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Blending literacy and technology: How computer-assisted instruction enhances vocabulary development in English language learners

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Abstract

The artificial intelligence (AI) revolution and expansion of educational technologies have reshaped how learners acquire literacy skills, raising critical questions regarding digital equity, sustainability, and teacher readiness. Nevertheless, integrating technology into literacy education continues to gain traction globally transforming how teaching and learning are conducted. For English Language Learners (ELLs), vocabulary knowledge is a central pillar in reading comprehension and overall language development. Yet, in many low-resource contexts such as Kenya, pupils struggle with foundational literacy, creating an urgent need for innovative interventions that merge literacy instruction with technology. This study investigated the role of Computer-Assisted Instruction (CAI) in strengthening vocabulary development among primary school pupils. The study was grounded in Bruner's Constructivist Theory, which views learning as an active process shaped by interaction and discovery. A pragmatist research paradigm guided the study, employing a quasi-experimental mixed-methods design that combined both qualitative and quantitative approaches in a concurrent embedded framework. The study population consisted of 6,960 pupils and 182 teachers across 174 schools in Soy Sub-County, Uasin Gishu County, Kenya, including both iMlango-supported schools (utilizing CAI) and non-iMlango schools. Four schools were purposively selected, two of which formed the experimental group (using CAI) and two formed the control group (traditional instruction) to participate in a four-week intervention. For the iMlango classes each teachers' class had 30 and 32 pupils while the other two without iMlango had 54 and 58 pupils. These formed the unit of analysis totaling 174 pupils across the two groups. Data

collection involved vocabulary tests, structured classroom observations, and teacher interviews. Quantitative analysis was done using descriptive statistics in the form of means, percentages and frequencies and inferential statistics through t-test analysis while qualitative data was analyzed thematically. Study findings revealed no significant differences between the experimental and control groups during the pre-test phase for both vocabulary development. However, post-test results demonstrated statistically significant gains in the experimental group for vocabulary development (M =8.758, SD=8.361, p =.000). These findings highlight a paradox: while CAI can powerfully enhance ELLs' vocabulary acquisition and development, teacher readiness and systemic support remain critical for sustainable implementation. The study thus concludes that CAI represents an effective instructional innovation for bridging literacy gaps among English Language Learners. Its capacity to combine interactivity, personalization, and multimodal delivery makes it particularly suitable for learners struggling with vocabulary retention. Nonetheless, the full potential of CAI can only be realized if challenges of teacher resistance, digital inequity, and resource constraints are systematically addressed. Accordingly, the study recommends that policymakers and educational stakeholders invest in the provision of affordable digital infrastructure to support classroom integration of CAI. Further, institutional policies should embed technology-enhanced instruction into literacy curricula to ensure long-term sustainability. By situating the findings within global debates on the AI revolution in education, this paper underscores the dual imperative of leveraging technology for improved literacy outcomes while attending to the ethical, pedagogical, and sustainability concerns it raises. Ultimately, blending literacy and technology through CAI offers a pathway toward more equitable, engaging, and transformative educational practices for English Language Learners.

Key terms: Computer-Assisted Instruction, Vocabulary Development, English Language Learners, Educational Technology, Digital Equity.

1.0 Introduction

Literacy development remains a cornerstone of educational success, yet many English Language Learners (ELLs) continue to struggle with acquiring the foundational skills required for reading comprehension. Among these skills, vocabulary knowledge has been widely recognized as one of the strongest predictors of literacy achievement, since it directly influences a learner's ability to decode, interpret, and construct meaning from texts. For ELLs, limited vocabulary not only restricts reading fluency but also hinders overall academic performance, as language proficiency is integral to learning across subjects. Gillon (2023) in his study posits that for children to experience early literacy success equally, addressing the global challenge of reducing current educational inequities as advocated by the United Nations Educational, Scientific and Cultural Organization and the United Nations education Sustainability Development Goal 4 on quality education for all (UNESCO, 2022) is crucial.

Reiser (2018) avers that literacy is still the unrivalled, but grossly under-implemented, key to learning both content and thinking skills. In his study, Schmoker (2018) argues that the focus of today's

educational agenda is to improve the reading achievement of all pupils for their reading has never had a higher priority. Yet it is only through extensive reading (about 150 hours per year) and critically analyzing primary sources, textbooks and newspapers that can children debate, argue, and write about the content they are exploring (Pasqualotto et al., 2022).

The integration of technology into literacy instruction offers promising possibilities. Computer-Assisted Instruction (CAI), in particular, provides interactive and multimodal learning experiences that can supplement traditional teaching methods. By blending literacy with technology, CAI has the potential to enhance vocabulary development, increase learner engagement, and address gaps in English language proficiency (Macaruso & Rodman, 2011; Kosgei, Opata & Yungungu, 2025). Understanding how such technological interventions affect ELLs is therefore crucial for informing educational practice and policy, especially in resource-constrained environments.

Problem Statement

English is a critical subject in technical and general education, serving both as a foundation for academic success across disciplines and as a key skill for employability in the global labor market. However, a growing body of evidence highlights significant challenges in literacy development among learners in Kenyan primary schools (Kim et al., 2020; Dubeck & Gove, 2015). Many pupils struggle with reading and vocabulary development skills that are essential for academic progression and lifelong learning. According to national performance data, English language scores in the Kenya Certificate of Primary Education (KCPE) within Soy Sub-County declined consistently from 2016 to 2019 (Soy Sub-County Education Department, 2020), signaling a pressing need for effective intervention strategies.

At the same time, technological advancements have transformed educational practices worldwide, with Computer-Assisted Instruction (CAI) emerging as a promising tool for enhancing literacy skills. CAI offers interactive and adaptive learning experiences that can support vocabulary development, improve reading comprehension, and boost learner motivation (Foorman et al., 2021). Despite its potential, Giménez et al. (2021) point out that the integration of CAI in Kenyan classrooms remains limited, and its effectiveness largely depends on teachers' willingness and capacity to adopt these technologies.

Moreover, the success of such technology-driven interventions may depend not only on learner outcomes but also on teachers' perceptions and willingness to adopt new pedagogical approaches. Despite global evidence demonstrating the potential of Computer-Assisted Instruction (CAI) to improve reading comprehension and vocabulary acquisition (Chen et al., 2016; Wang et al., 2018), little empirical research has been conducted in the Kenyan context. This gap necessitates a closer examination of how CAI can enhance literacy outcomes, particularly in public primary schools where resource constraints and teacher readiness significantly affect instructional practice.

Therefore, this study sought to address the gap by investigating how Computer-Assisted Instruction can enhance English vocabulary development in English among learners in public primary schools. The paper aims to explore integration of CAI into literacy instruction, as it is based on these elements of pupils' vocabulary development that the success and sustainability of such interventions may be felt through improved performance.

2.0 Literature Review

2.1 Theoretical Review

This study was also guided by Bruner's (1966) Constructivist Theory of Learning (CTL). Constructivism is a learning theory which suggests that learners actively construct knowledge and understanding through

their experiences and interactions with the world. Bruner's Constructivist Theory emphasizes that learning is an active process in which learners construct new ideas and concepts based on their current and past knowledge. According to Bruner, the learner is not a passive recipient of information but an active participant who makes meaning through interaction with the environment. Central to the theory are the ideas of scaffolding, discovery learning, and the spiral curriculum, where learners revisit concepts at increasing levels of complexity. Bruner also highlights the role of language as a tool of thought, positioning it as central to the development of higher cognitive functions.

In the context of this study, which investigates the role of Computer-Assisted Instruction (CAI) in enhancing vocabulary development among pupils, Bruner's Constructivist Theory provides a suitable theoretical framework. CAI integrates interactive features such as immediate feedback, pronunciation guides, and visual aids, which align with the concept of scaffolding by supporting learners as they gradually build their vocabulary. The repetitive yet progressively challenging exercises within CAI reflect the principle of a spiral curriculum, allowing learners to revisit words and expand their understanding in varied contexts. Similarly, the use of multimedia in CAI promotes discovery learning, where pupils actively engage with vocabulary in meaningful, contextualized ways (Saleem et al., 2021).

The theory informs this study by offering an explanation of why CAI is effective for vocabulary acquisition and development among English language learners. Through Bruner's lens, CAI acts as a mediating tool that facilitates active learning and knowledge construction rather than rote memorization. By providing opportunities for learners to manipulate, explore, and practice vocabulary, CAI strengthens the relationship between language and thought, making the learning process more engaging and meaningful (Zeng et al., 2025). Therefore, Bruner's Constructivist Theory not only grounds the study theoretically but also justifies the use of CAI as an instructional approach that supports active, scaffolded, and discovery-based vocabulary development.

2.2 Empirical review

Teachers of English often employ traditional vocabulary teaching techniques such as first language (L1) equivalents, pictures, word formation rules and word lists. They ask the pupils to read the new words aloud repeatedly and copy them as homework in order to reinforce pupils' retention of the words (Yu, 2020). Despite this, instructors and pupils usually complain of insufficient knowledge of English vocabulary. A study with a sample of English-as-a-Foreign-Language (EFL) instructors and pupils at the Preparatory Year Program in Saudi Arabia indicated that lack of vocabulary is one of the major factors in students' inability to speak English (Khan et al., 2018).

Vocabulary acquisition is seen as a complicated undertaking, with most pupils finding it tough to grasp (Stockwell & Liu, 2015). For learners attempting to understand English vocabulary, the complexity of word forms, word choices and diverse meanings offer challenges (Tan et al., 2020). Several translation software programmes have recently been developed, and they are being used by pupils as an alternate method for studying English vocabulary (Pavlik, 2015). Vocabulary study is essential for developing competence and achieving competency in the target language. As a result, researchers are constantly looking for the optimal strategy for teaching vocabulary (Nakata & Webb, 2016). On the one hand, there are four types of English learning strategies: cognitive, metacognitive, emotive, and social (Chen, 2016). The vocabulary learning process, on the other hand, can be separated into structured and unstructured ways (Hsiao et al., 2017). According to Oktaviana, (2018), structured learning approaches are viewed as more productive, whereas unstructured learning approaches are considered less beneficial to the learning process. Furthermore, structured learning frequently offers more systematic approaches to the organizing and management of study materials. Web-based instruction activities have been shown to have a positive impact on L2 vocabulary learning process. The results of many empirical studies suggest that many L2

learners often prefer to use the web-based instruction activities that include both synchronous and asynchronous forms of teaching L2 lexical items (Hajebi et al., 2018). According to Ta'amneh, (2021)the instruction resources of web-based vocabulary process can accomplish different types of learners' expectations and enhance the pupils' participation with different abilities and proficiencies.

A lack of vocabulary knowledge can be a significant factor in learners' reluctance to learn writing and comprehend the language in use. This is because there are obvious characteristics within the wide range of vocabulary challenges for instance, word frequency, saliency, learning burden, and learners' vocabulary needs (Stoller &Grabe, 2018). After all, L2 vocabulary is best taught only when learners are exposed to a lot of target language input (Clarke, 2020). The significance of vocabulary learning in L2 has created difficulties in facilitating learners to retain and retrieve words when needed. Increased demands for English as L2 acquisition have stimulating debates among researchers about how best to meet learners' needs in today's day and age. The issues on vocabulary learning and strategies have been explored since it was often given little priority in language programs and was often left to fester, receiving very limited attention in most of language learning (Volodina et al., 2020).

Although some teachers may think that vocabulary learning is easy, learning new vocabulary items has always been challenging for the learners. The educational implications for EFL students with limited vocabulary are profound. Students who do not have sufficient vocabulary or word-learning strategies continue to struggle throughout their educational careers, which leads to a cycle of frustration and continued failure (Khany & Khosravian, 2014). Furthermore, the vocabulary level of an individual is viewed as a means of unlocking or closing access to information and often illustrates whether a person is considered educated (Wasik & Hindman, 2020). One of the first problems a foreign language learner encounters is how to commit a massive number of foreign words to memory. Establishing independent vocabulary skills needs a high level of motivation on the learner's part and is a dynamic process that involves multiple variables and the practice of different skills. The sort of strategies used by the students often depends on the specific learner; however, inside the classroom, teachers can explicitly model their strategies, remind students about them, and practice them to motivate the students' independent vocabulary-building skills. This classroom practice gives students the chance to take learning into their own hands. Recent years have seen a wealth of interest in learning strategies designed to increase students' vocabulary acquisition and development (Van de Wege, 2018). The current study investigated the effect of use of CAI in learning of and vocabulary development among learners at public primary schools. In this study, two groups were used where the first group was taught vocabulary using CAI (experimental group) while another group (control) was taught using conventional methods. To this end, this paper uniquely investigates how Computer-Assisted Instruction effectively enhances vocabulary development among English Language Learners, offering evidence-based insights for integrating technology into literacy instruction.

3.0 Methodology

This study was anchored on the pragmatism paradigm, which emphasizes practical solutions to educational challenges and supports the use of multiple approaches to inquiry (Kaushik & Walsh, 2019). Pragmatism aligns well with the study's adoption of a mixed-methods research design with a concurrent embedded approach (Molina-Azorin &Fetters, 2022) as it allows for the integration of both quantitative and qualitative data that would provide a holistic understanding of the role of Computer-Assisted Instruction (CAI) in enhancing vocabulary development among English Language Learners. By combining a quasi-experimental approach with qualitative insights, the study not only measured the effectiveness of CAI but also captured the experiences and perceptions of learners and teachers within authentic classroom contexts.

The research was carried out in Soy Sub-County, Uasin Gishu County, targeting a population of 6,960 Standard Six pupils in all the public primary schools in the Sub County with a total of 182 teachers representing 174 public primary schools. Since the population studied was large, comprising 174 schools in the study area (62 iMlango-supported and 112 without iMlango), the researcher purposively picked two schools from each category considering the practical constraints and the quasi-experimental nature of the study, yielding a total of four (4) schools. Data were collected using a combination of vocabulary and comprehension tests, classroom observations, and interviews with both pupils and teachers. The procedure for administering the instruments was carefully structured to ensure consistency and to accurately capture the impact of CAI on learners' vocabulary acquisition. In terms of data analysis, the quantitative component involved both descriptive statistics such as means and standard deviations and inferential techniques, particularly t-tests, to determine whether significant differences existed between the groups. The qualitative data, on the other hand, were analyzed thematically to uncover patterns in learner and teacher experiences with CAI.

4.0 Results and Discussion

The study sought to find out how computer-Assisted instruction influences pupils' vocabulary development in English. To achieve this objective, the learners who were selected to participate in the study were grouped into two groups: the experimental and the control groups. Learners in the experimental group were subjected to teaching of English using computer-assisted instruction for a period of four weeks while learners in the control group were taught English using conventional methods. Initially, a pre-test was administered to all learners before the intervention period. A post-test was thereafter administered to all the learners after the CAI intervention treatment. The results of the vocabulary use were tallied and calculated to make 100% score. The means and standard error of these two tests were calculated and the results for pre-test are presented in Table 1.

Table 1: Mean Marks of Pupils in Pre-Test and Post Test in Vocabulary Development

Groups		Mean	Std. Error	Mean Gain in scores
Experimental	Pre-test	44.00	.780	12.97
	Post-test	56.97	.707	
Control	Pre-test	43.42	.673	4.83
	Post-test	48.25	.648	

Table 1 shows that during the pre-test, learners in the control group had a mean score of 43.42 with a standard error of .673 while those in the experimental group had a mean score of 44.00 with a standard error of .780. After the treatment, the mean of the test scores for the experimental group was 56.97 with a standard error of .707 while that for the control group was 48.25 with a standard error of .648. The results showed that the mean score for pupils' improvement in vocabulary development for the experimental group increased and was higher than the mean score for the control group which also showed some increment. The difference in the mean scores between pre-test and post-test was 12.97 for the experimental group while that for the control group was 4.83. A mean difference of 10.08 was obtained in post-test results between the experimental and the control group. This shows that the CAI intervention done by teaching learner's vocabulary yielded a difference of 10.08% showing that CAI contributed about 10% on learners' vocabulary development. The 10% contribution by use of CAI could be attributed to the adaptability aspect that was also observed among the pupils while teaching using

CAI. It was observed that CAI programs could be designed to align to the learners' individual needs and abilities. Through adaptive algorithms, the system adjusted to the difficult level of the comprehension tasks based on the pupils' performance, providing a platform for the pupils to use new English vocabulary.

In addition, multimedia integration as a tool for CAI tool was considered key. This is established from the study findings drawn from the observation schedule that CAI programs incorporated multimedia elements, such as audio recordings, videos, and interactive visuals which enhanced the comprehension learning process enabling pupils to acquire new English vocabulary to use. These multimedia components provided additional context and support for pupils and made the content more engaging and accessible for them.

The findings from the tests align with the information provided by the teachers during interviews. The teachers' responses suggested that CAI has a substantial positive effect on vocabulary acquisition, primarily due to its interactive and multimedia-rich environment. The use of tools like audio pronunciation guides, visual aids, and interactive games is highlighted as a key advantage of CAI, making the learning process more engaging and accessible for pupils with diverse learning needs. One of the teachers in the experimental group had the following to say;

From my experience as a teacher, Computer-Assisted Instruction (CAI) has a considerable influence on the vocabulary development of pupils, often surpassing the effectiveness of conventional methods. CAI provides an interactive and dynamic environment where vocabulary learning is enhanced through various multimedia tools, such as audio pronunciation guides, visual aids, and interactive games. These tools not only make learning more engaging but also cater to different learning styles, which can be particularly beneficial for pupils who may struggle with traditional text-based approaches. One of the significant advantages of CAI is its ability to provide immediate feedback, allowing pupils to quickly correct their mistakes and reinforce their understanding of new words. This instant reinforcement is crucial in helping students retain vocabulary, as it ensures that errors are addressed as they occur. In contrast, conventional methods often rely on delayed feedback, which can sometimes lead to misunderstandings or the reinforcement of incorrect usage(Teacher 2 EG, Personal Communication, 2021).

The teachers pointed out that one of CAI's significant strengths is its ability to offer immediate feedback, which plays a crucial role in reinforcing correct vocabulary usage and aiding retention. This was similarly established in the observation schedule as the researcher identified immediate feedback as one of the significant benefits of CAI. In this study, it was observed that pupils engaged with the comprehension exercises and questions and they received instant feedback on their responses, helping them to highly improve in their vocabulary acquisition and retention. This immediacy of feedback when using CAI intervention in teaching reading comprehension contrasts with conventional methods where feedback may be delayed, potentially leading to the reinforcement of errors and forgetfulness of new terms that may have been learnt.

Another teacher, during an interview session with the research averred that:

CAI offers personalized learning experiences, where the difficulty level can be adjusted according to the pupil's current proficiency. This adaptability means that pupils are consistently challenged at the appropriate level, promoting steady vocabulary growth. Conventional methods, while effective in a structured classroom setting, may not always provide the same level of individualization, potentially leading to disparities in vocabulary development among students. However, it is essential to recognize that the effectiveness of CAI can depend on factors such as the quality of the software and the availability of resources. In settings where these are lacking, conventional methods may still play a crucial role in

vocabulary development. Nonetheless, when implemented effectively, CAI has the potential to significantly accelerate vocabulary acquisition and retention, making it a valuable tool in modern education (Teacher 2 CG, Personal Communication, 2021).

Notably, the complexity of word forms, word choices and diverse meanings remain a challenge for learners attempting to understand English vocabulary thus various studies have reinforced the positive effect of Computer-Assisted Instruction (CAI) on vocabulary development, often highlighting its advantages over conventional methods. For instance, a study by Hsu et al. (2014) demonstrated that CAI tools, such as interactive vocabulary games and multimedia resources, significantly improved vocabulary acquisition among elementary school students. Their research emphasized that the engaging and interactive nature of CAI facilitated better retention and understanding of new words compared to traditional rote learning methods.

This corroborates with the study findings Kabigting (2020) who noted that CAI use in teaching of English incorporates multimedia elements. Studies by Archer et al. (2014) and Coleman et al. (2015), pointed out that learners can benefit from explicit instruction combined with computer-assisted instruction (CAI) on vocabulary development. As a result of this, enhanced vocabulary development by learners could be achieved when instruction is done through CAI.

Similarly, a study by Lin and Lan (2020) explored the effects of CAI on vocabulary learning in a foreign language context. They found that CAI tools that incorporated audio-visual elements and interactive exercises resulted in greater vocabulary gains and higher levels of student motivation. This study highlighted the effectiveness of CAI in making vocabulary learning more dynamic and responsive to individual learner needs, aligning with the teacher's observations about the adaptability and immediacy of feedback provided by CAI. Another relevant study by Ruan and Lin (2017) focused on the use of CAI for vocabulary instruction in secondary education. Their findings supported the idea that CAI's interactive features, such as quizzes and multimedia content, enhanced vocabulary learning outcomes and student engagement. The study also noted that CAI provided more frequent and immediate feedback, which helped students to quickly address and correct their misunderstandings, similar to the teacher's comments about the benefits of instant feedback.

Hypothesis testing on use of CAI and Vocabulary Development

The study established whether there were significant differences in the means of learners in vocabulary development as a result of the treatment through testing the null hypothesis at significance level of 0.05. The hypothesis stated:

H_0: There is no significant influence on use of computer assisted instruction on vocabulary development in the English language

First, the results from the pre-tests conducted between the two groups were analyzed using paired sample t-test. The results of the analyzed information are presented in Table 2.

Table 2: T-test for pupils' pre-test scores in Vocabulary Development

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			

Pair 1	Eprevoc–CpretVo	.242	2.998	.369	-.495	.979	.657	65	.514

Results from Table 2 show a mean score of .242 (SD=2.998). The t-test revealed that there was no significant difference in scores of learners in vocabulary development between the experimental and control group for pre-test scores (t (.657), p = 0.514) at 0.05 level of significance. This implies that pupils' vocabulary development in primary schools in the study area was similar before the introduction of teaching of reading comprehension using CAI. In support of this finding is the study conducted by Anwar and Balcioglu (2016) found similar results in a pre-test opining that there was no significant difference in students' mean scores. Vocabulary learning is an important component in the development of English language and thus a good mastery of vocabularies will enhance English language learning. This is illustrated by the results from the post-tests on vocabulary development among pupils between the two groups as were analyzed using paired sample t-test. The results of the analyzed information are presented in Table 3.

Table 3: Paired Sample t-test for posttest (Control and Experimental)

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Vocabulary development posttest control - Vocabulary development posttest experimental	-8.758	8.361	1.029	-10.813	-6.702	-8.509	65	.000

Table 3 shows a mean score of 8.758 (SD=8.361). The t-test revealed that there was a significant difference in scores of learners in vocabulary development between the experimental and control group for post-test scores (t (8.509), p = 0.000) at 0.05 level of significance. This implied that after the CAI intervention there was a significant improvement in the vocabulary development skill of the pupils. To this end, the null hypothesis that there is no significant influence on use of computer assisted instruction on vocabulary development in English language was rejected and the alternate accepted. This shows that after using CAI to teach English reading comprehension, there was improved vocabulary development among the primary school pupils as opposed to those who were taught using conventional methods of teaching English. The results showed that the pupils' post-test scores were higher than the pupils' pre-test scores. The pupils' vocabulary knowledge improved after they had studied with CAI learning instruction. From the results, it can be shown that the pupils got higher scores on the post-test because the CAI instruction that involved technology could enhance their motivation and make the class more engaging for the pupils. This study finding is supported by many previous studies, such as studies by

Sharifi et al. (2015), Krishnan and Yunus (2019) Wichadee, (2018) and Tozun (2015) which posited that blended learning through the integration of technology in teaching positively affected the students' vocabulary knowledge. The findings are also in line with those of Hajebi et al. (2018) which revealed a significant difference between experimental and control group concerning their vocabulary knowledge. According to Hajebi et al. (2018) Web based learning (WBL) instruction enhanced EFL learners' vocabulary knowledge similar to the current study where use of CAI in teaching enhanced primary school learners' vocabulary development.

Implications to Research and Practice

This study is significant in showcasing how Computer-Assisted Instruction (CAI) can enhance vocabulary development among English Language Learners (ELLs), directly contributing to the conference objective of promoting technological innovations and digital strategies that improve learning outcomes. Beyond documenting learner improvement, the study emphasizes how CAI can support inclusive pedagogies by providing interactive, multimodal learning experiences that accommodate diverse learning needs and abilities. This directly responds to calls for equitable and innovative approaches that ensure all learners, including those struggling with English as a second language, are not left behind.

For Research:

1. This study contributes to the growing body of literature on Computer-Assisted Instruction (CAI) by providing empirical evidence of its effectiveness in vocabulary development among English Language Learners (ELLs) in Kenyan primary schools.
2. The study highlights the need for more context-specific studies on how technology can bridge foundational literacy gaps in resource-limited settings.
3. By documenting both learner outcomes and teacher perceptions through interviews, the study opens new avenues for research on the intersection between digital pedagogy and teacher readiness in developing countries.

For Practice

1. The findings demonstrate that CAI can be integrated into classroom practice to enhance vocabulary acquisition, making reading lessons more engaging and effective for learners.
2. They underscore the importance of teacher professional development in digital literacy and instructional design, as teacher attitudes significantly influence CAI adoption.
3. Policymakers and education leaders can use this evidence to support scaling up CAI interventions, ensuring equitable access to technology-driven literacy tools.
4. The study further implies that technology can serve as a catalyst for inclusive and accountable education systems, aligning with national and global goals for sustainable educational innovation.

5.0 Conclusions and recommendations

5.1 conclusions

This study concluded that Computer-Assisted Instruction (CAI) significantly enhanced pupils' vocabulary development implying that technology-support instruction offers significant advantages over traditional approaches. From the study findings, there was no significant difference in the pre-test vocabulary scores between the experimental and control groups. However, after the intervention, the post-test scores showed a significant improvement in the experimental group, highlighting that CAI effectively supports vocabulary development. By integrating both quantitative and qualitative evidence, the study contributes to the theoretical discourse on blended literacy and technology while offering practical insights into how

CAI can improve learning outcomes. The results underscore the need for systemic teacher training to build digital pedagogical skills, equitable access to digital tools to avoid widening educational disparities, and sustainable policies that promote the long-term integration of educational technology. Collectively, these contributions highlight that meaningful adoption of CAI not only strengthens learners' vocabulary acquisition but also provides a pathway for rethinking literacy instruction in the digital age.

5.2 Recommendations

To enhance vocabulary, CAI can utilize features like interactive flashcards, personalized vocabulary lists, contextualized definitions, gamified learning, text-to-speech functionality, and progress tracking in the following ways:

i. Platform Selection: Schools should invest in educational platforms or apps (e.g., Quizlet, Kahoot, or Duolingo) that allow teachers to create interactive flashcards and vocabulary games aligned with the curriculum.

ii. Customizable Vocabulary Lists: Teachers should use tools that allow them to create personalized vocabulary lists based on the individual needs of students. For example, digital platforms can adapt to a student's learning pace, offering new words and revisiting challenging ones.

iii. Incorporate Text-to-Speech: Incorporating speech-to-text and text-to-speech tools (like Google Read & Write) to help struggling readers hear words pronounced correctly and practice pronunciation.

iv. Gamification:Encouraging the use of educational games that reinforce vocabulary, such as word-matching games, vocabulary quizzes, or digital scavenger hunts. These games could be integrated into the daily lessons or used as homework assignments.

Education policymakers should prioritize the integration of Computer-Assisted Instruction (CAI) into the national literacy curriculum to complement traditional methods and ensure that technology-enhanced learning becomes a structured component of classroom practice. Clear guidelines and resource allocation are necessary to support schools in adopting and sustaining CAI interventions.

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