accessibility and actual navigation difficulties. Institutions should focus not just on providing features, but also on ensuring they are intuitive, well-integrated, and effectively used by trainees.

3. Maintain Consistency across Learning Modes

The chi-square test showed no significant difference in accessibility ratings between synchronous and asynchronous learning. This consistency is positive, but it also means that any improvements made should be applied across both modes to ensure a uniform experience for all learners.

4. Provide Targeted Training for Educators

Many trainers reported limited or no prior training in delivering accessible digital learning. Institutions should invest in regular, hands-on training for educators on inclusive teaching strategies and assistive technologies.

5. Customize Platforms Based on Feedback

Given the variability in responses, institutions should implement feedback loops (e.g., surveys, focus groups) to continuously assess and refine accessibility features based on the lived experiences of visually impaired trainees.

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