



## THE INTERPLAY BETWEEN THE USE OF COMPUTER-ASSISTED INSTRUCTION AND LEARNING OF NUMERACY SKILLS AMONG LEARNERS WITH HI IN SELECTED PRIMARY SCHOOLS IN KENYA

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### Abstract:

The purpose of this study was to establish the interplay between the use of computer-assisted instruction and the learning of numeracy skills among learners with HI in selected primary schools in the four selected counties: Nandi, Uasin Gishu, Elgeiyo Marakwet, and Trans Nzoia. The study was based on B.F. Skinner's 'black box' theory. The study used a correlational research design. The study was carried out in Nandi, Uasin Gishu, Elgeiyo Marakwet, and Trans Nzoia Counties. In each county, one primary school with learners with HI was selected, making a total of 4 selected primary schools. The target population comprised teachers and head teachers in selected primary schools. The study selected 4 primary schools with learners with Hearing Impairment (HI). The total population of the study was 65 respondents. The institutions were sampled through stratified sampling. The study used both quantitative and qualitative research instruments (questionnaires and an interview guide). Statistical Package for Social Sciences (SPSS) was used to process and organize the data. To process the gathered data, both descriptive and inferential statistics were used. To determine the relationship between variables, inferential statistics, namely the Pearson correlation, were used. The relationship between variables was predicted using multiple linear regressions. Finally, the qualitative data from the open-ended questions were categorised to create recurrent themes and presented verbatim and in narrative form. The study results revealed that the majority of respondents believed that augmentative devices help hearing-impaired

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students understand others and communicate better themselves. Augmentative devices, such as hearing aids, cochlear implants, FM systems, and communication apps, are specifically designed to enhance auditory input and facilitate communication for individuals with hearing loss. The study concluded that there was a statistically significant positive correlation between computer-assisted instruction on academic performance among learners with HI ( $r=0.631$ ,  $p<0.05$ ). The study recommended that primary schools in Kenya enhance their utilization of CAI tools and resources. Schools should invest in accessible and adaptable CAI platforms that cater to the specific needs of learners with hearing impairments. Additionally, educators should receive comprehensive training in integrating CAI effectively into their teaching practices, ensuring that all students have equitable access to these instructional resources.

**Keywords:** learners with hearing impairment, computer-assisted instruction, mathematics, numeracy skills

## 1. Introduction

Global acknowledgement has been accorded to the significance of mathematics for survival, particularly in the domains of science and technology. Consequently, science and technology have taken centre stage in mathematics education. A major factor in the increased development of information, communication, and technology (ICT) in the twenty-first century has been the introduction of subsea fibre optic cables, which link every country in the world to the internet and establish a global village (Winseck, 2019). A wide range of disciplines and knowledge areas are included in the multidisciplinary field of educational technology (Erduran, 2020). It primarily focuses on the use of several instructional styles that help throughout the teaching and learning process to reduce abstract concepts. Computer-assisted Instruction (CAI) is the term used to describe the use of a computer as a teaching tool. In the process, the teacher instructs students on how to use a computer in a programming language, uses the computer as a tool with built-in software like word processors and spreadsheets, or uses it as a tutor. Students participate in drills, practice sessions, tutorials, exploration tools, simulations, and occasionally tests using the computer (Kormos, 2021).

In the era of information development, multimedia technologies and applications are perhaps some of the most intriguing inventions. The Internet and other innovations in communication and computing benefited and received support from them. The cognitive and psychomotor domains must actively interact for learning to be effective (Tambaoan & Gaylo, 2019). For a student whose fine motor coordination is compromised owing to a handicap, the usage of adapted computers bridges this gap by speeding up the manipulation of tasks. Learners write down what they have comprehended with their limbs. Since mathematics requires greater manipulation, learning effectiveness is hampered by the learners' degenerative limb diseases. Psychomotor exercises help with

retention. Interactive multimedia can give students with HI a successful learning environment by giving them control (Vanfleteren & Charlier, 2022).

The efficacy of computer-aided education in teaching the idea of place value to primary school students with hearing impairment in India was examined by Ramanakumari and Manjula (2020). The goal of the current study was to provide computer-aided instruction (CAI) for teaching place value to primary school students with hearing impairments as well as to evaluate its efficacy in doing so. The study used two matched groups, one utilizing CAI and the other using the conventional approach. The pre-and post-test results for the two groups revealed that the group that used computer-assisted learning software outperformed the group that utilized traditional techniques in terms of both learning speed and actual application of the idea.

In Africa, Going digital at a remote Namibian primary school, Abiatal and Howard (2019) looked at constructivist assistive technology in a mathematics classroom for the hearing impaired. The outcomes from the experiment and the interviews both support the idea that the constructivist digital assistive technology may have improved the students' mathematical ability. This offers an innovative addition to the field, as well as a potentially useful intervention, to enhance the teaching and learning of mathematics to deaf students. In Nigeria, the impact of computer-based training on the ability of students with hearing impairment to learn was examined by Maureen and Ifeanyi (2019). In Kenya, Kipkorir and Simatwa (2016) investigated the difficulties experienced by students with physical disabilities who were utilizing computer-based learning techniques to study mathematics. According to the study, students who received traditional instruction and those who received computer-based learning (CBL) scored significantly differently on their final exams. Kathare (2020) performed research on the impact of instructional strategies on arithmetic students' academic performance. The study found that students with hearing impairment do better academically in mathematics when a variety of teaching techniques are used. The survey also discovered that teachers mostly communicate with students who have hearing difficulties via complete communication and sign language. By allowing students to learn at their own pace and allowing teachers to identify common misconceptions among their students, computer-assisted instruction can give immediate feedback to learners and reduce the pressure on slow learners to keep up with their peers (Ramanakumari & Manjula, 2020). Complex or complex ideas may be made easy with the use of multimedia material, and boring math and numerical drills can be made into fun games.

One of the science-based core disciplines, mathematics has long been a part of the primary school curriculum and is essential to education (Orina, 2022). Most experts agree that the poor performance may be explained by the fact that few students with hearing impairments achieve below average on their final exams. Learners with hearing impairment may have a variety of disabilities, making it challenging to choose a facility that adequately meets their educational needs (Kathare, 2020). A new learning strategy

has emerged with the rise of the internet as the ideal response for this unique population (Ogunyi & Kiboss, 2012).

### **1.1 Objective of the Study**

- To examine the relationship between the use of computer-assisted instruction and the learning of numeracy skills among learners with HI in selected primary schools in Kenya.

## **2. Literature Review**

### **2.1 Theoretical Review**

The study was guided by B.F. Skinner's 'black box' theory and programmed instruction. The perspective of B.F. Skinner's theory is founded on a definition of learning as an obvious modification in behavior (Skinner, 1990). The use of computers in education has the potential to lead to more complex designs. Computers may be designed to evaluate student input and adjust lessons to suit each student's level of proficiency. Computers now can offer instructional information and demand mastery of each step in a tutorial mode in ways that were not achievable with the first machines. The key to making the most of a computer's capabilities is the instructional designer's sensitivity to various student learning styles. Even more sophistication is made possible by simulation, which uses a computer to simulate a real-world scenario and allows for realistic responses to learner input. The right conditions may be provided by well-made intellectual games to hone essential problem-solving abilities.

The relevance of this theory lies in the fact that it equates computer instruction to the conditioning of a desired behavior and that the learning process is based on the principle of reinforcement and the stimulus-response schema is based on operant conditioning, whereby a completely new behavior is learned to a familiar stimulus (Rutherford, 2009). The learner clicks on the computer to produce the required behavior and produce the intended outcomes from the learning process, and the classroom is compared to the "black box". To do this, CBL must deliver a stimulus, provide feedback on the learner's reaction (to the stimulus), and reinforce desired responses. The behavior that has to be learned must be broken down into manageable pieces (computer tasks) and given to the learner. The computer may repeat a given notion several times, depending on the learner's replies, which reinforces the desired behavior.

### **2.2 Empirical Studies and Knowledge Gaps**

Individuals with hearing impairments fall within the group of students who require special education (Martin & Cox, 2024). The classification of the hearing impaired is based on several factors. These are created based on the degree of hearing loss, the time it started, the reason, the location, the form, and the longevity. Hearing loss is measured using audiological tests, and the severity is identified using the phrases mild loss,

medium loss, further loss, and extremely late loss (Michels *et al.*, 2019). Although technology-based interventions have most frequently been applied in the social-communication sphere around the globe, differences in the treated areas at different ages are evident (Glumbić *et al.*, 2022).

In preschoolers, technology has mainly been used to improve joint attention, language skills (e.g., manding, tacting, intraverbal, vocabulary enrichment), recognizing emotions and facial expressions, and play skills. Speech-generating devices, computer-assisted instruction, video-based instruction, virtual reality, and robot-mediated interventions have been used for this purpose. Roberts (2021) sought to examine student achievement in math while using computer-assisted instruction in the classroom setting. This quantitative analysis of achievement and survey data included TN Ready math scores of 2019 and a student survey of one-to-one technology implementation of 8th-grade Middle School students. The student's performance on the TN Ready scores being compared to the state of TN scores of students, did not show a difference, and the use of computer-assisted instruction cannot be stated to affect student achievement. The student survey of one-to-one technology did show that the use of computer-assisted instruction motivated students to learn.

In the Philippines, Rogayan *et al.* (2021) conducted a one-group pre-post-test action research to establish the effects of Computer-Assisted Instruction (CAI) on motivation and academic performance in social studies among students in a public secondary school in Zambales. Findings revealed that the students had a fair level of motivation ( $M=3.20$ ) towards the subject before the intervention and had a high motivation ( $M=3.59$ ) after their exposure to CAI. The class had an average ( $M=23.18$ ) academic performance in social studies before the intervention and had improved to above average ( $M=37.82$ ) after the treatment. There was a significant difference in the motivation and academic performance of students after the application of the CAI.

In Indonesia, Dico *et al.* (2023) used a pre-experimental method in the form of a group pretest and posttest design; the data were obtained through the results of the pretest and posttest. Then the data is processed through analysis of hypothesis testing using the Wilcoxon Signed Rank Test technique. The results of the study explained the average value of the pretest and posttest. With the results of the hypothesis test, the value of Asymp.Sig. (2-tailed) of 0.041, Computer-Assisted Instruction (CAI)-Based Mathematical Education Game (GEMA) has an effect on improving simple arithmetic skills in mentally retarded students.

In North Macedonia, Mishev *et al.* (2021) presented a technology4good initiative in their study that integrates multiple breakthrough software modules to build a generic framework to aid the educational process for students with disabilities, such as hearing and vision impairments, as well as various types of dyslexia. The purpose of the study was to apply various distinct research methods, among which the highlighted one is on the text-to-speech engine for the first time developed to support the Macedonian language. Additionally, the framework integrated the Macedonian sign language to

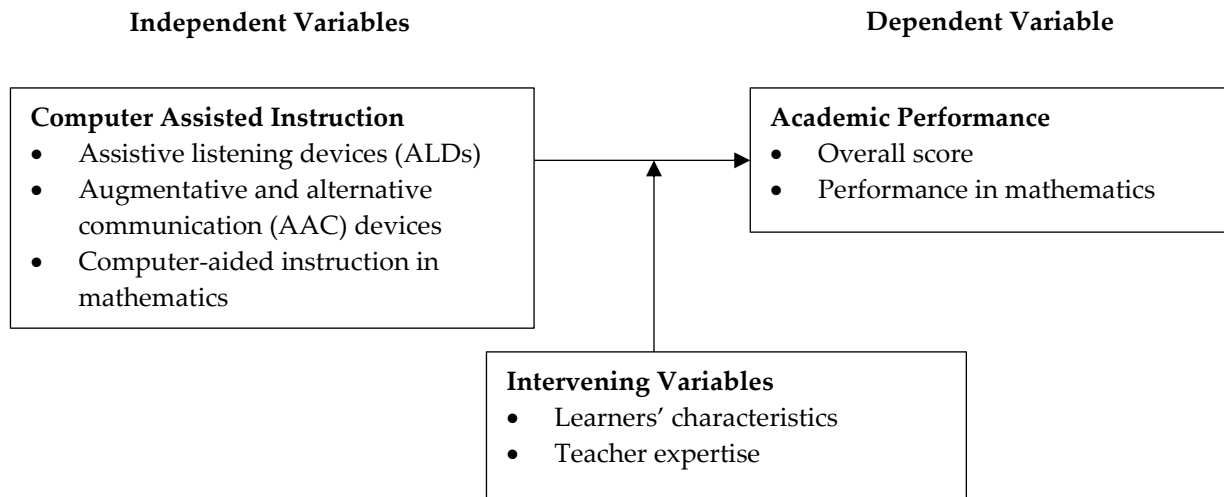
guide the hearing-impaired students through the contents of the educational framework. Also, there was a specially developed font (typeface) and color environment for students with specific reading difficulties (dyslexia). The methods that supported the educational framework were developed by a mix of social, special education, and computer science experts.

In Nigeria, Adeniran and Daranijo (2023) conducted a study on the use of computers in teaching and learning Mathematics to hearing-impaired students in a special school in Oyo State based on an experimental design. The researcher randomly selected 25 students with hearing impairment from Senior Secondary School 3D (SSS 3D) and 25 students with hearing impairment from Senior Secondary School 3R (S.S.S. 3R) from Durbar Grammar Schools in Oyo East Local Government Area of Oyo State as samples. The researcher chose Senior Secondary School Students because of the previous knowledge of computers they had from Junior Secondary School Classes. Twenty-five SSS 3D Students with hearing Impairment were used as the control class, while twenty-five SSS 3R Students with hearing impairment were adopted for the experimental class. Results showed that the students with hearing impairment who were taught Mathematics with a computer performed better than those students taught without a computer.

Iyamuremye *et al.* (2023) in their study presented a systematic literature review on the role of technology in Science education for students with Special Education Needs. An extensive search in academic databases yielded 24 journal articles from 2006 to 2022. These 24 empirical studies were reviewed through electronic databases, including Scopus, ERIC, Google Scholar, and Science Direct. The findings demonstrated that using assistive technology in Mathematics and Science education had a major positive impact on students' motivation, attitude, and academic performance. Positive learning outcomes probably depend on how digital technology is used, specifically, the capabilities of each unique technological implementation. The present study aimed to fill the gap by specifically investigating the impact of CAI on numeracy skills development among primary school students with hearing impairment in Kenya, thereby contributing to the understanding of how different technological interventions can be optimized to improve educational outcomes for this demographic.

## 2.3 Conceptual Framework

**Figure 1:** Conceptual framework



Source: Author's Conceptualization (2023).

## 3. Methodology

### 3.1 Study Locale

The study was conducted in Nandi, Uasin Gishu, Elgeiyo Marakwet, and Trans Nzoia Counties. The study was carried out in selected primary schools in Kenya. The selected primary schools were those that offer specialized education to learners with HI. In each county, one primary school with learners with HI was selected, making a total of 4 selected primary schools.

### 3.2 Research Design and Target Population

The study used a correlational research design, which entails measuring two variables and assessing the relationship between them, with no manipulation of an independent variable (Limberg *et al.*, 2021). A correlational research design investigates relationships between variables without the researcher controlling or manipulating any of them. The population under study comprised teachers and head teachers in selected primary schools. The study selected 4 primary schools with learners with HI. The total population of 65 respondents is depicted in Table 1.

**Table 1:** Target Population

County	Head Teachers	Teachers
Uasin Gishu County	1	13
Nandi County	1	17
Elgeiyo Marakwet County	1	19
Trans Nzoia County	1	12
<b>Total</b>	<b>4</b>	<b>61</b>

### **3.3 Sampling Techniques and Sample Size**

Using stratified sampling, the institutions that were sampled were chosen. The sample frame can be segmented into various strata when the population being studied falls into several unique groups. Individual respondents are then chosen at random from each stratum's sampled independent sub-population (Limberg *et al.*, 2021). There is an equal chance that each respondent in a stratum was chosen. Consistent representation in the sample is ensured by using the same sampling fraction for each stratum. By stratification and altering sampling percentages between strata, the researcher can accurately reflect minority groupings of interest to them (Creswell & Plano Clark, 2016). The study used a census survey. Census is the study of every unit, everyone, or everything in a population. A census provides a true measure of the population with no sampling error, benchmark data may be obtained for future studies, and detailed information about small sub-groups within the population is more likely to be available. Since the population is small (65), the census was used to collect information from the entire population (Stratton, 2021).

### **3.4 Research Instruments**

Data was collected through a questionnaire because of its benefits for data collection, including its general lack of interviewer bias, the large number of people who can be asked to participate, and the sense of anonymity that respondents may experience (Shatri, 2020). Closed-ended questions were created since they make data analysis simpler and more accurate (Agha *et al.*, 2021), allowing for a correct interpretation of the replies. Additionally, they facilitate comparisons, provide a high degree of impartiality, and lessen answer fabrication (Shatri, 2020). Additionally, open-ended questions would be employed, particularly for exceptional scores, since they allowed the researcher to go further into the research subject and provide rich information (Zou *et al.*, 2021).

### **3.5 Pilot Study**

A pilot study was conducted with 7 participants from 2 selected schools who were not included in the main research. Two schools tested the questionnaires. Questionnaires were supplied to the chosen school teachers to complete. The answers to the questionnaires and interview times were gathered and carefully examined. The construct and content validity of the research tool were tested through expert judgment. The tools were given to seasoned professors who are authorities in the field of educational administration to assess the authenticity of the content. Cronbach's alpha was used to test the reliability of the measures in the questionnaire (Peterson & Kim, 2013). A Cronbach's alpha of 0.781 was obtained, indicating that the data were reliable.

### **3.6 Data Collection Procedures**

The researcher sought approval from Kenyatta University to apply for a research permit from the National Commission for Science, Technology, and Innovation. The Director of Education from the four counties received a copy of the permission and was told of the

study. Additionally, the head teachers of the schools that were sampled were contacted and informed of the study to acquire informed consent. The researcher then started gathering data. The questionnaire was sent by the researcher after choosing responders. The responders were given a questionnaire to complete, and it was chosen right away. The head teachers' convenience was taken into consideration while scheduling the 30-minute interviews. The researcher took notes during the conversation as it went on.

### **3.7 Data Analysis**

Data cleansing came next to identify any missing, irrelevant, or inaccurate data for the objective of raising the quality. Errors and omissions were changed, replaced, or removed to make the data compatible with other sets that are comparable to it. Statistical Package for Social Sciences (SPSS) was used to process and organize the data. To process the gathered data, both descriptive and inferential statistics were used. Means and standard deviation were used to describe the acquired data using descriptive statistics. Second, to determine the relationship between variables, inferential statistics, namely Pearson Correlation, was used. Thirdly, the relationship between variables was predicted using multiple linear regressions.

## **4. Results and Discussions**

Data obtained from the field were analyzed using descriptive statistics with the aid of the Statistical Package for Social Science (SPSS). The study's target population consisted of teachers and head teachers in selected primary schools. The study sampled 65 respondents and managed to collect data from 64 respondents (60 teachers and 4 head teachers). This represented a 98.5 percent response rate. This was affirmed by Saleh and Bista (2017), who noted that a response rate of more than 75% is appropriate for data analysis.

### **4.1 Background Information**

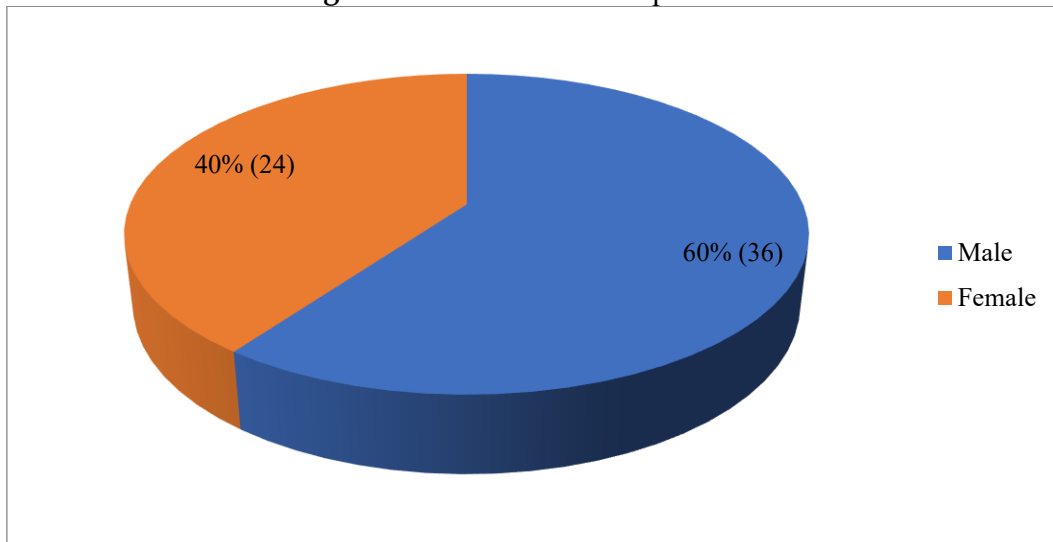
The study sought to establish the general information of the respondents. The study sought to establish the gender, years of experience, and highest educational level of the respondents. The study results were as follows.

#### **4.1.1 Distribution of Respondents by Gender**

The study sought to establish the distribution of respondents by gender. These findings are shown in Figure 2.

The study findings on the gender of the respondents showed that 60.0% were male, while 40.0% were female. This shows that the study managed to collect data from both genders, and their opinions were represented in the study. This implies that the majority of the staff are male.

**Figure 2: Gender of the Respondents**



#### 4.1.2 Distribution of Respondents by Age Brackets

The study sought to determine the distribution of respondents by age bracket and the results are presented in Table 2.

**Table 2: Age Bracket of the Respondents**

Age Bracket	Frequency	Percent (%)
Less than 25 years	2	3.0
25-35 years	23	37.8
36-45 years	26	42.9
46-55 years	10	16.3
<b>Total</b>	<b>60</b>	<b>100.0</b>

The study results revealed that the majority of the respondents were aged 36-45 years, representing 26 (42.9%), 23 (37.8%) were aged between 25-35 years, 10 (16.3%) were aged 46-55 years, while 2 (3.0%) were aged less than 25 years. This implies that the study managed to collect data from all the age brackets captured in the study.

#### 4.1.3 Distribution of Respondents by Level of Education

The study sought to determine the distribution of respondents by the highest level of education, and the results are presented in Table 3.

**Table 3: Highest Level of Education of the Respondents**

Educational Level	Frequency	Percent (%)
Undergraduate	36	60.2
Post-graduate	24	39.8
<b>Total</b>	<b>60</b>	<b>100</b>

The study findings on the education level of the respondents indicated that 36 (60.2%) were undergraduate degree holders, while 24 (39.8%) were postgraduate degree holders. This implies that the respondents were knowledgeable and therefore understood the study questions, and this could be interpreted to mean that they gave a true and fair view of the study questions.

#### 4.1.4 Distribution of Respondents by Years of Work

The study sought to determine the distribution of respondents by the years of work, and the results are presented in Table 4.

**Table 4:** Years of work

Years of work	Frequency	Percent (%)
1-5 Years	6	10.8
6-10 Years	26	43.8
11-15 Years	28	45.4
<b>Total</b>	<b>60</b>	<b>100</b>

The study results on the age of the respondents indicated that 6 (10.8%) of the respondents had served for 1-5 years; 26 (43.8%) had served for 6-10 years, whereas 28 (45.4%) had served for 11-15 years. This implies that the majority of the respondents had served for 11-15 years and that the study collected data from all the age brackets represented in the study.

#### 4.2 Use of computer-assisted instruction and Academic performance among learners with HI

The key aim of this study was to determine the effect of the use of computer-assisted instruction on the learning of numeracy skills among learners with HI. The study responses were as shown in Table 5.

**Table 5:** Use of computer-assisted instruction  
and Academic performance among learners with HI

Statements		SA	A	U	D	SD	Mean	Std Dev
Augmentative devices help hearing-impaired students understand others and communicate better themselves.	F	38	16	6	0	0	4.03	0.026
	%	63.1	26.2	10.7	0	0		
Presenting clear texts and visuals in presentations can help professors communicate their messages more clearly to students too.	F	38	15	7	0	0	4.51	0.275
	%	63.1	25.2	11.7	0	0		
Technologies designed for hearing in the classroom are abundant and diverse.	F	37	18	6	0	0	4.48	0.145
	%	61	29.2	9.8	0	0		
Using technology can be as simple as printing texts in larger fonts if students struggle to read smaller text.	F	24	28	7	2	0	4.17	0.273
	%	40	46.2	10.9	3.1	0		

The study results indicated that 90.2% agreed that Technologies designed for hearing in the classroom are abundant and diverse (Mean=4.48; SD=0.145) while none of them disagreed. Lastly, the study findings showed that 86.2% of the respondents agreed that using technology can be as simple as printing texts in larger fonts if students struggle to read smaller text (Mean=4.17; SD=0.273), as compared to 3.1% who disagreed. This finding is in line with the technological advancements discussed by Mishev *et al.* (2021), highlighting specialized educational frameworks that integrate tailored technologies to support accessibility and educational outcomes for students with disabilities. Regarding the simplicity of using technology, 86.2% of respondents agreed that technologies like printing texts in larger fonts can aid students who struggle with smaller text (Adeniran & Daranijo, 2023). This finding corroborates the practical adaptations observed by Adeniran and Daranijo (2023), who found that integrating computers in teaching mathematics improved academic performance among students with hearing impairment.

The study results on the effect of the use of computer-assisted instruction and the learning of numeracy skills among learners with HI indicated that 89.3% of the respondents agreed that augmentative devices help hearing-impaired students understand others and communicate better themselves (Mean=4.03; SD=0.026). None of the respondents disagreed with the statement. The findings indicate a high level of agreement among respondents (89.3%) that augmentative devices help hearing-impaired students understand others and communicate better themselves (Mishev *et al.*, 2021). This supports the effectiveness of assistive technologies in enhancing communication abilities among students with HI, aligning with the findings of Mishev *et al.* (2021), who emphasized the integration of text-to-speech engines and sign language support in educational frameworks. Similarly, 89.3% of respondents agreed that presenting clear texts and visuals in presentations improves professors' communication with students. This finding is consistent with Rogayan *et al.* (2021), who demonstrated that CAI enhances student motivation and academic performance in subjects such as social studies through improved engagement with multimedia content.

The findings of the current study underscore the pivotal role of computer-assisted instruction (CAI) in fostering academic performance among learners with hearing impairment. The high levels of agreement regarding the effectiveness of augmentative devices, clear texts and visuals, abundance of classroom technologies, and simplicity of technology use affirm the positive perceptions and benefits associated with CAI in educational settings. These findings align with global trends in assistive technology adoption, emphasizing its transformative impact on educational access and inclusivity (Mishev *et al.*, 2021; Rogayan *et al.*, 2021). By leveraging technological advancements and inclusive design principles, educators can create learning environments that cater to diverse learning needs. Continued investment in CAI and supportive technologies is essential for promoting equitable educational opportunities and fostering academic success for students with hearing impairment globally.

### 4.3 Inferential Statistics

Pearson correlation analysis was used to test the association between the study variables. Pearson correlation was used to measure the extent of correlation between variables of the study and to show the strength of the linear relationship between variables in the correlation ranges between +1 and - 1, where  $r > 0.7$  indicates a strong positive relationship,  $r = 0.5$  and below 0.7 indicates a moderate relationship and where  $r = 0.49$  and below indicates a weak relationship between study variables. Where  $r = 0$  indicates that there is no relationship. The study further sought to test the following research hypothesis:

**H<sub>02</sub>:** There is no relationship between the use of computer-assisted instruction and the learning of numeracy skills among learners with HI in selected primary schools in Kenya.

The study findings are tabulated in Table 6.

**Table 6:** Relationship between Study Variables

		Instructional techniques used	Use of computer-assisted instruction	Computer-assisted instruction
Instructional techniques used	Pearson Correlation	1		
	Sig. (2-tailed)			
Use of computer-assisted instruction	Pearson Correlation	.580**	1	
	Sig. (2-tailed)	0.000		
Computer-assisted instruction	Pearson Correlation	0.407	0.104	1
	Sig. (2-tailed)	0.642	0.306	
Academic performance among learners with HI	Pearson Correlation	.622**	.631**	.411**
	Sig. (2-tailed)	0.000	0.000	0.000
N		60	60	60

\*\* . Correlation is significant at the 0.01 level (2-tailed).

The study findings indicated that there was a statistically significant positive correlation between instructional techniques used and academic performance among learners with hearing impairment ( $r = 0.622$ ,  $p < 0.05$ ). Thus, the null hypothesis: '*H<sub>01</sub>: There is no relationship between the use of computer-assisted instruction and learning of numeracy skills among learners with HI in selected primary schools in Kenya*' was rejected. This finding corroborates those of Rusyani *et al.* (2021), who similarly found that interactive teaching methods, such as the Team-Games-Tournament (TGT) approach, significantly improved learning outcomes among students with hearing impairment in Indonesia. The collaborative nature of instructional techniques appears pivotal in enhancing numeracy skills and academic performance in this population (Rusyani *et al.*, 2021).

The use of CAI showed a significant positive correlation with academic performance among learners with hearing impairment ( $r = 0.631$ ,  $p < 0.05$ ). These findings are supported by Rogayan *et al.* (2021), whose study in the Philippines demonstrated that CAI effectively improved both motivation and academic performance in social studies among secondary school students. This aligns with the notion that technology-mediated

learning can enhance educational outcomes by providing accessible and engaging learning opportunities tailored to specific learning needs (Rogayan *et al.*, 2021). CAI had a statistically significant positive effect on academic performance among learners with hearing impairment ( $r = 0.411$ ,  $p < 0.05$ ). These findings agree with those of Adeniran and Daranijo (2023), who observed improved mathematics performance among students with hearing impairment in Nigeria when CAI was employed. The consistent positive impact of technology in enhancing academic achievement underscores its potential as a valuable tool in special education settings (Adeniran & Daranijo, 2023).

## 5. Conclusions

Based on the findings, it is logical to conclude that there was a positive relationship between the use of computer-assisted instruction (CAI) and the learning of numeracy skills among learners with hearing impairment in selected primary schools in Kenya. Augmentative devices and assistive listening devices were highlighted as effective tools in enhancing the understanding of content and communication for these students.

## 6. Recommendations

- 1) Given the positive relationship identified between computer-assisted instruction (CAI) and the learning of numeracy skills among learners with hearing impairment, it is recommended that primary schools in Kenya enhance their utilization of CAI tools and resources. Schools should invest in accessible and adaptable CAI platforms that cater to the specific needs of learners with hearing impairments.
- 2) For further research, it is suggested to explore the long-term effectiveness and sustainability of computer-assisted instruction (CAI) in enhancing numeracy skills and academic performance among learners with hearing impairment in primary schools.

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### **Conflict of Interest Statement**

The authors declare no conflicts of interest.

### **About the Author(s)**

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