

Effect of Utilization of Alerting Assistive Technologies on the Academic Performance in Primary Schools for Learners with Hearing Challenges in Meru and Tharaka Nithi Counties

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Abstract

Despite Kenya's robust legal frameworks that guarantee equitable education for learners with disabilities, primary school learners with hearing challenges in Meru and Tharaka Nithi Counties consistently score between 100 and 200 marks, compared with a national mean of 250, indicating a persistent academic performance gap. This study investigated the effect of on the academic performance of learners with hearing challenges in three special primary schools across the two counties. Guided by Miller's Learning Theory (1957), which frames technology as a critical cue mechanism enabling learners to perceive stimuli essential for academic engagement, the study adopted a descriptive survey design. The target population comprised 318 respondents, and adopted proportionate stratified random sampling, which yielded 118 participants, including 73 learners, 13 teachers, 9 technical staff, 3 head teachers, and 2 County Directors of Education. Data were collected via questionnaires, interview schedules, focus group discussions, and KCPE document analysis (2015–2021), then analyzed using SPSS for descriptive statistics and thematic analysis for qualitative data. Findings revealed that 70.9% of learners reported insufficient alerting devices, 74.4% had received no sensitization, 67.4% lacked utilization skills, and 68.6% noted poor maintenance. Correlation analysis yielded a statistically non-significant relationship ($r = .109$, $p = .345$), attributable to extremely low utilization rates. The study concludes that systemic deficits in device provision, training, and policy frameworks collectively compromise learners' environmental awareness and academic engagement. The Ministry of Education should prioritize procurement of vibrating alarms and visual alert systems, while the Teacher Service Commission and Kenya Institute of Special Education should implement targeted training programmes. Uniquely, this study provides the first empirical evidence on the role of alerting assistive technologies in the academic outcomes of hearing-impaired learners in Kenya.

Keywords: *Alerting assistive technologies, hearing challenges, academic performance of children with hearing challenges, special primary schools, special needs education*

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1. Introduction

Hearing challenges represent a significant global health and educational concern, affecting millions of children worldwide. According to the World Health Organization (2021), more than 1.5 billion people live with some degree of hearing loss, of whom approximately 34 million are children. The condition encompasses partial, moderate, severe, or complete hearing loss resulting from damage to the outer, middle, or inner ear, or to the hearing control centre in the brain (Musonda & Phiri, 2017). The academic implications for learners with hearing impairments are profound, as hearing constitutes a fundamental sensory channel through which instructional content is accessed, processed, and internalized.

Globally, the educational rights of learners with hearing challenges have been recognized through various international frameworks, including the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD, 2008), which mandates equal access to inclusive, quality education. Despite these provisions, research indicates that learners with hearing impairments consistently underperform academically compared to their hearing counterparts. Marschark et al. (2015) documented that in the United States, academic achievement among deaf and hard-of-hearing students is influenced by multiple factors, including communication methodologies, family socioeconomic status, and the availability of specialized educational resources. Similarly, Su et al. (2020) reported persistent academic achievement gaps among Aboriginal children with hearing impairments in Australia, noting that these disparities tend to widen as learners progress through educational levels.

In the African context, the situation mirrors global trends, with developing countries facing exacerbated challenges due to resource constraints. Musonda and Phiri (2017) observed that in Zambia, learners with hearing impairments in both special and inclusive schools demonstrate significantly lower academic performance, attributable to inadequate instructional resources, insufficiently trained teachers, and limited access to appropriate assistive technologies. Desalegn and Worku (2016) documented similar findings in Ethiopia, where the absence of resource centres, teachers' lack of sign language proficiency, and minimal stakeholder commitment to implementing inclusive policies collectively undermine academic outcomes for hearing-impaired learners.

Kenya has demonstrated considerable policy commitment to addressing educational equity for learners with disabilities. The Constitution of Kenya (2010), Article 53(1)(b), guarantees every child the right to free and compulsory basic education, irrespective of disability status. This constitutional provision is operationalized through the Basic Education Act (2013), the Persons with Disabilities Act (2003), and the National Special Needs Education Policy Framework (2009). Furthermore, Kenya has embraced international frameworks, including the Salamanca Statement and the Education for All goals, while recognizing Kenyan Sign Language as an official language and a medium of instruction in schools for the deaf (Kalya, 2020).

Despite these legislative and policy interventions, academic performance among learners with hearing impairments in Kenyan primary schools remains persistently below national expectations. Sambu et al. (2018) reported that, when ranked alongside their hearing counterparts, learners with hearing impairments consistently occupy the lowest performance quintiles in national examinations, with mean scores ranging from 100 to 200 marks, compared with the national average of 250 points. This underperformance pattern is particularly pronounced in Meru and

Tharaka Nithi Counties, where studies by Mwoma (2017), Muguna (2011), and Murithi (2014) have documented consistently poor academic outcomes among hearing-impaired learners, attributed to inadequate resources, insufficiently trained personnel, and limited access to appropriate instructional technologies.

Within the spectrum of assistive technologies designed to support hearing-impaired learners, alerting assistive technologies occupy a distinct and critical niche. These devices, comprising environmental sound detectors, vibrating alarm systems, visual alerting devices, and mobile notification systems, are designed to enable learners with hearing challenges to perceive and respond to auditory environmental cues, including emergency signals, class transition alerts, and instructional prompts (Hermawati & Pieri, 2020; National Institute on Deafness and Other Communication Disorders, 2021). Unlike listening assistive technologies that primarily amplify sound, alerting technologies facilitate environmental awareness, personal safety, and temporal orientation within the school context. The Center for Hearing and Communication (2021) emphasizes that such technologies are fundamental to creating learning environments in which hearing-impaired learners can function independently and respond to critical environmental stimuli as effectively as their hearing counterparts.

While extensive research has examined the role of sign language and inclusive education in supporting hearing-impaired learners (Kalya, 2020; Kathare, 2020; Nyambere & Okello, 2021), and some studies have investigated listening assistive technologies (Masayi, 2020; Soetan et al., 2021), the specific contribution of alerting assistive technologies to academic performance remains substantially under-researched. The existing literature predominantly addresses assistive technology as a homogeneous category, obscuring the potentially unique contributions of alerting devices to the learning environment and, consequently, to academic outcomes. Furthermore, in the Kenyan context, specifically in Meru and Tharaka Nithi Counties, no empirical research has systematically investigated the relationship between the utilization of alerting assistive technology and the academic performance of learners with hearing challenges in primary schools. This gap in knowledge exists despite documented poor academic performance among this population and the theoretical plausibility that environmental awareness and safety perception, facilitated by alerting technologies, may significantly influence learners' engagement, confidence, and ultimately their academic achievement.

1.1 Problem Statement

The Kenyan government has established comprehensive legal and policy frameworks to support the educational rights of learners with special needs, including the Constitution of Kenya (2010), the Basic Education Act (2013), and the National Special Needs Education Policy Framework (2009). These instruments mandate equal access to quality education and have been complemented by increased budgetary allocations for special needs education, teacher training, and the provision of specialized learning resources (Jitolee, 2016; Kalya, 2020). Despite these interventions, academic performance among learners with hearing impairments in primary schools remains persistently below the national average of 250 marks, with affected learners consistently scoring between 100 and 200 marks in national examinations (Musonda & Phiri, 2017; Masayi, 2020; Mugisa, 2017). This underperformance is particularly pronounced in Meru and Tharaka Nithi Counties, where studies have documented inadequate learning resources, insufficiently trained

personnel, and consistently poor academic outcomes among hearing-impaired learners (Muiti, 2010; Muguna, 2011; Murithi, 2014; Mwoma, 2017).

Within the spectrum of assistive technologies, alerting devices, comprising environmental sound detectors, vibrating alarm systems, and visual notification systems, are theoretically positioned to enhance learners' environmental awareness, safety perception, and temporal orientation, factors that may significantly influence academic engagement and performance (Hermawati & Pieri, 2020; NIDCD, 2021). However, while existing research has examined sign language (Kalya, 2020; Sambu et al., 2018), inclusive education (Nyambere & Okello, 2021), and listening assistive technologies (Masayi, 2020; Soetan et al., 2021), no empirical attention has been directed specifically toward alerting assistive technologies. Consequently, the extent to which alerting devices contribute to academic performance among learners with hearing challenges, and the nature of their utilization in primary schools within Meru and Tharaka Nithi Counties, remains unexplored. This study seeks to address this gap by investigating the effect of alerting assistive technology utilization on the academic performance of learners with hearing challenges in the study counties.

2. Literature Review

Alerting assistive technologies constitute devices, systems, and equipment that enable individuals with hearing challenges to perceive environmental sounds and respond to auditory stimuli as effectively as their hearing counterparts (Hermawati & Pieri, 2020). According to the Center for Hearing and Communication (2021), these technologies encompass a broad range of equipment designed to create attention, awareness, and perception of immediate environmental events, including emergency signals, doorbells, alarm clocks, telephone rings, and baby cries. The fundamental purpose of alerting devices is to achieve environmental sound awareness and localization through visual, tactile, or vibrotactile feedback mechanisms (Bragg et al., 2016; Kumari et al., 2015).

Commercially available alerting technologies include vibrating alarm clocks, flashing smoke detectors, doorbell signaling devices, phone alerting systems, baby-cry monitors, and paging systems that convert auditory signals into visual or tactile notifications (American Speech-Language-Hearing Association [ASHA], 2015; National Institute on Deafness and Other Communication Disorders [NIDCD], 2019). More recent innovations include wireless sensor networks, mobile applications for environmental sound detection, PiCam visitor alerting systems, and smartwatch-based notification devices that specify sound direction (Daoud et al., 2015; Mielke & Bruck, 2016; Hermawati & Pieri, 2020).

Globally, research on alerting technologies has primarily focused on technological development and innovation rather than on educational applications. Studies by Bragg et al. (2016) and Kumari et al. (2015) developed mobile-based applications and wearable devices that enable sound detection, while Mielke and Bruck (2016) developed smartwatch technology that identifies sound direction. However, these investigations addressed general independence and safety concerns rather than academic performance outcomes.

In educational contexts, alerting technologies serve critical functions including classroom transition notifications, emergency alerts during school activities, and temporal orientation

throughout the school day (Marschark et al., 2015; Mordini et al., 2018). Despite these potential contributions to the learning environment, research specifically examining the relationship between the utilization of alerting technology and academic achievement remains exceptionally limited. Kim and Lee (2016) emphasized the need for informed policies to guide technology utilization, while Dhanjal and Singh (2019) noted that alerting systems enhance communication and environmental response capabilities.

Within the African context, literature on alerting assistive technologies is particularly sparse. The World Health Organization African Region Report (2021) attributed the scarcity and underutilization of assistive devices to weak governance systems, inadequate funding, insufficient regulatory frameworks, limited procurement systems, and critical knowledge gaps resulting from minimal research. Desalew et al. (2020) further noted that these challenges demonstrate limited commitment to supporting the acquisition of hearing assistive technology in the region.

In Kenya, despite constitutional and policy commitments to learners with disabilities, empirical studies specifically addressing alerting assistive technologies are virtually non-existent. Existing research has predominantly focused on sign language use (Kalya, 2020; Sambu et al., 2018), inclusive education (Nyambere & Okello, 2021), and general availability of assistive technology (Mwololo, 2017; Makewa & Mutie, 2018). Studies examining hearing impairment have concentrated on physically challenged and visually impaired learners, leaving alerting technologies for hearing-impaired populations largely unexplored (Fred, 2020; Ndlovu, 2020). This conspicuous research gap underscores the need to investigate how the use of alerting assistive technology influences academic performance among learners with hearing challenges, particularly in Meru and Tharaka Nithi Counties, where such learners continue to underperform academically despite existing policy frameworks.

The study was informed by Miller's Learning Theory, propounded by Neal Miller in 1957. The theory posits that effective learning results from the interaction of four fundamental factors: motivation, cue, response, and reward (Miller, 1957). Motivation refers to the internal drive that impels learners to engage in educational activities; cue encompasses the environmental stimuli that learners must perceive to access instruction; response entails learners' active engagement with learning tasks; while reward represents the satisfaction and reinforcement derived from successful learning experiences. Applying this theory to the current study, alerting assistive technologies function as critical cue mechanisms that enable learners with hearing challenges to perceive environmental stimuli, including class transition signals, emergency alerts, and instructional prompts, which would otherwise remain inaccessible. When learners consistently detect and respond to these cues with appropriate behaviour, and subsequently experience the reward of improved academic engagement and performance, positive reinforcement strengthens their motivation to continue using the technologies. Thus, Miller's framework provides theoretical justification for investigating how the utilization of alerting assistive technology influences academic performance among hearing-impaired learners in Meru and Tharaka Nithi Counties.

3. Methodology

This study adopted a descriptive survey research design to investigate the effect of alerting assistive technology utilization on academic performance among learners with hearing challenges in Meru and Tharaka Nithi Counties, Kenya. The design was appropriate for obtaining opinions,

describing the current status of technology utilization, and establishing relationships between variables without manipulating existing conditions (Creswell, 2018). The study was conducted in the three special primary schools serving learners with hearing impairments across the two counties.

The target population comprised 318 respondents, distributed as follows: 3 head teachers, 42 teachers, 29 non-teaching staff, 242 learners with hearing difficulties, and 2 County Directors of Education. A sample of 118 respondents was drawn using proportionate stratified random sampling. Following Mugenda and Mugenda's (2003) recommendation of 30% representation, the sample included 13 teachers (30% of 42), 9 technical staff (30% of 29), and 73 learners (30% of 242). All 3 head teachers and both County Directors were purposively selected due to their strategic positions and specialized knowledge (Patton, 2015).

Data were collected using questionnaires for learners, interview schedules for head teachers and County Directors, and focus group discussion guides for teachers and support staff. Document analysis of KCPE performance records (2015-2021) supplemented primary data. The instruments were piloted at Isiolo Primary School for Hearing Impaired Learners to establish validity and reliability. Quantitative data were analyzed using SPSS version 26 to generate descriptive statistics (means, percentages), while qualitative data were subjected to thematic analysis (Creswell, 2012). Findings were presented using tables and narratives.

4. Results and Discussion

In this study, the reliability assessment yielded Cronbach's alpha coefficients exceeding the acceptable threshold of 0.7 for all variables, confirming the internal consistency and dependability of the research instruments (Bryman & Bell, 2011). From the 91 questionnaires administered to learners, all were retrieved; however, five were deemed defective due to incompleteness, leaving 86 (94.5%) valid for analysis. All three head teachers and two County Directors of Education participated in interviews, achieving a 100% response rate. Of the 22 teachers and technical staff invited for focus group discussions, 18 (81.8%) attended. The overall response rate of 94% reflected strong cooperation from participants.

Demographic analysis revealed gender disparities, with female learners outnumbering males across both counties, indicating higher enrolment of girls with hearing impairment in primary schools. This finding aligns with Masayi (2020) and Yabbi (2015), who attributed similar patterns to cultural practices, enrolment challenges, and societal prejudices.

The study sought to determine the effect of alerting assistive technology utilization on the academic performance of learners with hearing challenges in primary schools in Meru and Tharaka Nithi Counties, Kenya. Alerting assistive technologies encompass devices, systems, and equipment that enable individuals with hearing impairments to perceive environmental sounds and respond to auditory stimuli through visual, tactile, or vibrotactile feedback mechanisms (Hermawati & Pieri, 2020). These technologies include vibrating alarm clocks, flashing smoke detectors, doorbell signaling systems, phone alerting devices, baby-cry monitors, and paging systems that convert auditory signals into accessible notifications (American Speech-Language-Hearing Association [ASHA], 2015; National Institute on Deafness and Other Communication Disorders [NIDCD], 2019). In educational contexts, alerting devices serve critical functions,

including classroom transition notifications, emergency alerts during school activities, and temporal orientation throughout the school day, potentially influencing learners' academic engagement and performance. The study's results on Adequacy and Availability and Utilization of Alerting Assistive Technologies in the mentioned schools are provided in Table 1.

Table 1: Adequacy and Availability and Utilization of Alerting Assistive Technologies

Sentiments on alerting assistive technologies (N = 86)	SD(1)	D(2)	N(3)	A(4)	SA(5)	
All buildings in our school are fitted with alerting devices that can notify us in case of an emergency	49 (57.0%)	14 (16.3%)	17 (19.8%)	1 (1.2%)	5 (5.8%)	1.83
I have the skills to use alerting assistive technology devices	35 (40.7%)	23 (26.7%)	9 (10.5%)	16 (18.6%)	3 (3.5%)	2.17
Our school has clear guidelines on the utilization of alerting assistive technology devices	28 (32.6%)	25 (29.1%)	8 (9.3%)	18 (20.9%)	7 (8.1%)	2.43
The alerting assistive devices are repaired in a timely manner	26 (30.2%)	33 (38.4%)	8 (9.3%)	14 (16.3%)	5 (5.8%)	2.29
Learners are sensitized to use alerting assistive technology devices	38 (44.2%)	26 (30.2%)	8 (9.3%)	7 (8.1%)	7 (8.1%)	2.06
We have adequate alerting assistive devices in our school	40 (46.5%)	21 (24.4%)	7 (8.1%)	11 (12.8%)	7 (8.1%)	2.12

The findings revealed a substantial inadequacy in alerting assistive technology devices across the three participating primary schools. As presented in Table 2, 70.9% of learners with hearing impairments indicated that alerting assistive devices were insufficient in their schools, with only 20.9% acknowledging adequacy. This finding was corroborated by the response to a specific statement about building fittings, in which 73.3% of learners reported that buildings in their schools were not fitted with alerting devices capable of notifying them in case of emergencies or program changes. The mean score of 1.83 on this item, the lowest among all alerting technology indicators, signified a critical deficit in safety and communication infrastructure.

These findings indicate a significant level of non-compliance with safety recommendations from the National Institute on Deafness and Other Communication Disorders (2021), which emphasizes the need for environmental alerting systems for individuals with hearing challenges. The absence of such infrastructure in educational settings potentially compromises learners' safety and their ability to respond appropriately to time-sensitive environmental cues, including class transition signals, fire drills, and emergency announcements. This situation aligns with observations by the

World Health Organization African Region Report (2021), which attributed inadequate availability of assistive technologies in African countries to weak governance systems, insufficient funding, and limited procurement mechanisms for disability-related equipment.

During focus group discussions, teachers elaborated on the specific alerting devices lacking in their institutions. One participant noted:

"We don't have vibrating alarms for our learners. The regular bells and alarms used for class changes and emergencies are purely auditory, so our hearing-impaired learners cannot perceive them. Sometimes we have to physically move from class to class to alert them, which is not only inefficient but also undignified for the learners."

This qualitative insight underscores how the absence of appropriate alerting technologies creates dependence and potentially undermines learners' autonomy and temporal orientation—factors that are theoretically linked to academic engagement and performance.

Utilization and Skills for Alerting Assistive Technologies

Beyond mere availability, the study assessed the extent to which learners utilized the few available alerting devices and their competence in doing so. The findings indicated that 67.4% of learners lacked the necessary skills to utilize alerting assistive technology devices, with only 22.1% affirming that they possessed such competencies (mean = 2.17). Furthermore, 74.4% of respondents reported not having been sensitized to the use of alerting assistive technology devices, suggesting that even when devices were available, their potential benefits remained unrealized due to knowledge and training deficits.

The lack of utilization skills represents a significant barrier to the effective deployment of alerting technologies in educational settings. As Rekkedal (2012) observed, the successful integration of assistive technologies depends not merely on device availability but fundamentally on users' competence and confidence in device operation. Similarly, Soetan et al. (2021) emphasized that skill acquisition is a prerequisite for meaningful assistive technology utilization among learners with hearing impairments, without which devices remain underutilized despite their potential benefits.

Focus group discussions with teachers revealed additional dimensions of this challenge. One teacher explained:

"Even when we receive devices through donations or government support, we often struggle because neither the learners nor we, the teachers, have received adequate training on how to use them. Some devices remain in their packaging because we are afraid of damaging them or using them incorrectly. This is particularly true for more sophisticated electronic alerting systems."

The above observation resonates with findings by Chibuzor (2017) and Lantang (2016), who documented that deficits in technical assistance and inadequate training programs significantly impeded the utilization of assistive technology in Nigerian special-needs schools. The situation underscores the necessity of comprehensive capacity-building initiatives that accompany device procurement.

Maintenance and Policy Guidelines

The study further investigated the maintenance status of alerting assistive devices and the existence of institutional guidelines governing their utilization. Results indicated that 68.6% of learners disagreed that assistive devices were repaired in a timely manner, while 61.7% reported that their schools lacked clear guidelines for alerting to assistive technology use. These findings suggest systemic weaknesses in the sustainability frameworks supporting assistive technology provision.

The absence of maintenance protocols has significant implications for device functionality and longevity. As Winfred (2018) documented in Tanzanian primary schools, poor maintenance practices render many assistive devices non-functional within short periods, negating initial procurement investments and depriving learners of anticipated benefits. Similarly, Visagie et al. (2017) observed that in several African countries, assistive devices were often repaired by individual users or family members rather than qualified technicians, resulting in suboptimal functionality and reduced device lifespan.

The lack of clear institutional guidelines for the use of alerting technology reflects broader gaps in policy implementation. Kim and Lee (2016) emphasized the necessity of informed policies to guide technology utilization in educational settings, arguing that without explicit frameworks, technology integration remains fragmented and dependent on individual initiative rather than systemic support. The World Health Organization African Region Report (2021) attributed such policy deficits to weak governance systems and insufficient prioritization of assistive technology within broader educational and health frameworks.

Implications for Academic Performance

The cumulative effect of inadequate alerting devices, limited utilization skills, poor maintenance, and absent guidelines has direct implications for learners' academic performance. During interviews, head teachers articulated how deficits in alerting technology affected the learning environment. One head teacher stated:

"Our learners frequently miss class transitions because they cannot hear the bell. They arrive late to lessons, miss instructions, and sometimes entire sessions. This affects their continuity of learning and ultimately their examination performance. In science practical sessions, for instance, they may miss critical safety warnings because they cannot hear them."

This observation resonates with and provides theoretical support for Miller's (1957) Learning Theory, which posits that effective learning requires learners to perceive environmental cues that signal learning opportunities and transitions. When alerting technologies are absent or nonfunctional, learners with hearing impairments are deprived of essential cues, disrupting their engagement in learning and potentially compromising academic achievement.

Quantitative analysis of academic performance data corroborated these concerns. The mean scores for alerting assistive technology items were consistently low (overall mean = 2.15), indicating widespread inadequacy across all measured dimensions. While the correlation analysis between alerting technology utilization and academic performance yielded a statistically insignificant relationship ($r = .109$, $p = .345$), this finding must be interpreted in light of extremely low

utilization rates. As Kothari (2014) noted, where predictor variables exhibit minimal variance, detecting significant relationships becomes statistically challenging.

Nevertheless, the findings contrast with those of Kisanga et al. (2018), who observed significant positive relationships between specific assistive tools and academic performance in Tanzanian vocational institutes. However, Ndlovu (2020) reported findings consistent with the current study, noting that although assistive technologies facilitated learning and independence among South African learners with disabilities, their impact on academic performance in inclusive settings was not statistically significant.

Measures for Improvement

Focus group discussions and interviews generated valuable suggestions for improving alerting assistive technology utilization. County Directors of Education emphasized the need for comprehensive policy frameworks, increased budgetary allocations, and systematic training programs. Teachers advocated for a range of alerting devices, including vibrating watches, visual fire alarms, and classroom signal lighting systems. Technical staff recommended establishing regular maintenance schedules and creating user manuals in accessible formats.

These recommendations align with global best practices documented by MacLachlan and Scherer (2018), who advocated for systems approaches encompassing policy development, personnel training, procurement mechanisms, and maintenance protocols. The World Health Organization African Region Report (2021) similarly emphasized the necessity of multisectoral partnerships and government ownership of assistive technology procurement and support systems.

5. Conclusion

The study revealed significant inadequacies in alerting assistive technology provision across primary schools for learners with hearing challenges in Meru and Tharaka Nithi Counties. The available devices were insufficient in quantity and variety, poorly maintained, and used by learners who lacked adequate skills and training. Institutional guidelines governing the use of alerting technology were conspicuously absent, and sensitization programs for learners were minimal. These deficits collectively compromised the learning environment by limiting learners' awareness of environmental cues essential for academic engagement, temporal orientation, and safety. While statistical analysis did not reveal a significant direct relationship between the utilization of alerting technology and academic performance. The extremely low utilization rates and qualitative evidence suggest that addressing these deficits could improve learning outcomes for hearing-impaired learners in the study counties.

6. Recommendations

Based on the findings, this study recommends that the Ministry of Education prioritizes the procurement and installation of comprehensive alerting assistive technology systems, including vibrating alarms, visual fire detectors, and classroom signal lighting, in all primary schools serving learners with hearing challenges. Schools should establish regular maintenance schedules and clear utilization guidelines to ensure device functionality and sustainability. The Teacher Service Commission, in collaboration with the Kenya Institute of Special Education, should develop and implement systematic training programs for teachers and technical staff on the operation and maintenance of alerting devices. Additionally, schools should institute sensitization programs for

learners to develop competencies in alerting technology utilization, thereby enhancing their environmental awareness, temporal orientation, and academic engagement. The adoption of these measures would collectively address the identified deficits and potentially improve academic performance among hearing-impaired learners.

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