COMPUTER-ASSISTED LEARNING ON ENGLISH LANGUAGE WRITING SKILLS AMONG LEARNERS WITH HEARING IMPAIRMENTS IN KIAMBU COUNTY, KENYA

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DECLARATION

I declare this thesis my original work which has not been presented in any other university or learning institution for consideration of any certification. This research thesis has been complemented by referenced sources duly acknowledged. Where text, data, or tables have been borrowed from other sources, including the internet, these are specifically accredited, and references are cited using the current APA system and in accordance with anti-plagiarism regulations.

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DEDICATION

I dedicate this work to my mother, Martha Wangui for her invaluable support towards my education and my late grandfather, Paul Kamau (1930-2014), whose unyielding commitment to constant learning remains the force behind my unending desire for quality education for myself and future generations.

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ABBREVIATIONS AND ACRONYMS

CAL	Computer Assisted Learning
HI	Hearing Impairments
HL	Hearing Loss
KCSE	Kenya Certificate of Secondary Education
SL	Sign Language
TC	Total Communication

ABSTRACT

Despite research showing that integration of CAL in the teaching and learning process has helped to improve performance in different learning areas, data has continued reveals that learners with hearing impairments perform dismally in English writing skills. The purpose of this study was therefore to ascertain the effectiveness of CAL in improving writing skills of secondary school learners with HI in Kiambu county Kenya. The following four objectives guided the study; determine the level of English writing skills of learners prior to the implementation of CAL at Kambui School for HI, establish the effect of CAL on learners' English writing skills, investigate how learners' degree of hearing loss affects English writing skills when using CAL and when using CAL, determine the effect of gender and age on English writing skills. The study was guided by the Cognitive Theory of Multimedia Learning. The study adopted single subject Quasi-Experimental research design. The study was conducted at Kambui Secondary School for the hearing impaired. The study consisted of 19 participants who were learners with hearing impairments: 8 female and 11 were male. The Written Test of Language Development was administered before and after the treatment. Treatment using CAL was provided using the English Grammar Test application. Quantitative data was collected and analyzed using both inferential and descriptive statistics and results were displayed in frequency distribution tables. Results showed that learners with HI improved their English writing skills after utilizing CAL. In addition, hard of hearing learners performed better than their deaf counterparts in English writing skills when using CAL. As a result, the study concluded that CAL positively influences English writing skills of learners with HI. Consequently, the researcher recommends that KICD should consider digitizing content and resources on writing skills for learners with hearing impairments. Currently, learners with hearing impairments struggle to access the curriculum using different pedagogical methods than their hearing peers, which leads to an overreliance on sign language and traditional pedagogies.

CHAPTER ONE

INTRODUCTION AND CONTEXTUALIZATION OF THE STUDY

1.1 Introduction

This chapter entails the background to the study, statement of the problem, the purpose of the study, objectives of the study, research questions, research hypotheses, significance of the study, limitations and delimitation of the study, assumptions of the study, theoretical and conceptual frameworks, and operational definitions of terms.

1.2 Background to the Study

The United Nations Educational, Scientific, and Cultural Organization affirms that universal access to quality education is a fundamental right (UNESCO, 2021). Unquestionably, the Kenyan government remains committed to education, allocating a significant portion of the national budget and gross domestic product (GDP) to this sector, while also implementing significant policy and legal framework reforms. The 2010 constitution secures the right of every child to access free and compulsory basic education that is of excellent quality (Constitution of Kenya, 2010). The Basic Education Act of 2013, article 14, further affirms this commitment to providing accessible, equitable, and quality education for all children in the country. This promotes inclusive education, ensuring that children with disabilities, marginalized groups, and other vulnerable populations have equal access to educational opportunities (Basic Act, 2013). Realizing the unique learning abilities and capabilities of each individual learner, the Government of Kenya (GoK) rolled out the Competency-Based Curriculum (CBC), which emphasizes the development of core competencies over mastery of content (KICD, 2020). For instance, in 2024/2025, the government allocated 3.92 trillion (27.6%) of the

national budget to the education sector. Therefore, it would be a costly endeavor to invest in education without fulfilling its intended purpose.

According to the Ministry of Education, there are four English language skills, which include listening, speaking, reading, and writing (MoE, 2020). Furthermore, the MoE underscores the critical role of writing skills in the national curriculum, emphasizing their progressive development across all educational levels. The CBC Curriculum emphasizes writing as a means of communication, creativity, and critical thinking. The CBC Curriculum encourages learners to express ideas coherently and effectively through various forms of writing, such as descriptive, narrative, and expository styles. The MoE focuses on building writing skills through structured exercises in grammar, punctuation, spelling, and sentence construction, while also fostering creativity and clarity in conveying information. Continuous assessment tests and national examinations assess writing proficiency to ensure learners meet the expected standards of language use and expression. According to Alghammas (2020), developing the art of good writing is crucial for learners to excel in both academic and professional levels. All learners must possess strong writing skills to enhance their employability and meet educational requirements.

According to Ching, Dillon, Leigh, & Cupples (2018), learners with hearing impairments have demonstrated greater difficulties in developing their writing skills. Their auditory limitations cause them to struggle with understanding and acquiring English syntax and morphology, which leads to numerous errors in sentences. The difficulties learners with HI face in reading limit their exposure to examples of effective writing. In addition,

teachers choose to embrace approaches limited to writing at sentence level; learners with HI-written work, albeit correct, may disinterest the reader and lack cohesion and informativity (Dostal & Wolbers 2020). However, the writings of learners with HI differ significantly from those of hearing learners. According to Wolbers, Dostal & Bowers (2018), learners with HI often exhibit simple and rigid writing styles, characterized by fewer words, incomplete sentences, minimal subordinate clauses, fewer noun phrase modifiers, and frequent omission of functional words. A study by Kerubo (2019) revealed that the mode of instruction among learners with HI is one of the factors that influences their English language performance.

Hearing impairment is defined by IDEA (2020) as an impairment in hearing, whether permanent or fluctuating, that adversely affects educational performance. When a person cannot hear as well as someone with normal hearing, they are considered to have hearing impairments. This means the person has a hearing threshold of more than 20 dB or better in both ears (ASHA, 2020). According to the World Health Organization, a deaf person is one who has significant hearing loss and primarily uses sign language for communication. A person who is incapable of hearing experiences mild to severe hearing loss, yet they are still capable of verbal communication (WHO, 2021). Due to their auditory input limitation, learners with hearing loss, unlike their hearing peers, face greater challenges when learning using traditional pedagogies.

Technological advancement has continued to influence and shape various spheres of human life in the 21st century. As posited by Gnambs (2021), computers are vital, and their influences are notable in almost all domains of life. In education, this has led to

transformation through productive and interactive instructional strategies (Jogezai et al., 2021). We categorize Computer Assisted Learning (CAL) as computer-based learning that utilizes audio and visual content to enhance students' motivation. CAL establishes a setting where computer programs and applications aid in the teaching and learning of various subjects (Bianchi et al., 2022). The use of CAL in presenting information, testing, evaluating, and providing feedback using computers fosters creativity and problem-solving skills, leading to independence among the learners (DeCoito & Estaiteyeh, 2022).

According to Budiarto and Rejekiningsih (2021), learners with HI greatly benefit from the use of CAL, as it provides tailored support that enhances their educational experience. CAL tools, such as interactive software, multimedia content with visual aids, and sign language videos, allow these learners to access information in a more engaging and accessible manner. These technologies help bridge communication gaps by offering visual representations, captioning, and sign language interpretation for lessons. Furthermore, computer-assisted learning promotes independent learning, allowing students to progress at their own pace and receive immediate feedback, thus improving their comprehension and academic performance.

The United States of America has well-thought-out CAL as a technique to improve learners' performance and subject skills. CAL involves a personalized interaction with audiovisual aids that enhance classroom demonstrations, accelerate learning, and provide immediate feedback (Zhao & Lei, 2019). Additionally, Fraser, Walberg, Welch, and Hattie (2019) found that CAL led to improved learners' concentration, teamwork, success in various subjects, and a comprehensive curriculum. Similarly, Bangert and Kulik

(2020) found that learners who receive CAL study more efficiently and quickly, and they also have a higher capacity for retention.

According to Daintith and Wright (2019), the use of CAL has become increasingly notable in more challenging subjects such as sciences. This is due to its capacity to deliver information in various formats such as texts, audio, and visuals, thereby enhancing memory stimulation. Students can learn at their own pace, redo areas they feel were lacking, and share with classmates. The incorporation of animated graphics and three-dimensional aspects enhances the learning experience (Sanger & Greenbowe, 2020). This gave learners with HI the chance to engage in self-guided instruction, which is crucial for achieving significant academic success.

In Europe, Jason, Rachels, and Rockinson-Szapkiw (2018) conducted a quasi-experimental study to study the influence of CAL on Spanish language achievement among third and fourth grade students, with findings indicating learners' posttest performance significantly improved compared to the pretest. Further, a study by Ivers and Barron (2019) on the efficiency of CAL in instruction of chemistry, biology, and physics found that the use of CAL had improved the educational outcomes of learners through improved academic achievements, attitudes, and motivation among secondary school learners. Gustavo, Frederik, & Chang (2019) conducted a study in Belgium and found that learners showed interest in using the Duolingo application for language learning. The learners concluded that the application was well-intentioned because it assisted them in language acquisition and matched their individual needs and preferences.

A study by Abhijit, Shawn, Esther, and Leigh (2019) found the use of computer-assisted learning in India to have greatly helped to improve performance in mathematics among the learners without hearing loss. During the two consecutive years of the study, the scores of learners who received instruction using Computer-Assisted Learning (CAL) significantly improved compared to those who did not. Reports also indicated that the learners had developed a previously absent interest in the subject. In further studies in the Philippines, for instance, Jarata (2019) found the use of CAL to have improved the performance of English grammar among college students. This was after the posttest, during which the learners in the experimental group produced satisfactory results compared to their peers in the control group. The wide range gap in performance after the posttest shows how effective CAL was in improving the performance. Fafchamps and Mo (2018), in China during the 2011–2012 academic year, piloted a randomized controlled study on peer effects of CAL. This involved providing remedial tutoring in mathematics, with the goal of emphasizing the school's regular curriculum using CAL. At the end, the learners had improved their mathematics scores. Ranade (2019) discovered that CAL provided learners in secondary school chemistry with fresh opportunities and experiences, in contrast to traditional teaching methods.

Countries in Africa have not lagged behind in this technological advancement. Both the Continental Education Strategy for Africa (CESA) 2016–2025 and the Africa Agenda 2063 emphasize the importance of leveraging information and communication technology (ICT) as a crucial tool for achieving high-quality education. The third strategic objective of CESA emphasizes the importance of utilizing ICT to improve education and training systems management, quality, and accessibility. Furthermore, the

strategy anticipates that African countries will create their own ICT integration plans, increase their capacity to integrate ICT, and create mobile and all-accessible platforms for education and training. Developing nations have also boosted their budgetary allocations on ICTs for schools despite the absence of adequate empirical data regarding the results of such initiatives (Piper et al., 2024).

Rwanda, like many other countries, has adopted ICT integration into their system of education. Rwanda has been working to ensure that her people are comfortable using ICT to ensure every student received the best possible education (Farrell, 2019). As a result, Rwanda's Vision 2020 plans to integrate ICT at all levels of education (Rwanda Vision 2020). With the support of UNICEF and UNESCO, Rwanda has embarked on Accessible Digital Textbooks (ADT) initiatives, which transform textbooks into accessible formats by digitally incorporating audio text and sign language to allow learners with HI access learning content equally as their peers without hearing loss (eKitabu, 2021).

In South Africa, CAL has gained significance, especially as a means of addressing gaps in educational access and quality. The necessity to address issues with infrastructure, teacher shortages, and resource gaps, particularly in underfunded schools, has prompted the incorporation of CAL into South African education (Bonsu et al., 2020). Through several initiatives, the South African government's Department of Basic Education (DBE) has introduced CAL tools to improve learning results. The DBE initiated the e-Education Policy as one such initiative to promote the use of computers and the internet in the classroom for teaching and learning purposes. Furthermore, the Thutong Education Portal, an online resource center that provides digital information, instructional materials,

and tools to support computer-based learning to teachers and students, has enhanced CAL use (Hartley & Treagust, 2019).

According to Kamatongo and Muzata (2021), the government of the Republic of Zambia, through the Ministry of Education, recognizes the rights of learners with HI to have access to excellent and quality education. Their study revealed that learners with HI in the country faced numerous challenges when learning languages, causing them to lag behind their peers. Furthermore, the study uncovered a lack of adequate teaching and learning materials, as well as a shortage of qualified, supportive teachers who had positive attitudes towards teaching learners with hearing impairments, despite the government's commitment to providing high-quality education to all students. CAL helped provide additional instruction methods for learners with HI to complement the underlying challenges.

CAL has become an increasingly important aspect of education in Kenya, particularly in addressing disparities in access to high-quality learning materials. Government programs like the Digital Literacy Program (DLP), which brought tablets to public schools, and collaborations with private organizations for online learning platforms like Eneza Education and Longhorn e-learning are examples of important initiatives (MoE, 2022). In addition to supporting remote learning during the COVID-19 pandemic, CAL has proven especially helpful for subject areas such as math and science.

Researchers have conducted studies to investigate the effectiveness of CAL on learners' performance. A study by Murithi (2022) proved that CAL is an effective tool in

improving the performance of learners with hearing impairments in primary school. In addition, a study by Ong'onda, Anashia, and Muindi (2019) investigated the effectiveness of CAL software on training pronunciations on Kenyan English phonetics at a university class. The study noted that learners pronounced different words in Kenyan English with fewer difficulties. Another study by Nduati (2015) in Murang'a County on the effect of computer assisted learning on secondary school students' achievement in chemistry showed that the learners were able to improve their chemistry results. Samuel (2022), on secondary school science performance enhancement using CAL, noted the use of CAL to have greatly enhanced the performance of learners in science subjects. Rwaimba (2024) conducted a study on the use of CAL to teach story grammar to learners with HI in secondary school, which showed that integrating ICT technologies positively impacts the performance of learners with HI.

As cited in Maina et al. (2020), English is one of the difficult subjects for all students, not only those with HI. According to Maina et al., a majority of learners with HI graduate from secondary school, while their comprehension of English words is still rather low. Their continuously poor performance in English in the Kenya Certificate of Secondary Examination (KCSE) serves as evidence. The Kenya National Examination Council (KNEC) divides the KCSE English examination into three main papers: Paper 1 (functional skills), Paper 2 (comprehension, literary appreciation, and grammar), and Paper 3 (creative composition and essays). Writing skills play a crucial role, especially in Paper 1 and Paper 3. Paper 3 specifically concentrates on writing skills, emphasizing original and creative composition, which can significantly influence the final English

score. Other papers frequently incorporate writing into their comprehension and functional writing sections.

According to Haider, Ali, and Ikram (2022), writing skills and inscription abilities are important pieces of correspondence and communication procedures through which people can communicate their musings, sentiments, and views. In addition, excellent writing skills are necessary for personal and professional communication throughout life, including in job applications and reports. Writing skills for learners with hearing impairments can present unique challenges due to language exposure limitations, especially in environments where sign language is the primary mode of communication. Learners may struggle with complex sentence structures due to differences between sign language and written language grammar (Gunawan et al., 2020). Additionally, using learner-centered methods that engage learners with HI at all levels by stimulating all senses, particularly the sense of sight for the deaf and the auditory senses for the hard of hearing, is the only way to elicit and sustain the interest and passion that learners with HI have for writing due to communication limitations.

Historically, pedagogical strategies for teaching learners with HI have relied heavily on manual communication methods such as sign language and traditional written language instruction. While effective, these methods can limit access to a broader range of learning experiences, particularly in areas like auditory comprehension or multimedia engagement. Incorporating CAL into teaching and learning enhances understanding, expands educational access, and improves learners' overall learning experience with HI (Sitara & Geetha, 2022).

Researchers generally agree that using computers in teaching and learning improves learning outcomes and is essential for equipping HI learners to deal with globalization problems in the twenty-first century (Mbodila & Kikunga, 2012). Data from KNEC (2018-2022) shows that over the past five years, the performance of learners with HI in the KCSE English examination has remained below average. On average, deaf students have scored below 4.0 points out of a possible 12. Therefore, experimenting with the integration of CAL into the teaching and learning process may yield better results in English writing skills.

Over the years, the adoption of CAL in a variety of subject areas, including chemistry, mathematics, languages, and social science, has proven effective in improving the performance of learners, with the majority of the studies focusing on hearing learners. In his study, Rwaimba (2024) recommended conducting additional research on the integration of computers in teaching writing skills to high school learners with hearing impairments, citing successful results in improving story grammar performance in Embu and Tharaka Nithi counties. The researcher's goal in the current study is to investigate the effectiveness of integrating CAL into teaching English writing skills among learners with HI in Kiambu County. Given the gaps in knowledge and the background of the target population, the researcher believes that this research is worth contributing to.

1.3 Statement of the Problem

The writing skills of learners with hearing impairments in Kenya are significantly underdeveloped, leading to poor academic performance, especially in subjects like English. This issue stems from gaps in language acquisition, as learners with hearing

impairments often struggle with vocabulary, grammar, and syntax due to limited exposure to spoken or written language. Additionally, traditional teaching methods do not adequately address these unique challenges.

In KCSE, 100% of the performance in all 3 English papers depends on the learner's ability to write and express ideas in a logical, concise, and creative manner. For learners with hearing impairments, focusing on writing skills is critical because writing serves as a primary mode of communication, allowing them to express ideas and interact with the world. Given their limited access to auditory language, strong writing skills help bridge communication gaps. Additionally, writing fosters critical thinking, creativity, and comprehension of language structures, which are essential for future opportunities in education and employment. Improving these skills can greatly enhance their inclusion in society.

Due to the influence of sign language, English writing skill acquisition remains a significant issue for learners with HI. As such, teachers should explore all pedagogical options that may support the acquisition of English writing skills (Kerubo, 2019). KCSE The use of traditional pedagogical approaches may have contributed to the poor English performance of learners with HI over the years. This underscores the necessity for this study to explore the effectiveness of CAL among secondary school learners with hearing impairments, with the aim of determining whether the introduction of a technological approach can improve their writing skills.

1.4 Purpose of the Study

In Kiambu County Kenya, the study sought to ascertain the effect of CAL in improving English language writing skills among secondary school learners with hearing impairments.

1.5 Objectives of the Study

The study's objectives were to:

i. Establish the level English writing skills of learners prior to the introduction of CAL.
ii. Investigate the effect of CAL on learners' English writing skills.
iii. Investigate how learners' degree of hearing loss affects their English writing skills when using CAL.
iv. When using CAL, determine the effect of gender and age on English writing skills.

1.6 Research Hypothesis

The research hypothesis:

H_{01}: There is no significant difference in English writing skills when using CAL.

H_{02}: There is no significant difference in English writing skills when using CAL based on degree of hearing loss.

H_{03}: There is no significant difference in English writing skills when using CAL based on gender.

H_{04}: There is no significant difference in English writing skills when using CAL based on age.

1.7 Significance of the Study

The goal of the study was to help learners with hearing impairments acquire writing skills effectively. Some of the contributions include:

a) Help teachers of learners with hearing impairments integrate CAL into teaching English writing skills, as it influences the choice of pedagogical approach.
b) Learners with HI can increase their interest in utilizing CAL to improve their English writing skills, which in turn leads to good performance in KCSE.
c) Software developers may also use the results of these findings to create accessible computer applications that support learners with HI.
d) Enable the Ministry of Education to integrate CAL into learners' teaching and learning processes with HI.
e) Serve as useful reference material for special education researchers, scholars, and other individuals interested in the welfare of learners with HI.
f) Bridge the existing gaps in literature and create new knowledge in the field of special needs education.

1.8 Limitation and Delimitation

1.8.1 Limitation of the Study

Despite the use of purposive sampling, the sample may not have accurately represented the entire spectrum of hearing impairments. This depends on the age at which HI begins, as congenital deafness affects language acquisition more than post lingual deafness. The researcher used a single-subject quasi-experimental design, which presented a threat to internal validity. To overcome this, the study population was subject to pretest, treatment, and posttest. The Ministry of Education's guidance on syllabus coverage limited the

number of lessons the researcher could allocate during the period. Therefore, the researcher utilized remedial lessons to support the learners. Controlling the study's limitations led to the findings' generalizability.

1.8.2 Delimitation

The study focused solely on utilizing CAL to enhance writing skills, despite the existence of alternative teaching strategies. This was due to the widespread use of computers and the accessibility features of CAL, which meet the unique disability needs of learners with hearing impairments. The research focused on writing skills and did not investigate other language skills. This is because English writing skills account for 100% of KCSE marks, and learners must seek proficiency in order to improve their performance. The study did not examine other key stakeholders in education, such as teachers, school administration, parents, and the government. This allowed the study to rely on data from the primary users of CAL collected during the pretest, treatment, and posttest.

1.9 Assumptions of the Study

The study assumed that learners and teachers were knowledgeable about the use of computers and CAL applications. There were applications that were readily available and enriched with writing skills used by the learners. During the study, it was also assumed that the area had good internet coverage and electricity supply.

1.10 Theoretical and Conceptual Framework

1.10.1 Theoretical Framework

The study adopted the cognitive theory of multimedia learning by Mayer (2001). The theory's framework explains how effective learning occurs when instructional materials combine multimedia elements such as words and pictures. Several cognitive principles focusing on how learners process information form the foundation of the theory.

Mayer (2001) posits that individuals learn more effectively when presented with information through both visual/pictorial and auditory/verbal channels. Each channel has a limited capacity to process a certain amount of information simultaneously. This suggests that instructional design should avoid overwhelming learners with too much information at once. For meaningful learning to occur, learners need to engage in active cognitive processing. This includes selecting relevant information, organizing it into a coherent mental structure, and integrating it with prior knowledge. As such, learners tend to learn better from a combination of words and pictures than from words alone. Furthermore, the close presentation of related words and pictures in time or space enhances learners' learning and facilitates easier connection-making. Additionally, presenting verbal information as speech instead of on-screen text prevents visual overload and optimizes the use of the auditory channel.

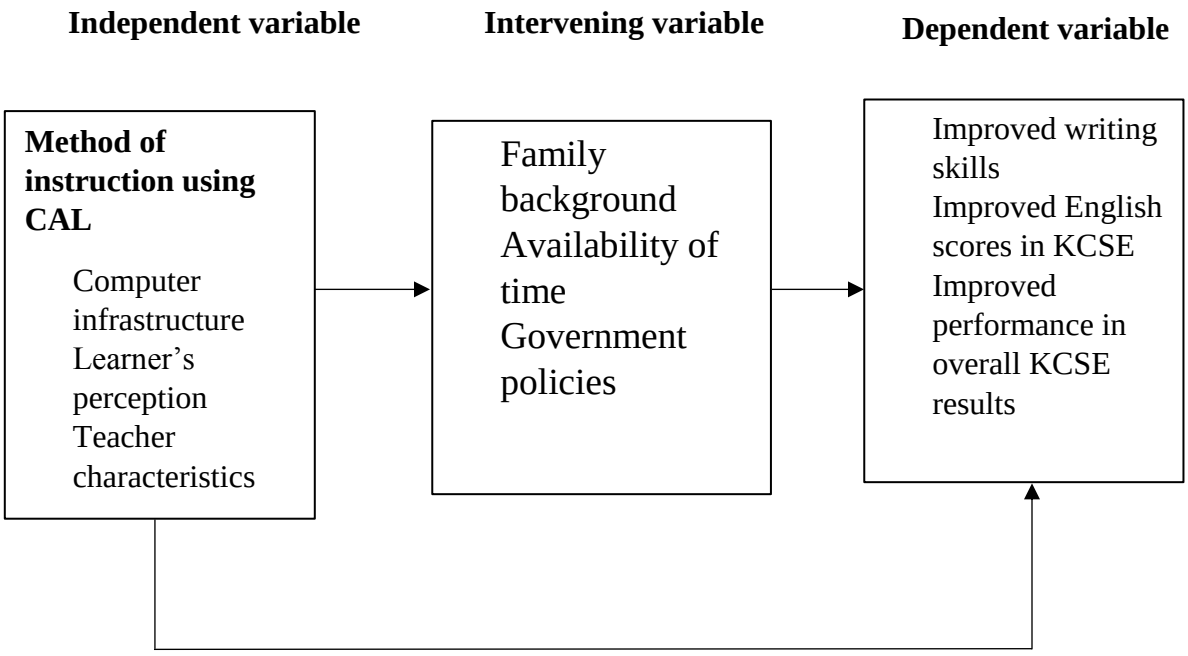
The Cognitive Theory of Multimedia Learning was considered ideal to guide the study because it considered the auditory limitations of learners with HI and how CAL can be integrated in the teaching and learning process. First, the dual channels of information processing help the different categories of learners with hearing impairments. Lin,

Niparko, and Ferrucci (2019) define Hard of Hearing (HoH) learners as those with hearing loss, ranging from mild to severe, who can communicate through spoken language, captioning, cochlear implants, hearing aids, and other assistive technologies. Therefore, this group of learners was able to benefit through stimulation of both auditory and visual channels. Deaf learners, specifically those with profound hearing loss, who often rely on sign language for communication, utilize their visual perception to acquire information. Therefore, CAL focused on visual aids, such as pictures, videos with subtitles, sign language interpretation, and written text instructions to reinforce learning. Visual animations were used to supplement the absence of auditory input and help improve engagement and understanding.

Secondly, writing is a cognitive process that requires the integration of different elements such as grammar, vocabulary, and structure. CAL facilitated active processing by offering interactive exercises that prompted learners to actively construct sentences, choose the right words, and organize their thoughts. For instance, the CAL application presented visual prompts or sentence starters, expecting learners to engage in active cognitive processing by dragging and dropping to form correct sentences. Lastly, teaching writing to learners with HI through multimedia, such as visual stories, diagrams, and interactive text-based exercises, helped them form better associations between concepts and writing skills. Mayer's multimedia principle, which emphasizes the integration of text and visuals for enhanced learning effectiveness, aligns with this approach. For example, the use of illustrated images that show an action (like "running") paired with the written word or sentence could strengthen vocabulary learning and sentence formation. This approach effectively suited the study, as it allows an English

teacher to link the learner's auditory limitations with the use of the CAL application, thereby improving their writing skills.

1.10.2 Conceptual Framework



Source: researcher own (2022)

Figure 1.1: Conceptual Framework

Figure 1.1's framework demonstrates how various dimensions interact to effectively integrate CAL, thereby enhancing the writing skills of learners with hearing impairments. The school's availability of computer infrastructure (computers, internet, projectors, etc.) influenced the method of instruction using CAL, an independent variable that facilitated smooth interaction between the devices and the learners. When using computers, learners' perceptions influence their confidence and efficacy, which in turn affects their performance. A negative attitude among learners may lead to a resistance to integrating CAL into the learning process. Additionally, the teacher's competence in the subject

content and their ability to support learners with HI and technological skills influence the delivery of the curriculum. Therefore, how the teachers combine the three dimensions will affect the study's outcomes. The intervening variables were monitored as they had noteworthy influence on the study. Effective integration of CAL in the learning process resulted in improved writing skills among learners with HI. His continuous application of these skills could result in improved English scores in KCSE and the overall performance of the learners.

1.11 Operational Definition of Terms

CAL Refers to the use of computers and related technologies to facilitate the educational process, typically by enhancing learning and teaching. CAL uses software, multimedia, or online platforms to support and deliver instructional content, practice exercises, and feedback (Sharma, 2019).

Deaf person Is one whose hearing is disabled to an extent (usually 70 dB or greater) that precludes the understanding of speech through the ear, without or with the use of a hearing aid (ASHA, 2020).

Deafness A hearing impairment that is so severe that the child is impaired in processing linguistic information through hearing, with or without amplification that adversely affects a child's educational performance (ASHA, 2020)

Hearing impairments A person who is not able to hear as well as someone with normal hearing this means the person has a hearing threshold of more than 20 dB or better in both ears (ASHA, 2020)

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

In this chapter, related literature was reviewed on the following topics: levels of writing skills among the HI learners before and after the introduction of CAL, and the role of age, gender, and level of hearing loss in improving English language writing skills when using CAL.

2.2 English Writing Skills of Learners with Hearing Impairments

The significance of good writing, whose utility is not limited to Kenya but worldwide, need not be overemphasized. Russell (2023) opined that openings are available for those with excellent English writing skills because of continually growing international exchanges and interactions. In the Kenyan system of education, English plays a major role in curriculum delivery at all levels. All other subjects, except Kiswahili and foreign languages, use English as both a language of instruction and examination. This leaves English at the center of learners' achievement, not only in the English subject but also in all other learning areas whose language of testing is English (Cox & Graham, 2019). According to Dietz and Wilson (2019), one's capacity to create an extensive text is a predictor of academic achievement. Because writing incorporates tests of memory, language, and thinking skills, it is referred to as a cognitive task (King & Quigley, 2020). Additionally, language competence is required to produce coherent text that expresses the topic clearly. Working memory's task is to produce extended text that represents the intended ideas, the text's written meaning, and the reader's imagined meaning during text production.

The ability of learners to produce fluent written text is limited until they understand the art of handwriting and spelling (McCutchen, 2018). He adds that it is important to learn the art of writing in early years because it frees up working memory components involved in planning, generating, and reviewing written text. Learners should master handwriting and spelling skills in order to maintain the creation of written text (Graham & Harris, 2019).

Hearing impairments have a significant impact on language acquisition and development, which is closely related to the development of writing skills. Learners with hearing impairments often face challenges in written expression, stemming from limited access to auditory language input during early childhood. The absence of hearing during critical language development periods can result in delays in the acquisition of syntax, grammar, and vocabulary (Graham & Harris, 2019). In addition, hearing loss at an early age can impact oral communication development as it restricts access and input to speech and language. First, it is important for a child with hearing impairments to acquire language for effective communication. Various methods can be used to acquire language, such as the auditory-verbal approach, natural oralism, maternal reflective method, total communication approach, and bilingualism method.

According to Easterbrooks and Beal-Alvarez (2021), language development for learners with hearing impairments typically relies heavily on visual language modalities, such as sign language. However, transitioning from sign language to written forms of spoken language poses additional complexities. Research suggests that these learners may struggle with the syntactic structures of written language, as their primary language

modality (sign language) has different grammatical rules compared to spoken languages. For instance, learners with hearing impairments often exhibit shorter and less complex sentence structures, a tendency to omit function words (e.g., articles, prepositions), and difficulty with verb tenses and agreement. These limitations can lead to difficulties in constructing coherent, grammatically accurate written texts.

DeVries et al. (2018) found that children with hearing loss often struggle with their grammatical and vocabulary skills, as well as their phonological abilities in school. Students with hearing difficulties, particularly those who were born with them, have a significant impact on the acquisition of writing skills in language development. Most students with HI have a very difficult time learning writing skill (Browder, Spooner, & Courtade 2020). According to Berk (2018), for learners who have mild to moderate hearing losses, the effect of learning writing skills may be insignificant. Additionally, for individuals with pre-lingual moderate hearing loss, oral communication skills can be facilitated by the perceptible voiced sounds of audio speech, which may facilitate the development of writing skills.

Humphries, Kushalnagar, Mathur, Napoli, Rathmann & Smith (2019) established the positive effects of sign language and parental encouragement. By using sign language and providing necessary support, parents with hearing loss may be able to communicate with their children more effectively. Encouragement of writing practice at home with parents, as opposed to just in the classroom, significantly increases students' writing skills achievement. Parents who write to their children, give them books, control how much TV

they watch, and provide them with interesting experiences assist their students in learning writing skills (Hall, 2019).

Bilal et al. (2023) conducted a study in Pakistan on teachers' perspectives on teaching English writing skills, finding that most students in public sector institutes do not perform well in English language writing tasks and ultimately face average to poor academic results. This is largely because teaching English writing skills involves developing the learner's linguistic and communicative competence, which is quite a challenging task. Conventionally, teachers of the English language make use of textbooks and chalkboards to deliver their lessons (Plastina, 2023). This text-centered approach has been primarily focused on meeting the language development needs of learners. Practically speaking, the materials and activities selected generally involve performing grammar and vocabulary exercises. This way, learners are regarded as only passive language recipients. Therefore, the process of teaching and learning fails to assist learners in addressing the challenges associated with their cognitive thinking skills, real-life situations, and topical content, among other areas.

Souriyawongsa (2022) conducted research at the LAO National University (Democratic People's Republic of NUOL) on the factors that contribute to students' poor performance in English subjects. He discovered that the use of antiquated teaching techniques, which made the learning process boring and uninteresting, was one of the main causes of learners' low achievement in English, leaving them disinterested and bored.

Naba’h (2022), in his investigation into how CAL affected Jordanian secondary school pupils' proficiency in English grammar, discovered that students taught English grammar using traditional methods performed poorer than those taught English grammar using CAL. Naba'h used a sample of 212 students divided into experimental and control groups for this study. While those in the control group received the same education in English grammar via traditional teaching styles, the experimental group learned the subject through computer-assisted language learning software. Both groups took pre- and posttests to assess the effectiveness of CAL in English grammar learning. The results indicated that the continuation of traditional teaching strategies perpetuates low English achievement. Due to the small group of learners under study, the current study utilized a single subject quasi-experimental design, without assigning the learners to either an experimental or control group.

Banda (2019) conducted a study in South Africa involving 10 second-year university students, all female, aged between 19 and 23, who came from the Eastern Cape Province and primarily spoke isiXhosa language. These students had completed their primary and secondary education in areas with limited English language instruction. The study's findings revealed a low level of proficiency in academic writing. The common writing deficiencies identified included lack of coherence and cohesion in argument structure, over-reliance on primary (informal) discourse, and difficulties shifting to formal academic discourse. Also, there was poor sentence structure with either overly long or excessively short sentences. Grammatical errors, including poor concord, incorrect tenses, and word choice issues, were also reported. In addition, there was a limited vocabulary and minimal use of complex grammatical structures such as nominalization.

Students' overreliance on spoken, informal English, more prevalent in their communities and schooling than formal academic English, exacerbated these issues. The current study focuses on learners with hearing impairments in secondary school's writing skills and strategies to improve them.

Ebotagbo and Anyang (2024) conducted a study in Cameroon to explore the reasons for the dearth of English writing skills among students at the University of Yaounde. The study aimed to highlight a link between dearth of writing skills and the teaching approach, as well as ignorance and neglect by the students. The study was qualitative and used 650 written documents from Yaounde University's Department of English to assess writing skill proficiency through an error analysis approach for grammatical errors, organizational errors (such as in paragraph organization and formal letter structuring), and strategic communication errors. The written exercises identified numerous errors related to grammatical infelicities, spelling errors, paragraph structure and organization, as well as writing in accordance with expected norms and registers. All the findings pointed to poor teaching approaches vis-à-vis the attainment of proficiency in writing skills, as well as gross neglect by the students' application of rules and lack of practice. The current study utilized a quasi-experimental design, allowing the researcher to identify the learner's areas of need and provide treatment, thereby introducing a change in the teaching methodology.

Niyibizi, Bazimaziki, Karengera, and Muragijimana (2024) conducted a case study in Rwanda with the aim of investigating the impact of English writing skills on learners' performance in secondary schools in Kicukiro District. Guided by Vygotsky's

sociocultural theory and Richards' Communicative Language Teaching (CLT), the study used a mixed-methods approach. The study targeted 147 participants, including learners, teachers, and heads of studies, from which proportionate stratified and purposive sampling techniques selected a sample of 75 participants. Primary data was collected through both interviews and questionnaires, assessing the impact of English writing skills on learners' performance, exploring effective teaching approaches, identifying factors contributing to low English writing skills among learners at secondary schools in Rwanda, and examining the influence of teaching strategies on learners' writing skills. The study's findings suggest that regular writing activities such as letters and short stories can improve learners' writing skills. English teachers should serve as role models for their students during instruction to enhance their writing motivation. Current research has explored the need for integrating CAL in teaching the writing skills of learners as technology has become a widespread advancement and has been proven to improve learners writing abilities.

Studies on learners' writing skills and how to improve them have taken place in Kenya. Patrick (2019) highlighted that schools often expose learners with hearing impairments to American Sign Language (ASL) as they develop literacy skills in English. The results of Kenya Certificate Primary Education conducted by the Kenya National Examination Council in Kenya since the year 2010 showed that learners with hearing impairments at Njia Special School performed poorly in English. The study sought to establish strategies for teaching written English to learners with HI at Njia Special School. This study employed a descriptive survey design. This study included a sample of five English language teachers, eight learners with HI, and one head teacher. The study's findings

revealed that teachers lacked adequate knowledge of strategies and projects that could enhance writing among learners with hearing impairments. Instead, they relied on methods such as teaching new words, incorporating them into sentences, copying sentences, and engaging in continuous writing that was not done frequently. This approach failed to elevate learners to the desired writing level.

A study by Rwaimba, Muriithi, and Muthee (2024) used a quasi-experimental research design combined with a descriptive survey design to look at how using ICT in the classroom affected the grammar skills of secondary school students with hearing loss in the counties of Tharaka Nithi and Embu in Kenya. The Technological Pedagogical Content Knowledge (TPACK) theory guided the study. Purposively, a secondary school for learners with HI was picked from each county. The sample size consisted of all 40 learners, two English teachers, and the principals from the two sampled schools. Learners were presented with a Students Story Grammar Achievement Test (SSGAT) for pre- and post-test. The study findings revealed that ICT integration enhances story grammar achievement ($t = 2.415$, $p = 0.0180$) among secondary school learners with hearing impairment. The study focused on story grammar, which is part of English grammar, while the current study focused on the English writing skills.

Ayabei, Omulando, and Barasa (2019) conducted a study to evaluate the effectiveness of group work in teaching writing skills in secondary schools in Keiyo North sub-county, Kenya. The study used a descriptive survey research design, and it targeted 43 English teachers and 3,574 Form 4 students from 19 secondary schools in Keiyo, north Sub County. The study's data analysis revealed that most teachers did not employ group work,

a proven method for enhancing writing skills among learners. The current study concentrated on utilizing CAL to enhance writing skills, specifically targeting a smaller group of learners who had hearing impairments.

Most Kenyan students with hearing impairments appear to exit school without having achieved the necessary writing skills for a smooth transition to life after school (Adoyo, 2019). Adoyo emphasizes that the use of unsuitable teaching methodologies by teachers is the fundamental reason learners with hearing impairments graduate from school with only a limited level of writing skills. This calls into question the efficacy of the instructional strategies utilized in schools to teach students with hearing impairments. There is a dearth of literature on the integration of CAL to enhance the writing skills of learners with hearing impairments, making this study essential in shedding light on this area.

2.3 Effects of CAL on the Writing Skills

According to Ivers and Baron (2020), computer-assisted learning is the method of helping students learns using computers and computer applications. CAL allows for the use of a variety of learning activities, such as drill and practice, gaming, simulation, Socratic questioning, testing, and instruction. CAL focuses on either helping students acquire new concepts or consolidating topics they have already mastered. Both students and instructors utilize CAL, which provides real-time feedback, instantly evaluating student performance and revealing remedies. As a result, it may give the learner quick feedback while not only cataloguing errors but also offering analytics that go above and beyond to aid in student improvement.

People have cited CAL as the best technique for enhancing the learning process through interactions and engagement. Adopting any form of CAL aims to actively involve students. More frequently than not, students are likely to respond favorably to these innovative and engaging methods of learning than they are to traditional classroom education (Jonassen, 2020). Several CAL programs modify their methods in accordance with each learner's development. Also, students can move at a speed that suits them, and the program will adapt to fit their needs. A more individualized approach results in greater engagement and more effective learning outcomes (Gerlach, 2019).

According to Zhao, Llorente, and Gómez (2021), learning is a process where learners develop new opinions and perceptions based on experiences and prior understanding. A learner can create new meaning by reorganizing the cognitive structure through the links between the new experience and prior knowledge. Fernández-Gutiérrez, Gimenez, and Calero (2020) argue that constructivism opposes traditional learning theories that assert knowledge transmission through learning and advocate for student-centered, methodical, and structured instruction.

Initially, researchers tried CAL with science-based subjects and found it effective, later replicating it in languages and humanities (Vensel, 2019). Education has currently adopted CAL, creating diverse tools and applications to enhance learning. Teachers have widely adapted CAL for teaching in elementary, high schools, colleges, and universities, integrating it with the curriculum to enhance learners' capacities. Language learning is a discouraging undertaking, particularly if the learner has developed a mother tongue. To successfully acquire a second or foreign language, it is critical to choose an effective

learning strategy. Hence, computer-assisted learning resources can be adopted to facilitate the learning process of the writing skills (Adejumo, Abioye, & Tar, 2020). The study further asserts that CAL, like other instructive software, has the possibility to aid, hasten, stimulate, and develop language learning skills.

One major advantage of CAL over other teaching methods, including traditional methods, is that it allows learners to study at their own pace. Lawson (2019) asserts that CAL provides students with ample time and resources to revisit specific topics that require clarification. If they demonstrate familiarity with a topic, they can swiftly move on to the next, accelerating their goal attainment. This is in contrast to traditional learning methods that require learners to adhere to a predetermined timetable and master the subject matter. Self-paced learning also offers schedule flexibility. Anyone with access to a computer can learn almost anywhere (Congram, 2018). This helps to eliminate the need for lesson scheduling and group instructions, especially for learners who study while working (Dhanjal, 2019).

Jarata (2019) conducted a study on 30 first-year students at Don Mariano State University in the Philippines and found that the use of CAL significantly impacted the learners' results. The learners' altered attitudes towards language learning are responsible for this. The learners in the experimental group achieved a post-test score of 19.20, while those in the control group scored 13.13, indicating a statistical difference of 6.07. The results of both were compared, and the EG had a mean of 11.67, and after the treatment they had 19.20, thus the men's difference was 7.53, showing how effective CAL had been. These findings complement Bush (2020), who conducted a related study investigating 59

undergraduate students on their attitude toward CAL. The findings demonstrated that students positively learned language using computers, leading to an improvement in their language performance, with a mean difference of 8.0 between the pretest and posttest. The study's limitations included the use of 30 hearing university students in the Philippines, whereas it focused on 19 high school students with hearing impairments in Kenya.

A study by Nsabayezu et al. (2022) focused on teachers' and students' perceptions about the effectiveness of computer use to enhance chemistry teaching and learning in inclusive classrooms. This study sought to investigate how students with visual and hearing disabilities could easily access chemistry instructions. The study employed a mixed-method approach, collecting data using both qualitative and quantitative methods. The results revealed that the computers were effective in teaching chemistry because they helped students with hearing and visual disabilities learn the subject. Furthermore, a computer assists teachers in teaching chemistry concepts and provides students with the necessary resources for their learning. This encourages learners to explore new concepts, brainstorm, and search for relevant information for both teachers and students. In Rwanda, this study focused on chemistry subjects and how computers can improve performance, whereas the current study focused on English writing skills in Kenya.

The English Grammar Test application was used in a study that aimed to explore Malaysian English Second Language learning and students' perceptions of the usability of the mobile application for testing and improving English grammar skills. Mobile learning technologies are increasingly important in modern education, but understanding users'

perceptions is essential for successful implementation. 78 undergraduate students from Universiti Sains Malaysia (USM) participated in the study. The study employed a quantitative approach using the System Usability Scale (SUS) questionnaire to gather data on the usability of the app. The study found that users perceived the app as moderately usable, with an overall SUS score of 64.17. Advanced mobile users gave it higher ratings, highlighting technical issues such as lagging and limited compatibility as areas for improvement (Ganapathy, Shuib, & Azizan, 2020). While the previous study concentrated on the application's usability and university learners, the current study aimed to enhance the writing skills of learners with hearing impairments in secondary school in Kenya.

In Germany, Zaidi, Naeem, and Butt (2024) conducted a study to evaluate the impact of an English grammar test application on secondary-level students' English language grammar skills. According to them, using an appropriate smartphone application for teaching and learning ESL grammar skills is a challenge that must be considered. Other associated challenges, such as internet connectivity, appropriate teaching pedagogy, learners' socio-cultural and socio-economic backgrounds, and low motivation levels among ESL learners, require a viable solution. Through mixed-method techniques, pre-tests and post-tests were conducted. The study employed a purposeful sampling technique in both phases, selecting the assigned teacher and ten students to fill out a questionnaire following the post-test. The study employed Skinner's learning theory of behaviorism to practice stimulus, response, and reinforcement techniques. The findings concluded that although the students faced learning constraints, the teacher and students positively responded to the English grammar test application. While Zaidi et al.'s study focused on

English grammar skills, the current study focused on English writing skills in a population of learners with hearing impairments.

Tifani (2024) conducted a study to determine whether the English Grammar Test (EGT) application had a significant effect on students' grammar mastery of simple past tense in the eighth grade of junior high school. This research employed a quantitative research method and a quasi-experimental design. It was conducted in the eighth grade on a population consisting of 60 students from two classes. Using the saturation sampling method, the two classes, namely VIII-A and VIII-B, were selected as the sample of this study, with each class consisting of 30 students. Furthermore, we selected the VIII-A class as the control class and the VIII-B class as the experimental class. In collecting the data, multiple-choice and "fill in the blank" test forms were used in this study. After data analysis, the study concluded that the English Grammar Test application had a significant effect on students' grammar mastery of simple past tense in the eighth grade. While this study focused on hearing 8^{th} graders, the current study focuses on learners with hearing impairments in Form 2. Tifani (2020) conducted a similar study, emphasizing the importance of mastering basic English grammar to facilitate the understanding of advanced tenses. Tenses are basic language formulas that relate to the simple construction of sentences. The English Grammar Test application is designed based on need analysis, which consists of functional needs and non-functional needs. After introducing the application to teach the use of tenses, the results showed that the mean of the pretest was 27.4, and the mean of the posttest was 60.65. Therefore, we concluded that the application effectively enhanced the students' grammar competence and practice.

While the previous study concentrated on English grammar tenses, the current study concentrated on English writing skills.

The use of CAL can effectively accelerate language writing competency for learners with HI, as research indicates that these learners learn language more effectively and quickly when they actively participate in the learning process (Browder, Spooner & Courtade 2020). Few studies have demonstrated the effectiveness of CAL for learners with hearing impairments, despite these assertions. None of the cited studies focused on the use of the English Grammar Test to enhance writing skills, particularly among learners with hearing impairments in Kenya. Therefore, this study aimed to bridge the knowledge gap by exploring the potential of this application to enhance the writing skills of learners with hearing impairments.

2.4 Influence of Learners' Degree of Hearing Loss on English Writing Skills When Using CAL

According to WHO (2020), there are two main degrees of hearing loss. Hard-of- Hearing ranges from mild to severe hearing loss. This hearing loss greatly reduces but does not entirely disallow auditory perception of spoken words. The hearing loss threshold ranges from mild to severe, representing 21-80 dB. According to the National Center for Biotechnology Information (2020), deaf people are those who have a substantial hearing loss, which means they have little to no hearing. They often communicate by signing. Notably, the term 'deaf' refers to an audiological condition with profound hearing loss or a member of a community with a shared identity and use of sign language. When referring to a group or its members, the word 'Deaf' first letter is capitalized (Marschark

& Spencer, 2019). The study utilized the term "deaf" to refer to the condition. According to Mayers (2019), early identification is critical because it allows the child to receive early interventions such as language and speech training based on their age. The child can also be provided with amplification devices that allow them to acquire language at a young age, therefore impacting their language writing skills.

According to Marschark, Lampropoulou, and Skordilis (2022), writing acquisition is a crucial skill for all learners, but for Deaf and Hard of Hearing students, the process presents unique challenges. These learners often acquire written language at a slower pace due to limited exposure to spoken language and auditory feedback. Their experience with language is predominantly visual, and their primary mode of communication, whether sign language, lip-reading, or a combination, affects how they approach writing. According to Okombo, Akaranga, Mweri, and Adera (2020), the form of communication to employ when teaching writing skills depends on the severity of the hearing impairment, the child's communication requirements, interests, and capabilities.

Koehlinger, Horne, and Moeller (2019) conducted a study on 36 hard-of-hearing children and 36 deaf children in Belgium to investigate the acquisition of second languages among children with hearing impairments. They found that the hard-of-hearing children acquired their second language faster than the deaf children. Often, their language lacks articles and verb tenses. Children who are deaf do not learn words as quickly as their hard-of-hearing counterparts, who can learn words from their environment. Deaf children can learn simple nouns and verbs but find it challenging to learn abstract words such as adverbs, adjectives, and conjunctions. Often, their language lacks articles and verb tenses.

Children who are deaf often struggle to understand the meanings of words; they find it challenging to learn new vocabulary, comprehend sentence structure, and understand idiomatic idioms. This causes them to lag behind their peers who are hard of hearing, primarily due to a lack of experiential learning. ASHA's (2019) research demonstrates that both hearing students and those able to use amplification devices can acquire language through environmental exposure.

Deafness does not only hinder the acquisition of spoken language but rather a wide dimension of a child's life, including the child's social, emotional, and academic development (Kluwin, Stinson, & Colarossi, 2020). Deafness typically causes vocal difficulties, delays in speaking, and problems with articulation (Csizér, Kontra, & Piniel, 2020). Students may encounter challenges in the areas of writing, listening, speaking, and reading in school. Compared to their peers without hearing impairments, individuals with hearing impairments frequently struggle to learn academic subjects due to a lack of verbal-auditory input from teachers, peers, and their surrounding home and school environment. Sometimes, due to a lack of expressive language, they experience loneliness and isolation from their peers. However, they often find comfort in the company of their peers who have hearing impairments, as they feel accepted and can express themselves and receive feedback. This makes it difficult for them to participate in group activities where there is less interaction because of the language barrier caused by auditory limitations (Sabers & Stinson, 2019).

An experimental study by Baykoc (2024) on 40 learners with hearing impairments—56% deaf and 44% hard of hearing—showed that all the learners significantly improved in

mathematics skills to secondary school learners after using computers. There was no significant mean difference between the two groups in the pretest and posttest results. In the pretest, hear-of-hearing learners scored 46.8 and deaf learners scored 42.1, while in the posttest the mean was 65.2 and 64.8, respectively. Researchers credited the improvement in performance to the rise in self-respect among students utilizing computers. Students with hearing loss benefit from computer-assisted instruction in various ways, such as increased success rates and the development of higher-order thinking skills (Kontra & Piniel, 2019). Analyzed studies found that the use of computers in the instruction of deaf and hard-of-hearing pupils boosted academic progress (Baker, 2018). The current study examined the impact of CAL on the English writing skills of 19 deaf and hard-of-hearing secondary school learners, comparing it to other studies conducted outside Africa in European countries.

A study in Eswatini by Ntinda and Tfusi (2019) explored the experiences of teachers of deaf and hard-of-hearing students in a special needs high school for the deaf in Eswatini. The study adopted a qualitative approach and was exploratory in nature, comprising of eighteen purposively sampled teachers of deaf and hard-of-hearing students. They participated in individual in-depth and focus group discussion interviews on the aspects of teaching writing skills to deaf and hard-of-hearing students. Teachers reported experiencing gaps in professional competencies to teach writing skills to learners who were deaf or difficult of hearing, and that difficult-of-hearing learners acquired writing skills faster as compared to their deaf counterparts. Variation in sign language impacting learner engagement hindered teachers' communication with the deaf and hard-of-hearing students and their parents. This study focused on teachers and their experiences, whereas

the current study focused on deaf and hard-of-hearing learners by experimenting with CAL as a teaching strategy to improve their writing skills.

Nweke, Okeke, Anusiuba, and Egbo (2019) conducted a study in Ibadan, Nigeria, to determine the effect of computer-assisted instructions (CAI) on the achievement of deaf and hard of hearing learners in biology. The study used a quasi-experimental research design with a pretest-posttest approach. The purposeful sampling technique was used to select deaf learners from three secondary schools in Ibadan, Nigeria. The results indicated a significant main effect of treatment on achievement in biology among both deaf and hard-of-hearing learners. Hard-of-hearing learners achieved the highest mean score of 13.74, followed by deaf learners, who achieved a mean score of 10.51. CAI was more effective in enhancing biology achievement among hard-of-hearing learners than deaf learners. While this study focused on biology in Nigeria, the current study focused on writing skills in Kenya. Studies on deaf and hard-of-hearing learners have taken place in Kenya. Wamae (2021) conducted a study to investigate the effectiveness of deaf and hard-of-hearing teachers in special units. The study employed a descriptive survey design to explore Kenyan teachers' practices in science using computer-assisted instruction for the deaf and difficult of hearing. The results showed that although Kenyan science teachers are aware of computer-assisted instruction, they often only implement these practices and strategies superficially in their classrooms.

The Kenyan Vision 2030 initiative aims at improving the quality of education for all learners. Despite the Kenyan secondary school curriculum's design to achieve the Vision 2030 initiative's goals, learners who are deaf or hard of hearing significantly

underperform in writing skills, a problem that extends to other writing-intensive subjects such as biology, chemistry, and physics (Wamae, 2021). This study examined the integration of CAL into the teaching and learning process to enhance the writing skills of deaf and hard-of-hearing learners. Despite this, the majority of the reviewed studies focus on different subject areas, neglecting writing skills, which are crucial for learners who are deaf and hard of hearing.

2.5 Influence of Gender and Age on English Writing Skills for Learners with Hearing Impairments when Using CAL

2.5.1 Gender

According to WHO (2018), gender refers to the responsibilities, actions, activities, traits, and opportunities considered appropriate for boys and girls, men and women, by any society. In September 2016, the Kenyan government unveiled its national implementation plan for the Sustainable Development Goals, pledging to ensure that no one falls behind in the country's economic and social development (GoK, 2024).

The classroom denies females the opportunity to learn and develop ICT-related skills. This can prevent them from acquiring the literacy and self-assurance necessary to use and access ICTs in a classroom setting. According to Medel and Pournaghshband (2019), other barriers, including limited information on technology and a lack of knowledge and skills, still prevent girls from utilizing ICT. When they enter adolescence, many girls lose interest in math, science, and computer technology (Cimpian, Kim, & McDermott, 2020). Many educational approaches discourage girls from pursuing careers in science and technology (Doughty, Karessli, Leonard, Li, Martinez, Mobasher, & Yadav, 2021).

Boys use computers more frequently than girls, according to a number of indications; this difference, like computing attitude, only becomes noticeable in high school. Boys and girls used computers roughly equally in the fourth grade of one survey of 6,800 pupils, but by the eighth grade, males reported much more utilization (Riegle-Crumb & Morton, 2020). In their homes, the houses of their friends, and after-school groups, boys use computers more frequently than girls do. While girls manipulate ICT for email, instant messaging, and homework, boys use them for gaming, educational applications, and internet access. When it comes to computer use, boys are typically more assertive and authoritative, while girls are typically more submissive. Teachers tend to give girls more leeway than boys when it comes to technological issues. Boys seem to like and utilize technology for tasks that have clear objectives and relevant situations. Girls like cooperative learning that is inquiry-based and covers a variety of subjects (Dodik, Sellán, Kim, & Phillips, 2022).

Teachers can address gender inequalities in computer attitude and use in a variety of ways. As The American Association of University Women (2021) recommends that teachers establish a clear set of guidelines and expectations to foster a positive computing environment where students can use computers appropriately. is important to stress a helpful, cooperative environment. Additionally, it's crucial to monitor computer use closely. Finally, teachers should provide meaningful help and guidance rather than completing the assignment for the girls (American Association of University Women, 2021).

Making same-sex computer study groups is one strategy for reducing boys' aggressive, domineering behavior (Medel & Pournaghshband, 2020). In addition, it is important for teachers to understand the different styles that boys and girls need when teaching using computers and try to find a solution that is equal to all genders, rather than looking for ways to legitimize various perspectives on technology. In order for boys and girls to pursue careers that interest them, a number of different things need to be promoted, such as peer working to solve academic challenges, applying in a wide scope of scenarios, and giving room to project creation (Medel & Pournaghshband, 2021).

Dodik, Sellán, Kim, and Phillips (2022) conducted a study in Europe and the USA, which revealed that boys interacted with computers more in school and dominated jobs and conversations involving computers. BoTeachers typically reported that boys participated more actively in computer class discussions, expressed themselves more freely, and received more inquiries from teachers. rls, on the other hand, were more likely to underestimate their computer-related abilities and lack computing confidence. Boys significantly enhance their computer skills through hands-on experience at home; their greater enthusiasm for computer use, along with their higher levels of self-assurance and self-esteem, contribute to this, compared to their female counterparts (Peixoto, 2019). In contrast to the previous study, the current study investigated the use of CAL among both boys and girls in Kenya.

In 2022, researchers conducted an extensive descriptive investigation involving 1138 university undergraduates in Flanders, Belgium, to investigate the relationship between gender, attitudes, and routines in both education and daily tasks of university students.

The outcomes showed that girls performed equally as boys in their academic results, and girls had a less positive attitude concerning computers. However, their approach to using computers for learning purposes did not differ significantly from that of boys. These results revealed that context, not gender, determines an individual's attitude towards computers (Tondeur, Van de Velde, Vermeersch & Van Houte 2022). The current study was conducted in Kenya among secondary school learners with hearing impairments with a population of 19 learners, and the research design was experimental.

Drabowicz's (2019) study revealed that boys exhibited a greater love for computers compared to girls, and they also demonstrated greater confidence when using them. The study employed a descriptive research design, examining a sample of 522 boys and 417 girls. Their teachers' attitudes and actions may have played a significant role in increasing boys' computing confidence. According to Drabowicz (2019), when teachers encounter technological challenges, they often resort to boys because they assume that they have a certain level of experience. Some of obstacles such as eligibility, illiteracy, poverty, time, and provision of educational opportunities among girls are some of the key things that ICT is capable of doing. Other barriers, such as limited access to ICT, high costs associated with its purchase and maintenance, and insufficient knowledge and skills, continue to hinder girls' use of ICT. However, one can primarily blame social behavior, culture, and religious traditions for girls' lack of interest in using ICTs.

A curriculum that emphasizes mastering specialized computer skills in isolation may discourage girls from using computers. Computer use as a reward is a widespread practice that should probably be discouraged because it encourages boys to act more

assertively and aggressively. Some girls could back off and give way to boys who have greater confidence. However, Peixoto (2019) asserts that well-planned activities are crucial for effectively handling gender inequalities. It's crucial to develop teachers' computer literacy; according to Delaney and Devereux (2021), teachers must be able to create efficient computer-based lessons. Teachers will find it challenging to create successful computer-based classes or to direct meaningful computer use if they lack the skills and confidence to do so. Also, there is a need for teachers of the female gender to show competency in the field of technology; otherwise, gender attitudes will never change (Riegle-Crumb & Morton, 2020). Research has shown that boys and girls engage differently with technology; for example, girls are less skilled and interested in using computers than boys (Van Deursen et al., 2020). Doughty et al. (Doughty, Karessli, Leonard, Li, Martinez, Mobasher, & Yadav, 2021) assert that the gender of the user and how different genders interact with a technology's features, such as how easily they can utilize it to complete a task, influence technology adoption.

In Africa, the adoption of computers in school settings has accelerated, prompting studies on gender disparities in their use. For instance, Bovée, Voogt, and Meelissen (2019) conducted a study in South Africa to investigate the computer attitudes of 240 students from eight primary and secondary schools. All eight schools used computers for educational purposes, although their availability and use varied. The study investigated differences in computer attitudes between boys and girls. Unlike most studies on gender differences and computer attitudes, this research found no gender differences in computer attitudes. Contrary to this finding, a study by Kaino (2020) examined attitudinal gender biases towards girls in the use of computers in selected schools in Kenya. The findings

demonstrate that there was an attitudinal gender bias towards girls in computer use. This was due to the female students' perception of themselves, ignorance, public opinion, and their parents. Most of these studies employed a descriptive design to collect feedback on computer use among girls and boys, triangulating it with observable gender-related characteristics. Furthermore, most experimental studies took place outside of Africa and focused on hearing learners. Therefore, this study sought to fill the knowledge gap by providing insights on the use of computers among learners with hearing impairments in Kenya.

2.5.2 Age

The integration of computers in education has transformed the learning landscape across age groups, providing personalized learning experiences, improving engagement, and enhancing educational outcomes. From early childhood to adult education, the use of computer-assisted learning (CAL) has become a pivotal tool in classrooms worldwide. Technological advancements, including interactive software, online learning platforms, and multimedia resources, allow teachers to tailor instruction to meet the needs of diverse learners. However, the extent of adoption and effectiveness of these tools vary depending on a variety of factors, including age, region, access to resources, and teacher training (Tapscott, 2019).

According to Plowman and Stephen (2020), in high-income countries, the use of computers based on age in education is well-established, with a growing body of research demonstrating improved academic performance across subjects like mathematics, literacy, and science. For example, in early childhood education, the interactive

educational games help build foundational skills in literacy and numeracy. Computers enhance learning outcomes in primary and secondary education, especially in STEM subjects where simulations and visualizations aid in understanding complex concepts. In contrast, based on age, the adoption of CAL in Africa has faced challenges related to infrastructure, digital literacy, and accessibility. Despite these obstacles, there are promising initiatives across the continent aimed at bridging the digital divide. In Kenya, South Africa, and Nigeria, various educational programs are leveraging computers to provide inclusive and accessible education (Wambugu & Githua, 2020).

It is therefore vital to investigate how much age influences students' academic achievement. There is proof that older children do academically better than their younger counterparts (Pianta and La Paro, 2020). In their study on the relationship between age and academic achievement, Suleman, Hussain, Syed, Parveen, Lodhi, and Mahmood (2019) argued that older students in a class outperform their younger counterparts. Paul and Jefferson (2019), in contrast, found no evidence of a connection between age and academic success. At age nine, they discovered a considerable accomplishment gap between the oldest and youngest students; however, by the age of seventeen, this gap had vanished.

Academic success is a result of one's own willpower, cognitive growth, and motivation, among other favorable correlates (Bugler, McGeown, & St Clair-Thompson, 2020). Age does not greatly affect academic achievement, according to other studies like Buhl-Wiggers, Jones, and Thornton (2021), even though other factors like the teaching technique and level of enthusiasm do.

The younger learners tend to be more academically motivated than the older ones, according to Wigfield, Gladstone, and Turci (2019). Other non-academic problems may divide the attention of older students, leading to this phenomenon. While younger students may concentrate more on their academic work, they might not possess the necessary expertise to effectively manage the challenges associated with more advanced academic work. According to the study's findings, age has no discernible influence on academic achievement. A study on the impact of age on learner development and achievement discovered that there is a difference related to age, as junior students did not perform well as compared to the senior students on the achievement tests. The relative age of young learners had an enormous impact on achievement. While the discrepancy continued throughout elementary school, the relative age gap decreased for older primary students. The difference was still noticeable at the secondary stage, but it was not statistically significant (Mavilidi, Marsh, Xu, Parker, Jansen & Paas, 2022).

Age and academic accomplishment have a skewed relationship, according to several studies. According to Gajda's (2024) research, the relationship between age and academic achievement weakens as pupils age. According to the study's findings, schools offer equalizing experiences; therefore, the longer pupils are enrolled in school, the less of an effect age has on student accomplishment. Also, as learners get older, more of them will drop out of school, weakening the association. In contrast to this study, the current study focused on the writing skills of learners with HI when using CAL.

Over the past ten years, many researchers have assessed the feelings and opinions of people of different ages regarding computers. According to Roussinos and Jimoyiannis

(2019), the majority of the investigations identified four interconnected dimensions. Fear or caution about using computers, self-efficacy and self-confidence in one's own abilities to use technology, liking one's use of technology and computer applications, and opinions of the worth and use of using computers in one's personal life are some of these.

Strong internal motivation and frequent computer use, not the pupils' age, are the foundations for the growth of their computer knowledge. Nonetheless, the trainees gain confidence after using computer tools. According to research done by Ashenafi (2019), the new generation, which has grown manipulating computers, smart phones, and the internet, does not fear any technological advances and is keen to try out new computer programs and features. This stands in stark contrast to adult learners.

A study carried out by Hahnel, Goldhammer, Naumann, and Kröhne (2020) for the Program for International Student Assessment (PISA) on 15-year-old learners investigated the individual differences of computers to learners. The fact that over half of the students in the study said that they firmly concur that using computers is essential shows that these students are aware of the importance of computers in their lives. Drabowicz (2019) conducted a study in Europe on 364 11-12-year-old learners and 575 15-16-year-old learners and found out that in computer usage, there was no statistical significance difference since the learners of different age groups showed how they equally view computers as useful and use them on a daily basis. The current study will focus on learners with hearing impairments aged 14–22 years. The study was also conducted in 2019, while this one was conducted in 2021. The study focused on hearing

learners in Europe; the current study focused on 19 learners with hearing impairments in Kenya.

According to Matlay, Abaho, Olomi, & Urassa (2022), after their study on a group of high school learners in Nigeria, their recommendations were that in maximizing secondary school learners' abilities and familiarity in the different curriculum areas, it is greatly essential that we use computers with the right method. A method that recognizes and denotes the learner's beliefs owing to their age. According to a study by Muriithi (2022) in Kenya, learners aged 11-16 enjoyed spending more time on computers because they found them more motivating and intriguing than older learners aged 17-19. This affected the learners' outcomes since the younger learners performed better in computer-related tests as compared to the older learners, who showed less interest in the learning activity. The current study aimed to explore whether the varying ages of learners with hearing impairments could influence the effectiveness of CAL in enhancing their writing skills. These studies were conducted on a population of hearing learners, while the current study was conducted on a population of learners with hearing impairments.

2.6 Summary of the Literature Review

The literature review brought to light several significant issues regarding the integration of CAL among learners with hearing impairments in secondary school. These issues include the impact of integrating CAL on the writing skills of learners, as well as the demographic characteristics of learners, such as age, gender, and the level of hearing loss, whether deaf or hard of hearing.

The literature review highlights numerous advantages and justifications for the importance of integrating CAL in teaching different subjects such as mathematics, English, sciences, and social sciences to hearing learners. Most of the reviewed studies focused on integrating CAL using the English Grammar Test application in secondary schools and universities, but none specifically targeted learners with hearing impairments in Africa. To fill this gap, this study was conducted in Kenya on a target population of learners with HI by using the CAL application (English Grammar Test) to enhance the writing skills of secondary school learners in Form 2.

Most studies used descriptive research designs, with only a few utilizing quasi-experimental designs. The current study used a single-subject quasi-experimental design to collect data on the effectiveness of computer-assisted learning on the writing skills of learners with HI. The researcher concentrated on Kambui Secondary School for HI, a location where few studies have explored the integration of CAL in teaching English writing skills to learners with HI.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter discusses research design, variables, study location, target population, sampling techniques and sample size, research instruments, piloting, validity and reliability, data collection techniques, data analysis techniques, and logistical and ethical considerations.

3.2 Research Design

This study aimed to investigate the impact of CAL on enhancing the writing skills of learners with HI at Kambui Secondary School in Kiambu County, Kenya. The study used a quasi-experimental design with a single subject. This design involves studying the effect of a treatment on a small group of participants over time before, during, and after treatment to assess changes in behavior or outcomes (White & Sabarwal, 2024). According to Byers (2016), the single subject Quasi Experimental Design was ideal because it focuses on a small group of participants, which makes it easier to provide individualized support during the treatment. The design is flexible, making it easier for the researcher to tailor the treatment to meet the unique needs of learners with hearing impairments.

The researcher used the quasi-experimental design to collect quantitative data through the pretest and posttest. After administering the treatment using CAL, the researcher compared the pretest and posttest results to ascertain the treatment's effectiveness.

Table 3.1 : Quasi-Experimental Research Design

3.2.1 Variables

Independent variables explain changes in the dependent variable (Ary, Jacobs, Sorensen, and Walker, 2014). In this study, the use of CAL in pedagogical practices was the independent variable. The research's goal was to determine how effective CAL is in improving the English language writing skills of learners with hearing impairments. The improved writing skills of the learners demonstrated this, resulting in enhanced performance in the Kenya Certificate of Secondary Education (KCSE) English paper and overall improvement. The intervening variables were the learner's family background, time availability, and government policies to support CAL integration in schools.

3.2.2 Location of the Study

The study took place at Kambui Secondary School for the Hearing Impaired in Kiambu County, KenyaThe institution was founded in 2010 in response to an expressed need for a secondary school to accommodate the large numbers of learners who had been enrolled at Kambui Primary School for the HI (established in 1963) and who needed to transition to secondary school.

The school was ideal for the study, as it is one of Kenya's oldest and most established institutions for students with hearing impairments. Many students with HI have been

enrolled in school, but despite this, only 18% of the learners since 2010 have managed to transition to university due to low performance and often not meeting the pass mark (MoE, 2022). In addition, the school boasts a well-established technological infrastructure thanks to the support of a community-based organization, Githunguri Youth United, which in 2020 contracted a computer college to teach basic computer skills and packages to both learners and teachers in the school. The researcher aimed to utilize these basic computer skills in the study to enhance the learner's writing skills.

In this context, the researcher chose the school because it presented a strong argument for identifying the root cause of the poor performance and implementing CAL to reverse the trend, thereby enhancing English language writing skills. This resulted in enhanced performance in the KCSE exam and a rise in the transfer of students with HI to higher education establishments.

3.3 Target Population

The researcher targeted secondary school students because they had more exposure to English language writing over time. This caused the researcher to focus on refining and improving these skills rather than establishing a foundation. In addition, secondary school learners with HI have had more exposure to English, both written and signed, which can help researchers better isolate the effects of the intervention on writing skills. However, learners with hearing impairments may find it particularly challenging to acquire English writing skills due to limited access to spoken language, which is crucial for acquiring grammar, syntax, and vocabulary.

3.4 Sampling Technique and Sample Size

3.4.1 Sampling Techniques

The study adopted purposive sampling. Crossman posits that purposive sampling allows for the selection of a sample based on the study's goals, population characteristics, and design (Crossman, 2018). Kiambu County was purposely selected because of Kambui Secondary School for HI, which had a well-established computer lab, and learners were well equipped with computer skills to utilize CAL. In addition, the school has maintained a high enrollment rate of learners with hearing impairments, with only 18% of them transitioning to higher institutions of learning due to their poor performance in the KCSE.

All Form Two learners were purposively sampled. Form Two marks a critical period for academic growth, even though the KCSE examinations take place in Form Four. In the Kenyan secondary school system, the Form Two curriculum emphasizes more advanced English language skills, including writing compositions, essays, and structured argumentative writing; therefore, this stage is crucial for mastering the skills required.

3.4.2 Sample Size

In the single-subject quasi-experimental design, the subjects acted as their own controls, eliminating the need for a control group. The sample size consisted of two learners, who, according to the school's registration records, were 19 in 2021.

Table 3.2: Sampling Grid

	Female	Male	Total
Target population	41	42	83
Sample size	8	11	19

3.5 Research Instruments and Techniques

In this study, the collection of data was done using CAL, pretest/posttest and observation.

3.5.1 Computer Assisted Learning

Thanh Vu Truong developed a computer application named "English Grammar Test" for the study. The application was version 1.01 and was available for downloading in the Android, Microsoft, and iOS versions (https://play.google.com/store/apps/details?id=org.tbsoft.englishgrammar). As the application was compatible with laptop computers, the researcher sought permission from the school principal and ICT department to install the application on school computers with the support of the IT technician. The app was selected as the learning content reflected the content available in the form of two syllabuses that were being utilized, and studies in the literature review conducted using the application proved effective in improving the writing skills of learners. The researcher supplemented the learning experience with sign language videos from the website (www.youtube.com/@boonary), which provides English grammar in sign language and captioned resources.

During the first week of the treatment, the researcher taught the learners how to manipulate the application, including signing in, creating their accounts, and keeping a record of their work. Depending on the topic they were learning, the researchers guided the learners to access sign language videos and material resources from the YouTube page. The school's reliable internet connections made it easy for learners to access the learning resources. The IT technician was always available to address and resolve any technical issues that arose.

The researcher collaborated closely with the English teacher who taught Form 2. The teacher assisted in identifying areas of need and topics that the learners were unable to understand, and then referred them for support using CAL. After the referral, the researcher provided support and reinforced the lessons learned in class. This ensured that the learners, despite their difficulties, were at par and understood the material (Appendix i).

3.5.2 Pre-Test/ Post-Test

Larsen and Hammil (2008) developed the Test of Written Language-4 (TOWL-4) assessment tool, which the researcher adapted to create the pretest and posttest. The pretest, before the introduction of treatment, aimed to gather information about the learner's strengths and needs in the different areas of English language writing skills. The test comprised five sections that assessed learners' skills in spelling, punctuation, connecting sentences, cloze tests, and tenses.

The test contained a total of 50 marks. The pass mark was 20 marks out of 50, which was equal to 40%. Therefore, the learner received treatment based on their performance on the test, even if they scored low. This meant that each learner received a different task based on their areas of need. After administering the treatment for 12 weeks, the learners were given a posttest to evaluate the effectiveness of CAL in improving the writing skills of learners with HI (Appendix ii).

3.6 Piloting

Leon, Davis, & Kraemer (2017) stress the importance of piloting in determining the validity of the research instruments. Piloting was conducted in Murang'a School for the Deaf in Murang'a County, the institution was purposely selected, and Form 2 students were used for piloting. This is because the learners in this class had similar characteristics as compared to the learners at Kambui School for HI. The learners in Form 2 had been introduced to the same contents, and the classes had similarities ranging from age to the levels of hearing loss. After piloting, we carried out all instrument modifications and adjustments with supervisor clearance. The school involved in the pilot study did not participate in the main study.

3.6.1 Validity

The pilot study established the content validity of the tools. The pretest and posttest were constructed using the Form 1 and 2 English syllabus to ensure the content is in line with what was being taught. The study's use of the entire population helped maintain internal validity by eliminating selection bias. Special Needs Education experts, peers, and

supervisors from Kenyatta University's Department of Early Childhood and Special Education who are conversant with this area of study were also consulted.

3.6.2 Reliability

Reliability has been defined as how consistently the measurement methods produce the same results after numerous trials, which is what reliability is all about (Heale & Twycross 2019). This study employed the test-retest method to assess the reliability of the pretest/posttest. The following steps were observed:

i. The pilot respondents, who were not among the research respondents, received the pretest.
ii. The finalized tests were analyzed manually.
iii. The same respondents received the posttest after using CAL for two weeks.
iv. The finalized tests were analyzed manually.
v. An evaluation of answers made in (ii) and (iv) was analyzed.

Person-product correlation was used to calculate the correlation coefficient of the pretest and posttest, where the correlation was 0.8. Orodho (2019) states that a 0.75 correlation coefficient ought to be sufficient to indicate instrument reliability. The researcher also triangulated the study instruments using the observation checklist.

3.7 Data Collection Techniques

To test performance before the introduction of CAL, learners with HI were subjected to the TOWL-4 test as a pretest. The test scores served as the baseline for the effect comparison after treatment and posttest.

The researcher collaborated closely with the English teacher in Form Two to identify learners' writing needs and use CAL to complement these areas of learning. The researcher introduced the 'English Grammar Test' computer application and utilized Boonary's sign language videos (www.youtube.com/@boonary) to enhance the teaching and learning process. The researcher conducted this treatment in 40-minute sessions, three times a week. The entire treatment lasted for 12 weeks. Sign language was used as a medium of teaching because both the researcher and the learners were conversant. At the end of the 12 weeks, the researcher administered a post-test that helped to compare the results before and after the treatment.

3.8 Data Analysis

The data was analyzed using the SPSS version 22.0 program generally used for social science studies. The data from the pretest and posttest underwent descriptive and inferential statistical analysis to test the hypotheses for all the objectives. A paired t-test and two-way ANOVA tests were used to analyze the data and findings presented in the form of tables. The findings led to conclusions and recommendations.

3.9 Logistical and Ethical Considerations

3.9.1 Logistical Considerations

The researcher obtained an authorization letter from Kenyatta University and the Kenyatta University Ethics Committee due to their involvement with children. Next, using a letter from the graduate school, the researcher sought authorization from the National Commission for Science, Technology, and Innovation (NACOSTI). The researcher then proceeded to inform the County Commissioner of Kiambu County and

the County Director of Education Kiambu about the proposed study. Lastly, the researcher sought permission from the school principal and arranged the study dates.

3.9.2 Ethical Considerations

The researcher utilized sign language as the primary communication method with the learners, as it was a language they were familiar with. The researcher maintained the confidentiality and identity of the respondents, respected their privacy, and communicated this to them using sign language from the outset of the study. Furthermore, to ensure ethics, the researcher used pseudo names for the learners. The researcher made participation voluntary, sought written consent from the learners to participate in the study, and informed them of the genuine nature and aim of the study.

CHAPTER FOUR

PRESENTATION OF FINDINGS, INTERPRETION AND DISCUSSION

4.1 Introduction

This chapter presents findings, interpretation and discussion according to the objectives. Four research objectives as stated below were used to base the findings:

i. Establish the level English writing skills of learners prior to the introduction of CAL.
ii. Investigate the effect of CAL on learners' English writing skills.
iii. Investigate how learners' degree of hearing loss affects their English writing skills when using CAL.
iv. When using CAL, determine the effect of gender and age on English writing skills.

The research hypothesis were:

H_{01}: There is no significant difference in English writing skills after introduction of CAL.

H_{02}: There is no significant difference in English writing skills when using CAL for deaf and hard-of hearing learners.

H_{03}: There is no significant difference in English writing skills when using CAL based on gender.

H_{04}: There is no significant difference in English writing skills when using CAL based on age.

4.2 General and Demographic Information

The data was obtained from 19 learners with hearing impairments in form two at Kambui Secondary for the hearing impaired. The demographic details include age, gender and degree of hearing loss.

4.2.1 General Information

100% response rate was obtained from the learners with HI sampled, which was sufficient for the analysis on the effectiveness of CAL in improving writing skills of learners with HI in Kambui Secondary School for HI. Discussions of the findings were conducted in accordance with the study's goals.

4.2.2 Respondent's Demographics

4.2.2.1 Age of the Learners

The graph below represents the learner's age in the study.

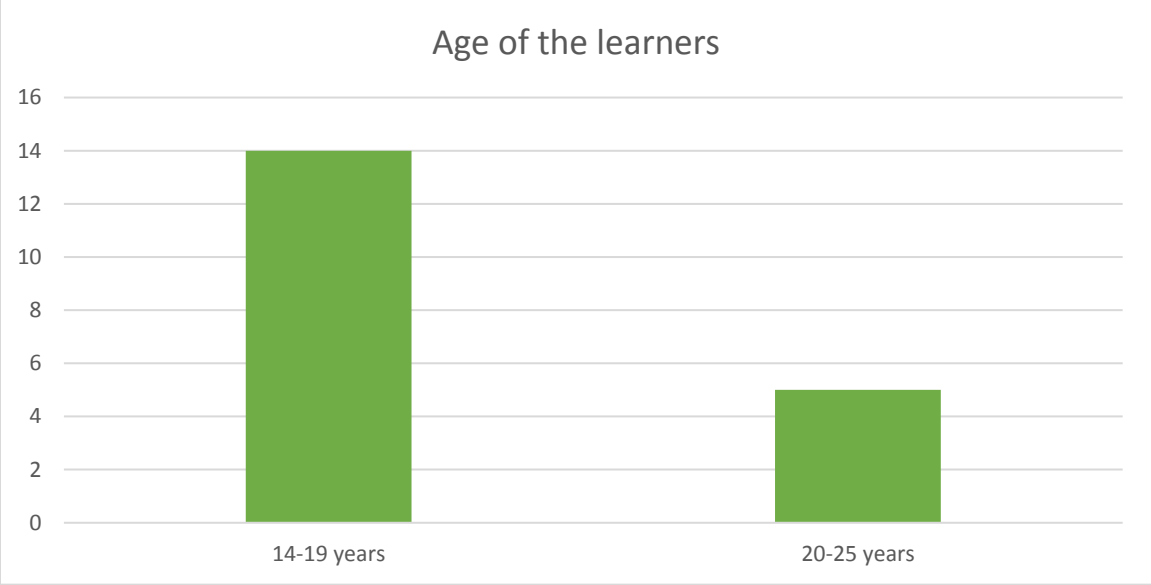


Figure 4.1: Age of the Participants

The sample was heterogeneous, with the youngest learner aged 14 and the eldest aged 25. The figure indicates that the majority of the learners, 14 (73.7%), were aged 14–19, while the rest of the learners, 5 (26.3%), were aged 20–25, with the modal age being 16. The high age difference among the learners can be attributed to factors such as late school enrollment of learners with disabilities due to delayed identification, assessment, and placement in schools.

4.2.2.2 Gender of the Learners

The sample size was comprised of 19 learners with hearing impairments in the study. There were more male learners 11(57.89%) as compared to 8(42.11%) who were female.

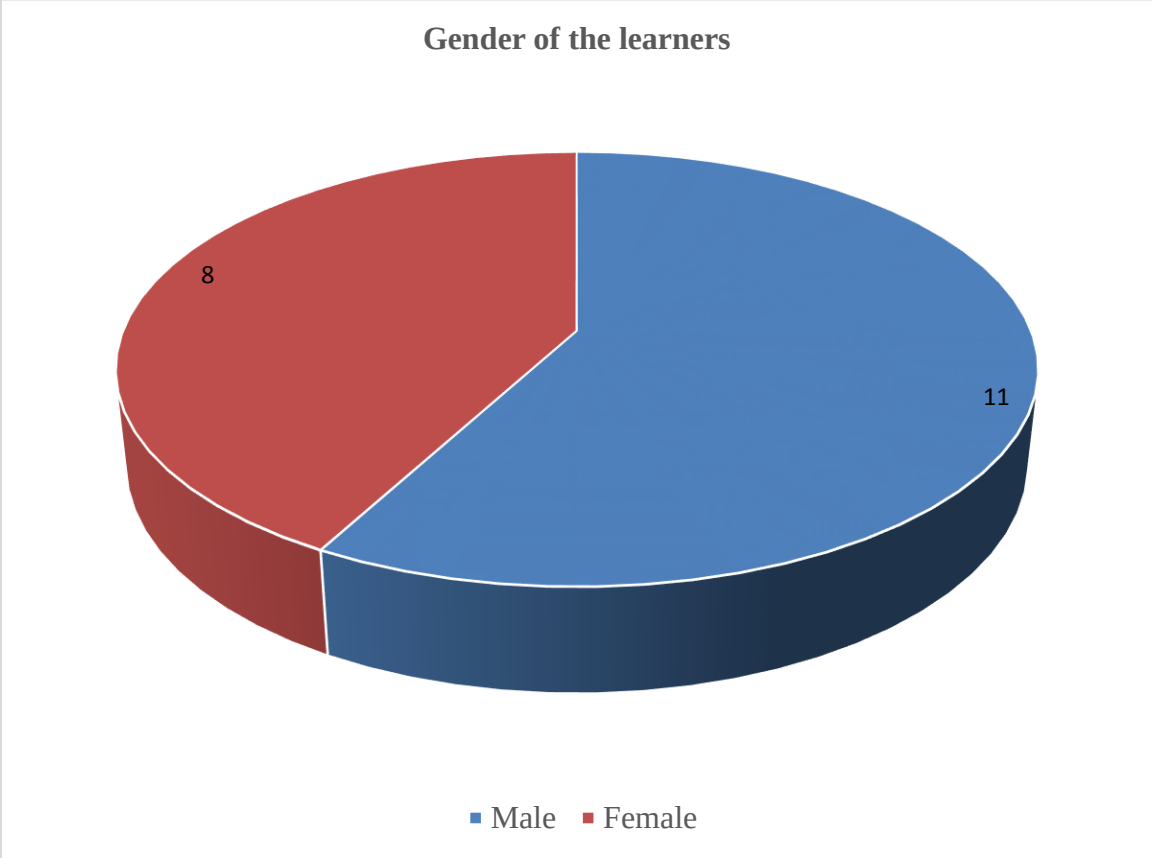


Figure 4.2: Gender of the Participants

4.2.2.3 Degree of Hearing Loss

The Educational Assessment and Resource Centres (EARCs) across the country assessed all 19 learners with hearing impairments in Form 2. Individual files containing the audiogram results of the learners were available at the school, which facilitated their placement. 8 out of 19 learners were hard of hearing, while 11 were deaf.

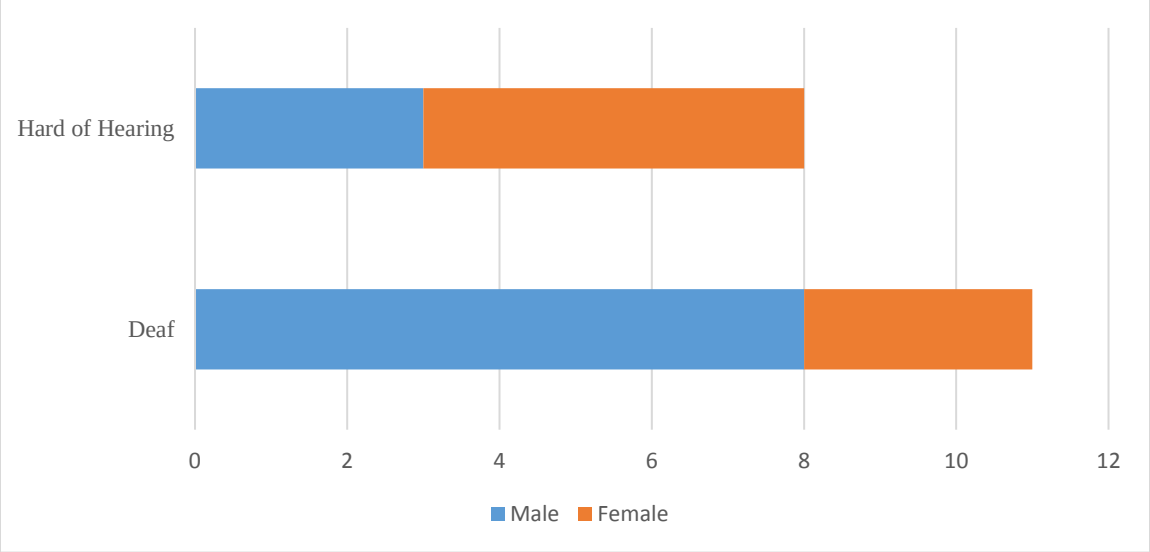


Figure 4.3: Degree of Hearing Loss

4.3 Learners' Level of English Writing Skills before the Introduction of CAL (pretest)

The first objective of this study sought to determine the learners' level of English writing skills before the introduction of CAL. This was done by administering the pretest adapted from the Test of Written Language Development: Primary, 4th Edition (TOWLD-P:4) assessment tool by Newcomer and Hammil (2008), which was out of 50 marks. Results were recorded and analyzed as follows:

Table 4.1: Learners Level of Performance before Introduction of CAL

Learner	Gender	Age	Hearing loss	Pretest out of 50	% score
A	M	14	Hard of hearing	5	10
B	F	17	Deaf	11	22
C	M	20	Deaf	30	60
D	M	17	Deaf	1	2
E	F	22	Hard of hearing	41	82
F	F	16	Hard of hearing	18	36
G	M	15	Deaf	9	18
H	M	16	Hard of hearing	24	48
I	F	17	Deaf	34	68
J	M	19	Hard of hearing	16	32
K	M	24	Deaf	26	52
L	F	18	Deaf	2	4
M	F	15	Hard of hearing	8	16
N	M	16	Deaf	24	48
O	M	17	Deaf	12	24
P	F	18	Hard of hearing	21	42
Q	M	15	Deaf	15	30
R	F	23	Hard of hearing	26	52
S	M	16	Deaf	20	40

From the result collected from the pretest, learners scored a mean of 18.05 in English writing skills. Female learners scored higher than their male counterparts, as they had a mean of 20.12 and 16.55, respectively. When comparing the scores of hard of hearing and deaf learners, the hard of hearing learners scored a higher mean of 20.8, while the deaf learners scored a mean of 16.7.

In many countries, including Afghanistan, Egypt, Honduras, Japan, and Kenya, 40% is considered a pass mark at the high school and college levels (Grading System by country, 2019). In this study, 40%, which was equal to 20 marks, was also considered the pass mark. From this pretest, the majority of the students, representing 11 (57.9%) of the

learners, scored below the pass mark of 20 marks, while the remaining 8 (42.1%) scored above this mark. This showed that the writing skills of the learners were below average.

The findings aligned with a study by Naba'h (2022), which revealed that the use of traditional methods to teach English grammar resulted in poor performance among learners. Furthermore, a study conducted by Souriyawongsa (2022) on university students in LAO revealed that inadequate teaching techniques, which made the learning process dull and uninteresting, contributed to the poor performance in writing skills among students, leaving them feeling disinterested and bored. Findings from a study by Rwaimba (2024) on teaching English story grammar to learners with hearing impairments in Tharaka Nithi and Meru revealed that learners performed poorly in the pretest, with an average mean score of 5.78. This was as a result of teachers utilizing traditional conventional methods to teach teachers' English story grammar to learners with hearing impairments, leading to low comprehension among learners.

4.4 Effect of CAL on Learners' English Writing Skills

The second objective of the study aimed to examine the impact of CAL on the English writing skills of learners. The study used CAL to teach English writing skills to learners for 12 weeks, utilizing an application known as 'English Grammar Test'. The application allowed for individual and self-paced learning, depending on the learners needs. The application introduced learners to basic grammar, including parts of speech, and provided captioned videos and texts to explain concepts. There were self-paced tests that learners took after completing each subtopic. After mastering basic grammar, learners progressed to advanced grammar, enabling them to connect phrases into clauses and compose

paragraphs. To establish the effect of CAL on learners' English writing skills, a posttest was administered after 12 weeks, which was similar to the pretest and tested on the writing skills of learners after they were exposed to CAL. The scoring procedure of the posttest was similar to the pretest, and results were analyzed as shown below.

Table 4.2: Learners' Performance in Post Test

Learner	**Gender**	**Age**	**Hearing loss**	**Pretest out of 50**	**% pretest**	**Posttest out of 50**	**% posttest**	**Deviation**	**% deviation**
A	M	14	HoH	5	10	17	34	12	24
B	F	17	Deaf	11	22	25	50	14	28
C	M	20	Deaf	30	60	34	68	4	8
D	M	17	Deaf	1	2	6	12	5	10
E	F	22	HoH	41	82	44	88	3	6
F	F	16	HoH	18	36	35	70	17	34
G	M	15	Deaf	9	18	24	48	15	30
H	M	16	HoH	24	48	35		11	22
I	F	17	Deaf	34	68	42		8	16
J	M	19	HoH	16	32	33	66	17	34
K	M	24	Deaf	26	52	36	72	10	20
L	F	18	Deaf	2	4	9	18	7	14
M	F	15	HoH	8	16	14	28	6	12
N	M	16	Deaf	24	48	34	68	10	10
O	M	17	Deaf	12	24	17	34	5	5
P	F	18	HoH	21	42	35	70	14	28
Q	M	15	Deaf	15	30	31	62	16	32
R	F	23	HoH	26	52	30	60	4	4
S	M	16	Deaf	20	40	23	46	3	6

The posttest analysis revealed that all learners had a positive increment from the pretest scores. The learners achieved a mean score of 27.58, indicating a 9.53 increase from the pretest score of 18.05. Female learners scored a mean of 29.3, which was higher than male learners' mean of 26.4. In terms of hearing loss, hard-of-hearing learners scored higher with a mean score of 30.4, compared to deaf learners who scored 25.5.

According to the analysis, 73.69% of the learners achieved scores above the average of 40%, while 26.31% scored below the average. The use of CAL exposed learners to a new teaching and learning method, which resulted in a significant improvement in performance, with a mean increase of 9.77 and SD of 1.28.

To determine how CAL has affected learners' ability to write in English, a t-test on pretest and posttest results was conducted. Table 4.6 presents a summary of the t-test (paired t-test) analysis of learners' scores on the performance of English writing skills.

Table 4.3: T-Test for Pretest and Post Test

	Paired Differences					**t**	**df**	**Sig. (2-tailed)**
	Mean	**Std. Deviation**	**Std. Error Mean**	**95% Confidence Interval of the Difference**				
				Lower	**Upper**			
Pretest score – post test score	-9.368	8.308	1.906	-13.373	-5.364	-4.915	18	.000

Table 4.3 provides a summary of the two-tailed t-tests conducted in the pretest and posttest to assess learners' performance in English writing skills. The results show that the t-value is 4.915, the degree of freedom (df) is 18, and the significant value (p-value) is.000. Fraser (2019) asserts that there is more evidence to reject the H0 the smaller the p-value. This resulted in thresholds of $p< 0.001$ signifying extremely strong evidence against H_0, $p< 0.05$ signifying moderate evidence, and $p< 0.1$ signifying weak evidence.

The hypothesis **H_{01}** which stated that "there is no significant difference in English writing skills when using CAL," was rejected. This is due to the p-value of 0.000, which indicates a strong correlation between the performance in English writing skills and the use of CAL. Given that most learners with hearing impairments learn best when using visual methods, the study's results suggest that CAL, as a visual means of instruction, could have contributed to the improvement in performance.

These findings complement a study by Ganapathy, Shuib, and Azizan (2020), which utilized the same application, the English Grammar Test, to teach 78 undergraduate students in University Sains Malaysia (USM) on English grammar skills. The study found out that the application was effective in improving learners' skills, as the overall score in the posttest was 64.17, which was a great improvement from 41.82 at the pretest. Tifani (2020) conducted a similar study using the same application to teach tenses to 8th grade learners, revealing a significant improvement from a pretest mean of 27.4 to a posttest mean of 60.65.

In addition, Adejumo, Abioye, & Tar (2020) assert that CAL, similar to other instructive software, has the possibility to aid, hasten, stimulate, and develop language learning skills. Additionally, Jarata (2019) and Bush (2020) show that use of CAL helped to improve performance in English among college students. This is because learners changed attitudes towards the subject, and learners positively engaged in language learning after the introduction of CAL. Abhijit et al. (2019) recommend CAL as effective in enhancing performance in other subjects like mathematics, English, and mother tongue.

In addition, according to Zhao, Llorente, and Gómez (2021), computer-assisted learning can promote learning by giving students access to tools that they can use to build knowledge, explore and evaluate material with others, and explain and portray what they have learned. According to Chekour (2019), teachers should strive to foster active learning, higher-level thinking capacities, and collaborative, multimodal activities while transitioning students from a traditional learning environment to a new one.

4.5 Comparison of English Writing Skills among Hard of Hearing and Deaf Learners when Using CAL

Objective three sought to establish the influence of learners' levels of hearing loss—hard of hearing and deaf learners—on writing skills when using CAL.

Table 4.4: Analysis of Pretest and Posttest of Hard of Hearing (HoH) Learners

Learner	Gender	Age	Hearing loss	Pretest out of 50	% pretest	Posttest	% posttest out of 50	Deviation	% deviation
A	M	14	HoH	5	10	17	34	12	24
E	F	22	HoH	41	82	44	88	3	6
F	F	16	HoH	18	36	35	70	17	34
H	M	16	HoH	24	48	35	70	11	22
J	M	19	HoH	16	32	33	66	17	34
M	F	15	HoH	8	16	14	28	6	12
P	F	18	HoH	21	42	35	70	14	28
R	F	23	HoH	26	52	30	60	4	8

The study included 8 learners with hearing impairments, of which 3 were male and 5 were female. The mean score of the pretest was 20.8, which increased by 9.6 points to 30.4 in the posttest. Female learners performed better in both the pretest and posttest, with a mean score of 22.8 in the pretest and 31.6 in the posttest, compared to male learners, who scored 15 and 28.3 in the pretest and posttest, respectively.

Table 4.5: Analysis of Pretest and Posttest of Deaf Learners

Learner	Gender	Age	Hearing loss	Pretest out of 50	% pretest	Posttest out of 50	% posttest	Deviation	% deviation
B	F	17	Deaf	11	22	25	50	14	28
C	M	20	Deaf	30	60	34	68	4	8
D	M	17	Deaf	1	2	6	12	5	10
G	M	15	Deaf	9	18	24	48	15	30
I	F	17	Deaf	34	68	42	84	8	16
K	M	24	Deaf	26	52	36	72	10	20
L	F	18	Deaf	2	4	9	18	7	14
N	M	16	Deaf	24	48	34	68	10	20
O	M	17	Deaf	12	24	17	34	5	10
Q	M	15	Deaf	15	30	31	62	16	32
S	M	16	Deaf	20	40	23	46	3	6

The study included 11 learners who were deaf. Among them, 3 were female, while 8 were male. Male learners performed better with a mean of 17.1 and 25.6 compared to their female counterparts, who scored 15.7 and 25.3 in both the pretest and posttest, respectively. The ANOVA test was used to attempt an inferential interpretation of the significance of this observation, and the findings are as follows in Tables 4.9 and 4.10 below.

Table 4.6: ANOVA Test of English Writing Skills Based on Level of Hearing Loss

	N	Mean	Std. Deviation	Std. Error	95% confidence interval for mean		Min	Max
					Lower Bound	Upper Bound		
Hard of hearing	8	1.86	1.176	0.147	1.62	2.21	1	5
Deaf	11	1.69	0.922	0.104	1.45	1.89	1	5
Total	**19**	**1.78**	**1.05**	**0.088**	**1.61**	**1.97**	**1**	**5**

The ANOVA test scores, as shown in Table 4.9, give information on scores for English writing skills relative to degree of hearing loss. The results showed that hard-of-hearing learners had the highest score on English writing skills (1.86) compared to deaf learners (1.69). Table 4.10 presented an ANOVA analysis summary for students' English writing skills scores.

Table 4.7: Summary of English Writing Skills Based on Degree of Hearing Loss-ANOVA

	Sum of Squares	Df	Mean Square	F	F Crit.	Sig.
Between groups	4.172	1	4.172	5.26	3.043	0.023
Within groups	107.488	17	0.793			
Total	**111.66**	**18**				

Table 4.10 presents a summary of students' ANOVA scores on English writing skills, stratified by their degree of hearing loss. At a significance level of 0.05, the ANOVA results are {F = 5,260; df = 1; 17; 18; P = 0.023; F Crit. = 3.043}. The rejection of the null hypothesis HO2, which asserted that "there is no significant difference in English writing skills when using CAL based on degree of hearing loss," indicates that learners who scored highly on English writing skills performed better after exposure to CAL.

The research findings indicate that CAL, when implemented as an instructional strategy for learners who are deaf and hard of hearing, enhances their English writing skills. This is in line with the findings of Koehlinger, Horne, and Moeller (2019), who discovered that when using CAL to teach English as a second language to deaf and hard of hearing learners in Belgium, performance significantly improved in the posttest. However, hard of hearing learners scored higher in both the pretest and posttest compared to deaf learners. Hard-of-hearing learners, who benefit from hearing aids, possess the advantage of residual hearing. This allowed them to absorb information using all forms of communication, including audio and visual means. The findings also concur with Baykoc (2014), who used CAL to teach mathematics to deaf and hard-of-hearing learners. Despite the fact that hard-of-hearing learners scored higher than deaf learners, there was a significant improvement in the pretest and posttest mean for both groups of learners.

The learners described the learning experience with CAL as engaging; there was more freedom, and students developed interest, which led to improved performance. Nweke, Okeke, Anusiuba, and Egbo (2019) conducted a study in Nigeria and found that hard-of-hearing learners outperformed deaf learners in biology when using CAI. This is due to

their ability to integrate both auditory and visual input in order to navigate and benefit from CAL tools more effectively than their deaf counterparts.

4.6 Comparison of Learner's Performance based on Different Demographic Factors

4.6.1 Effect of CAL on Students' Performance Based on Gender

Objective 4 (a) of the research sought to determine the effects of CAL on English writing skills of learners with hearing impairments when using CAL based on gender. First, the results of both pretest and posttest were comparatively analyzed based on gender.

Table 4.8: Pretest and Posttest Performance of Male Learners

Learner	Gender	Pretest out of 50	% pretest	Posttest out of 50	% posttest	Deviation	% deviation
A	M	5	10	17	34	12	24
C	M	30	60	34	68	4	8
D	M	1	2	6	12	5	10
G	M	9	18	24	48	15	30
H	M	24	48	35	70	11	22
J	M	16	32	33	66	17	34
K	M	26	52	36	72	10	20
N	M	24	48	34	78	10	20
O	M	12	24	17	34	5	5
Q	M	15	30	31	32	16	32
S	M	20	40	23	46	3	6

From the table 4.8, the total number of male learners who took both the pretest and posttest were 11. The learners had diverse level of hearing loss levels as 3 were hard of

hearing and 8 were deaf. In the pretest, the male learners managed to score a mean 16.55 which greatly improved in the posttest as they scored a mean of 26.36.

Table 4.9: Performance of Female Learners in the Pretest and Post Test

Learner	Gender	Pretest out of 50	% pretest	Posttest out of 50	% posttest	Deviation	% deviation
B	F	11	22	25	50	14	28
E	F	41	82	44	88	3	3
F	F	18	36	35	70	17	34
I	F	34	68	42	82	8	16
L	F	2	4	9	18	7	14
M	F	8	16	14	28	6	12
P	F	21	42	35	70	14	28
R	F	26	52	30	60	4	8

Table 4.9, represents 8 female learners who undertook both the pretest and posttest out of which 5 were hard of hearing and 3 were deaf. In the pretest, the learners were able to score a mean of 20.125 and showed improvement in the posttest where they scored a mean of 29.25.

Analysis of the pretest scores showed that out of the 11 learners who scored below 20, 7 were male (representing 64% of total male) while 4 were female (representing 50% of total female). This indicated low performance across both genders. Six learners attained the average score of 21-30 which included 4 male (representing 36% of the male learners) and 2 female learners (representing 25% of the female learners). The highest scores which ranged from 31-50, only 2 female learners (representing 25% of the female

learners) were able to attain the score while none of the male learners attained that score. The majority of the students (representing 14) scored higher than the required 20.

Analysis of the posttest showed that 8 of the 14 learners who attained a score of 20 or higher were men (73% of the total male population), while six were women (75% of the total female population). This suggested that both genders were performed well in the posttest as compared to pretest. The results were analyzed using ANOVA to compare performance of boys and girls when using CAL.

Table 4.10 ANOVA Test of English Writing Skills Based on Gender

	N	Mean	Std. Deviation	Std. Error	95% confidence interval for mean		Min	Max
					Lower Bound	Upper Bound		
Male	11	1.75	1.019	0.100	1.54	1.94	1	5
Female	8	2.04	1.169	0.200	2.45	1.89	1	5
Total	**19**	**1.89**	**1.058**	**0.090**	**1.64**	**1.99**	**1**	**5**

Table 4.10 provides details on the gender-related ANOVA scores for students' proficiency in English writing skills. The findings show that learners had a total score of 1.89; female students received the highest score, 2.04, while male students received a score of 1.75. Table 4.16 below contains a summary of an ANOVA analysis for the students' score.

Table 4.11: Summary of English Writing Skills Based on Gender – ANOVA

	Sum of Squares	Df	Mean Square	F	F Crit.	Sig.
Between groups	2.274	1	2.274	2.032	3.041	0.153
Within groups	151.422	17	1.128			
Total	**153.696**	**18**				

Results from Table 4.11 provide a summary of the students' gender-related ANOVA scores. The ANOVA findings show that the observed mean difference was not significant at the 0.05 level of significance (F=2.032; df=1; 16; 17; P=0.153; F Crit.=3.041). This means that there was no statically significant difference in the effects of CAL on students' English wring skills based on gender hence the null hypothesis $\mathbf{H_{03}}$ which stated that "there is no significant difference in English writing skills when using CAL based on gender" was confirmed.

According to studies, students' gender has minimal bearing on how well they learn English writing with CAL. From the findings of this study, female learners performed better as compared to their male counterparts when using CAL. This tends to agree based on research by Tondeur, Van de Velde, Vermeersch and Van Houte (2022) which showed that women tend to perform well or even better compared to their male counterparts when using CAL in the university. This is because, when computers are used for learning, all learners despite the different genders manipulate the devices for academic benefit and therefore, their attitudes are not linked to gender. When CAL was utilized, Peixoto (2019) and Dodik, Sellán, Kim and Phillips (2022) found no evidence of

a connection between gender and academic achievement. These scholars contend that motivation, cognitive growth, and self-discipline all contribute to academic success. In keeping with this, Cimpian, Kim & McDermott (2020) maintain that learners' performance is not influenced by their gender but rather by their entry behavior.

On the contrary, study by Delaney and Devereux (2021) shows that male learners tend to perform better than female learners when using CAL since they are more active in class discussions, tend to ask more questions and receive more answers from the teachers thus improving their computer literacy skills. On the other hand, female learners tend to lack computing confidence and have underrated computer related skills. Their findings tend to agree with the findings of a study conducted by Drabowicz (2019) which showed that male learners love computers more than female learners and this increases their computer confidence and, in some cases, when teachers experience technological challenges in class, they tend to resort to male learners as they are assumed to have some level of experience in resolving this challenge. The amount of time spent on utilization of the technological device plays a role on how learners acquire technological skills and manipulate these skills when using CAL.

According to Delaney & Devereux (2021), male learners often use computers to more at home, in school and after school for gaming, educational applications and internet access as compared to female learners who mostly use computers majorly for social purposes and that men predominately employ computer-assisted learning. In addition, boys and girls have different experiences when in the same classroom and listening to the same teacher. When exposed to CAL, boys typically performed better. This was particularly

clear in Europe and North America, where it was noticed that males had more access to computers in classrooms and dominated jobs using computers, both of which improved performance.

4.6.2 Effect of CAL on Students' Performance Based on Age

The objective sought to find out the effect of CAL on students' performance based on age. Comparative analysis of the learner's performance based on age; 14-19 and 20-25 was done.

Table 4.12: Pretest and Posttest Performance of Learners Based Between Age 14-19

Learner	Gender	Age	Hearing loss	Pretest out of 50	% pretest	Posttest out of 50	% posttest	Deviation	% Deviation
A	M	14	HoH	5	10	17	34	12	24
B	F	17	Deaf	11	22	25	50	14	28
D	M	17	Deaf	1	2	6	12	5	10
F	F	16	HoH	18	36	35	70	17	34
G	M	15	Deaf	9	18	24	48	15	30
H	M	16	HoH	24	48	35	70	11	22
I	F	17	Deaf	34	68	42	84	8	16
J	M	19	HoH	16	32	33	66	17	34
L	F	18	Deaf	2	4	9	18	7	14
M	F	15	HoH	8	16	14	28	6	12
N	M	16	Deaf	24	48	34	68	10	20
O	M	17	Deaf	12	24	17	34	5	10
P	F	18	HoH	21	42	35	70	14	28
Q	M	15	Deaf	15	30	31	62	16	32
S	M	16	Deaf	20	40	23	46	3	6

From table 4.12, a total of 15 learners were in the age group of 14-19 years. Majority representing 62.5% were male learners while 37.5% were female learners. In the pretest, the learners attained a mean of 15.625 and later in the posttest, a mean of 25.875 which was a positive increment. 10 learners (73%) scored below the pass mark on the pretest and this greatly improved in the posttest as only 5 learners (33%) scored below the mean score.

Table 4.13: Pretest and Posttest Performance of Learners Based Between Age 20-25

Learner	Gender	Age	Hearing loss	Pretest out of 50	% pretest	Posttest out of 50	% posttest	Deviation	% deviation
C	M	20	Deaf	30	60	34	68	4	8
E	F	22	HoH	41	82	44	88	3	6
K	M	24	Deaf	26	52	36	72	10	20
R	F	23	HoH	26	52	30	60	4	8

From the table 4.13 above, 4 learners were aged 21-25 where 2 (50%) were female and 2 (50%) was a male learner. In the pretest, the learners attained a mean of 31 and later improved to 36.667 in the posttest. All learners in this age group performed well in both pretest and posttest as no scores below the pass mark were recorded in both tests.

An ANOVA analysis was sought to aid in the interpretation of the findings and outcomes displayed in table 4.14 and 4.15

Table 4.14: ANOVA Test of English Writing Skills Based on Age

	N	Mean	Std. Deviation	Std. Error	95% confidence interval for mean		Min	Max
					Lower Bound	Upper Bound		
14-19	15	1.43	.417	.044	1.12	1.36	1	5
20-25	4	2.31	1.169	.090	1.65	1.89	1	5
Total	**19**	**1.87**	**.858**	**.056**	**1.34**	**1.56**	**1**	**5**

Table 4.21 shows an analysis of measures of central tendency of scores of learner's English skills in relation to their age. The outcomes show that learners aged 20-25 scored the highest score of a mean of 2.31 while students aged 14-19 scored a mean of 1.43 which was a deviation of 0.88 from the mean of age group 20-25 years. A summary of the ANOVA analysis for students' English skills was computed and represented in table 4.22 below.

Table 4.15: Summary of English Writing Skills Based on Age – ANOVA

	Sum of Squares	**Df**	**Mean Square**	**F**	**F Crit.**	**Sig.**
Between groups	26.481	1	26.481	37.512	2.687	0.010
Within groups	211.372	17	.713			
Total	**237.853**	**18**				

Results from table 4.15 summarize the ANOVA analysis of the students score in English writing skills based on age. The ANOVA findings reveal that the observed difference was significant at the 0.05 level of significance: F=37.512; df=1;17; P= 0.01; F crit=2.687. Thus, the null hypothesis **H_{04}**, which claimed that "there is no significant difference in performance of English writing skills when using CAL based on age," was accepted because there was no discernible difference in performance when using CAL based on the learners' ages.

The results of the study demonstrate that no particular set of students is impacted by CAL as a way of teaching and learning English writing abilities. This study agrees to Wigfield, Gladstone and Turci (2019) who suggests that the younger children are typically more driven to succeed academically than the older ones. This could be a result of various non-academic issues occupying the older students' attention. Younger students might be more committed to their studies, but they might not have the knowledge or experience to adequately deal with the challenges posed by more challenging academic work. However, results of the study show that age has no appreciable impact on academic achievement. Adding to it, Drabowicz (2019) in his study found out that there was no significant difference in computer usage and performance as learners in different age groups, they all equally found computers useful and were able to use it in academics. Roussinos and Jimoyiannis (2019) revealed that there are four interconnected dimensions that affect performance when using computers to learn which include a person's fear, reluctance to use computers, self-efficacy and confidence in one's own computer skills thus factors like age do not affect performance.

The study findings disagree with a study conducted by Li, Xiong, Zang, Kornhaber, Lyu, Chung, and Suen (2020), showed that younger students preferred spending more time on computers since they did so because they considered them more engaging and interesting than older students. This had an impact on the students' results because the younger students fared better on examinations involving computers than the older students, who were less engaged in the learning activity.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents key summary findings, conclusions based on the findings, and recommendations guided by the study's objectives. The study's implications led to policy and further research recommendations.

5.2 Summary of the Findings

The study aimed to assess the effectiveness of computer-assisted learning in improving the writing skills of learners with hearing impairments at Kambui Secondary School for HI. The Five objectives guided the study, encompassing the writing skills of learners prior to the introduction of CAL, the impact of CAL on these skills, and the effects of CAL on the writing skills of learners with hearing impairments based on their degree of hearing loss, gender, and age. The study was conducted on 19 learners with hearing impairments from Kamnui Secondary School for HI, and a single subject quasi-experimental design was utilized. The study achieved 100% participation from the learners. Out of the 19 learners, 8 were female and 11 were male; 8 were hard of hearing, and 11 were deaf.

The findings from objective one, which aimed to determine the level of writing skills among learners with HI, indicated that the learners already possessed English writing skills, as evidenced by their mean score of 18.05. Despite this, the performance was dismally low, as the majority of the learners (57%) scored below the pass mark of 40%.

The second objective of the study aimed to determine the impact of CAL on the writing skills of learners with HI. After learners were subjected to CAL, a posttest was administered to establish this effect. The writing skills improved at the posttest, with a mean score of 27.58 compared to 18.05 in the pretest, confirming the effectiveness of CAL. During the posttest, the majority of the learners (73.69%) scored above the pass mark of 20, while only a few learners (26.31%) scored below the pass mark.

The study's third objective was to compare the writing skills of deaf and hard-of-hearing learners when using CAL. The study found out that hard-of-hearing learners performed better than deaf learners in both pretest and posttest. An ANOVA test revealed that deaf learners had a mean of 1.69, whereas hard of hearing learners had a mean of 1.86. The fourth objective explores the effect of different demographic factors, such as gender and age, on the writing skills of learners with HI when using CAL. The study found that female learners performed better in both the pretest and posttest compared to their male counterparts. In relation to age, learners in the age group of 20–25 performed well in both the pre- and posttest as compared to learners in the age group of 14–19 when using CAL.

5.3 Conclusion

The study aimed to investigate the effectiveness of CAL in enhancing the writing skills of learners with HI at Kambui Secondary School in Kiambu County. Numerous study conclusions were drawn in accordance with the study objectives.

In line with the first objective of this study, which aimed to determine the writing skills of learners prior to the implementation of CAL, the study found that the learners' performance remained poor. Therefore, this study concluded that the use of traditional methods to teach learners with HI could have contributed to their low writing performance. These methods rely primarily on sign language and audio channels. This disadvantages learners with HI, who rely heavily on visual aids.

On assessing the effectiveness of CAL on the writing skills of learners with HI using the English Grammar Test application, there was a significant variation in the writing skills of learners between the pretest and posttest. Therefore, the study concluded that use of CAL was effective in improving writing skills among HI learners because learners were able to utilize both audio and visual stimulations in learning rather than audio formats only.

The third objective of the study aimed to compare the writing skills of deaf and hard-of-hearing learners when using CAL. According to the study, hard-of-hearing learners performed better than deaf learners. Therefore, the study concluded that hard-of-hearing learners improved their writing skills more than deaf learners because they were able to utilize both audio and visual channels when using CAL, unlike their deaf counterparts, who relied on visual channels only.

When using CAL, the last objective assessed different demographic factors, such as gender and age. In terms of gender, female learners performed better than their male counterparts in both the pretest and posttest when using CAL. The study concluded that

the majority of female learners were hard of hearing, while the majority of male learners were deaf, potentially contributing to the gender difference. When using CAL, learners between the ages of 20 and 25 performed better in both the pretest and posttest compared to those between the ages of 14 and 19. Therefore, the study concluded that the older learners, who had many years of exposure to written language, performed better than the younger learners who had a shorter exposure to writing skills. The researcher firmly believes that this research has successfully fulfilled its primary objective. All the sampled learners willingly participated in the study by utilizing CAL to improve their English writing skills in Kambui Secondary School for HI.

5.4 Recommendations

Based on the research outcomes, the following recommendations are made from the study.

5.4.1 Policy Recommendations

i. Existing policies on ICT in education and training (2021) advocate for content developers to be trained in adapting digital learning resources for learners with disabilities. The study's findings indicate that the use of CAL as a digital learning tool significantly improved the English writing skills of learners with hearing impairments. Therefore, MoE should put more emphasis on content developers creating accessible content for learners with hearing impairments.

ii. According to the research, KICD should consider digitizing content and resources on writing skills for learners with hearing impairments. Currently, learners struggle to access the curriculum using different pedagogical methods

than their hearing peers, which leads to an overreliance on sign language and traditional pedagogies.

iii. The 2021 ICT policy also advocates for enhanced teacher training curricula, which include skills development on digital learning resources for all categories of learners with HI. The ministry should also ensure that during these trainings, teachers are using differentiated pedagogical methods for deaf and hard-hearing learners due to the nature of hearing loss.

iv. According to the findings, the MoE should train teachers to use CAL tools in gender-sensitive and responsive ways. The MoE should equip teachers with strategies to ensure equal participation of boys and girls, fostering an environment where all students feel encouraged to engage with technology.

v. Teachers of learners with HI should consider early exposure to CAL tools as it can aid in the development of writing skills at an early age. Policies should encourage the introduction of basic computer literacy and educational software at an early age, tailored to the needs of learners with HI.

5.4.2 Recommendation for Further Research

This study on the use of CAL in improving learners' writing skills brought hope to their success with HI. Therefore, the researcher believes that further studies in this area are necessary to enhance the educational outcomes of learners with HI. As a result, the researcher suggested further investigation into:

i. The current study focused on using CAL to enhance the writing skills of learners with HI. Other areas of the English language, including oral literature and grammar, could be the subject of future research.

ii. Only one school in Kiambu County was the subject of the current study. To allow for generalizability and scaling, a similar study could target different schools in different counties and a larger population.

iii. Researchers could investigate the use of CAL in other subject areas like mathematics and sciences, where learners struggle.

iv. A similar study focusing on learners with other disabilities such as visual impairments and intellectual impairments could be conducted to ascertain the effectiveness of CAL on learners with different disabilities.

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APPENDIX I

PRETEST/ POSTTEST

Instructions:

This test is intended to seek information relevant on effectiveness of Computer Assisted Learning in the education of learners with Hearing Impairment in Kambui School for HI, Kiambu County, Kenya. Please answer all the questions.

SPELLINGS

Instructions: Fill in the blank spaces with the correctly spelt word. (10 marks)

1. Students are not _____ (aloud, allowed, alowed, allowd) to use this machine.
2. The _____ (great, grate, greet, graet) news is that the president will visit the school.
3. I have not _____ (scene, seen, sein, sene) him since the night we were in Nairobi.
4. The _____ (principle, principal, principel, principo) will be meeting the teachers to discuss about the timetable.
5. I know you had to (rite, write, right, light) it all down in your diary which you often (read, reed, raed, rid)

PUNCTUATION

Instructions: Rewrite the following sentences while punctuating them correctly. (10 marks)

1. The Babys Mother Is Called Mary
2. Where Is The English teacher

3. Mrs mwangi advised us to use the internet wisely however we should avoid being distracted
4. The Nurse said this child needs to be fed well to avoid malnutrition
5. Okono played for kambui school football team for two years

SENTENCES

Connecting sentences

Instructions: complete the following sentences by choosing the correct word that correctly completes the sentence. (10 marks)

1. My family (cares, care) for the orphaned children.
2. Cancer is an epidemic that (has, have) caused public alarm.
3. (We, us) are best friends.
4. Many forests were destroyed (before, since) the ministry of Environment and natural resources was created.
5. This is the woman (who, who's) brought the child to the school.

Cloze test

Instructions: read the cloze test below and fill in the correct choice that best fills the gap. (10 marks)

The continued deterioration _____ results of girls in the national exams; KCPE and KCSE and the general decline in mathematics and science across the genders is distressing. The results _____ by the Ministry of Education indicate the gap _____the genders _____ widened. Only 36,000 female students scored the

minimum _____ entry mark of C+, representing just 23-17 percent of the total _____ of candidates.

Boys nearly doubled this with 60,000 scoring C+, KCSE is a transition point for students and determines their social mobility. From here on, the lucky candidates will _____ onto university or _____ other tertiary institutions, the less luck often find _____ with a few choices. Such is the harsh _____ of Kenya's education landscape.

1.	On	In	at
2.	Released	Given	Rehearsed
3.	Under	Between	Above
4.	Have	Has	Had
5.	University	primary	secondary
6.	Number	Total	addition
7.	Drive	Move	separate
8.	Join	become	differ
9.	Herself	themselves	himself
10.	Reality	dream	future

Tenses

Complete the following sentence choosing the correct tense. (10 marks)

1. Where is Antony? He _____ (lie) under the car.
    a) is lying

b) is lieing

c) are lying

2. Mother _____ (rest) now.

a) is rest

b) is resting

c) are resting

3. There aren't good busses because the drivers _____ (go) on strike.

a) has gone

b) have gone

c) have goed

d) has goed

4. _____ (water) the tomatoes? Yes, I think she _____.

a) Have Mary watered/has

b) Has Mary watered/has

c) Has Mary watered/have

d) Have Mary watered/have

5. I _____ (live) here for 10 years.

a) has lived

b) have lived

c) has living

d) have living

Thank you.

APPENDIX II

Computer applications for CAL

Application: **English Grammar Test**

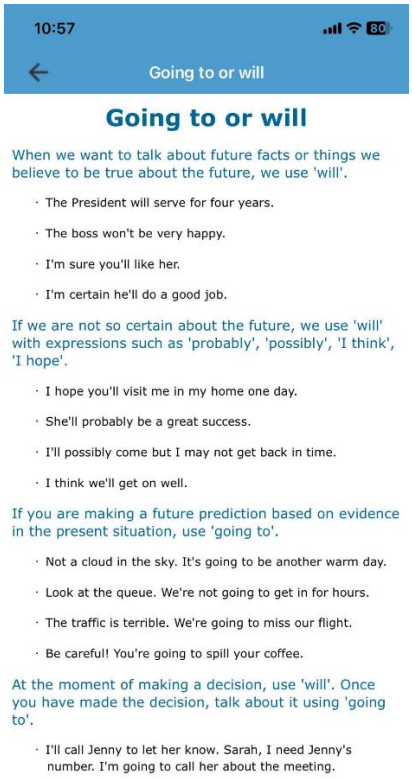

Figure 1: Sample English Grammar Test Application learning resources

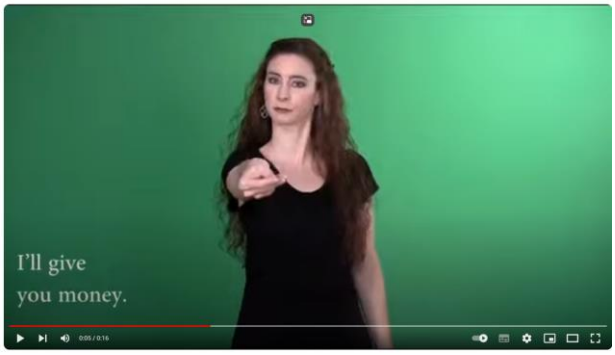

Figure 2: Online resources with sign language and captioning completing the topic.

After learners access the resources on English Grammar Test, they were allowed to use the internet to access sign language and captioned resources to enhance learning.

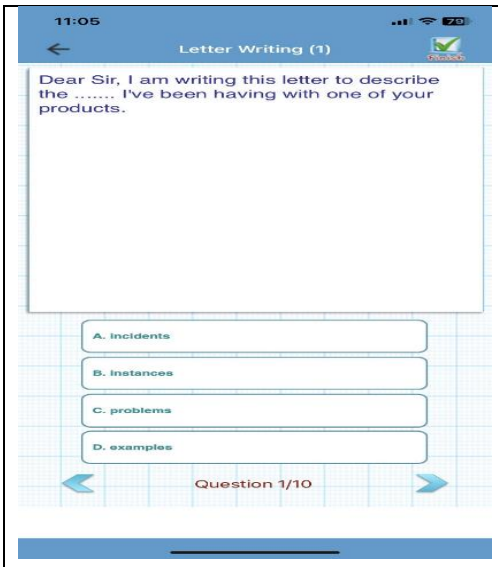

Figure 3: Sample test that learners undertook using the application.

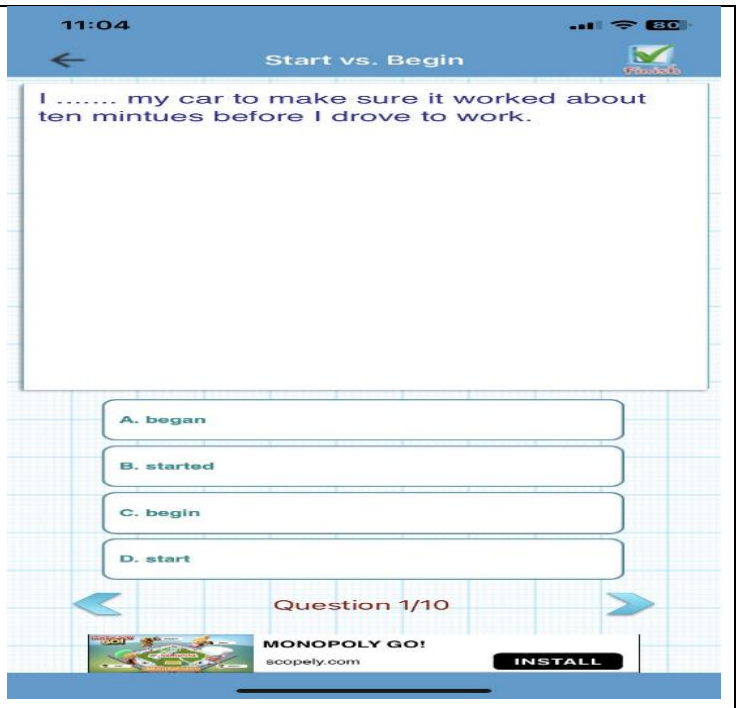

Figure 4: Sample test on irregular verbs.

APPENDIX III: PERMIT FROM NACOSTI

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

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