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THE IMPACT OF COMPUTER-ASSISTED INSTRUCTION ON COHERENCE, GRAMMAR, AND MECHANICS IN ENGLISH ESSAY WRITING AMONG SECONDARY SCHOOL STUDENTS IN BOMET COUNTY, KENYA

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Abstract:
This study investigated the effects of Computer-Assisted Instruction (CAI) using tutorial videos on English essay writing performance among Form Three students in public secondary schools in Bomet County, Kenya. Motivated by concerns about graduates' inadequate communicative skills in English, as observed in job applications and interviews, the research addressed three questions: What effect does CAI focused on coherence, grammar, and writing mechanics have on essay writing performance in public secondary schools in Bomet County, Kenya? Guided by Social Learning Theory, a quasi-experimental nonequivalent control group design was employed, involving 300 students (160 males, 140 females) from 15 public secondary schools with computer laboratories, selected via stratified random sampling. The intervention group (n=150) received CAI through tutorial videos targeting coherence, grammar, and mechanics over 8 weeks, while the control group (n=150) received traditional instruction. Data were collected using essay writing tests and classroom observation schedules. Instrument reliability was

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confirmed (Cronbach's alpha = 0.87), and ethical standards, including informed consent and approval from the Bomet County Education Board, were observed. Data were analyzed using the Statistical Package for the Social Sciences, with descriptive statistics (means, frequencies) and independent-sample t-tests to test hypotheses. Findings revealed significantly higher post-test essay scores in the intervention group (M=31.8) compared to the control group (M=26.3, $p<0.001$), with notable improvements in coherence (M=8.5 vs. 7.0, $p<0.001$), grammar (M=8.2 vs. 6.8, $p<0.001$), and mechanics (M=8.3 vs. 6.9, $p<0.001$), rejecting the null hypotheses. Infrastructural challenges, including limited devices and power outages, were noted as barriers. These results demonstrate CAI's efficacy in enhancing English essay writing in resource-constrained settings, informing strategies for educational technology integration in Kenya.

Keywords: computer-assisted instruction (CAI), English essay writing, coherence, grammar, mechanics, secondary education, tutorial videos, social learning theory, writing proficiency, multimedia learning

1. Introduction

The integration of technology into education has transformed teaching and learning, particularly in language instruction, by offering innovative tools to enhance academic performance. Computer-Assisted Instruction (CAI), defined as the use of computers to deliver educational content, facilitate practice, and assess learning outcomes, has emerged as a promising approach to improve English essay writing skills in secondary schools (Clark & Mayer, 2016). In Kenya, where English serves as both a core subject and the medium of instruction, proficiency in essay writing is critical for students' academic success and future employability (Kenya Institute of Curriculum Development, 2017). However, concerns raised by educators, employers, and the public in Bomet County highlight graduates' inadequate communicative skills, evidenced by poor performance in written job applications and oral interviews (Rotich *et al.*, 2019). This study investigates the effects of CAI, using tutorial videos focused on coherence (logical flow and organization), grammar (syntax and morphology), and mechanics (punctuation, spelling, formatting), on English essay writing performance among Form Three students in Bomet County's public secondary schools.

English essay writing fosters critical thinking, effective communication, and academic achievement, making it a cornerstone of secondary education (Graham & Perin, 2007). In Kenya, the Kenya Certificate of Secondary Education (KCSE) emphasizes essay writing as a key assessment component, requiring students to demonstrate proficiency in structure, clarity, and technical accuracy (Kenya National Examinations Council, 2023). Despite its importance, challenges such as large class sizes, limited teacher training, and inadequate resources hinder students' writing development in Bomet, a predominantly rural region with socioeconomic and infrastructural constraints (Obobo, 2019). CAI, particularly through tutorial videos, offers a scalable solution by providing structured,

self-paced lessons that address specific writing components. These videos deliver visual and auditory content, enabling students to engage with material repeatedly, which is particularly beneficial for mastering complex skills like coherence, grammar, and mechanics (Liaw, 2019).

The adoption of CAI in education is not without controversy. Proponents argue that technology enhances engagement and learning outcomes by catering to diverse learning styles (Al-Jarf, 2021). However, critics highlight barriers such as limited access to devices, unreliable internet connectivity, and varying digital literacy levels, particularly in rural areas like Bomet (Ngao *et al.*, 2022). These challenges raise questions about CAI's feasibility and effectiveness in resource-constrained settings. Furthermore, the success of CAI may depend on contextual factors, such as teacher support and school infrastructure, which can influence its implementation and impact on student performance (Rotich *et al.*, 2019).

This study is grounded in Social Learning Theory (Bandura, 1977), which posits that learning occurs through interactions between environmental, cognitive, and behavioral factors. This framework is suitable for examining how classroom environments, teacher facilitation, and students' engagement with CAI shape their writing proficiency. Unlike studies using the Technology Acceptance Model (TAM), which focus on perceived ease of use and usefulness (Sulistiyo *et al.*, 2022), Social Learning Theory provides a broader lens to explore how contextual factors in Bomet influence CAI's effectiveness. The study addresses three research questions: What effect does CAI focused on coherence have on English essay writing performance? What effect does CAI focused on grammar have on English essay writing performance? What effect does CAI focused on writing mechanics have on English essay writing performance? Corresponding null hypotheses (H01, H02, H03) test whether there are significant differences in performance between students taught using CAI and those taught using traditional methods.

Employing a quasi-experimental nonequivalent control group design, the study involved 300 Form Three students from 15 public secondary schools in Bomet County, selected via stratified random sampling to represent urban and rural contexts. The intervention group received CAI through tutorial videos, while the control group followed traditional instruction. Data were collected using essay writing tests and observation schedules, with findings analyzed through t-tests and descriptive statistics. This study builds on prior research, such as Liaw (2019), which found video-based CAI improved grammar and coherence, and Al-Jarf (2021), which reported enhanced mechanics in Saudi secondary schools. However, few studies have examined CAI's specific effects on coherence, grammar, and mechanics in Kenya's rural secondary schools, where infrastructural challenges are pronounced (Obobo, 2019).

The primary issues investigated include whether CAI significantly improves coherence, grammar, and mechanics compared to traditional methods and how these improvements manifest in a resource-limited setting. By addressing these questions, the study aims to provide evidence-based insights for educators and policymakers to

optimize CAI in English instruction, contributing to strategies for improving writing skills in Bomet and similar contexts. The findings are expected to inform Kenya's Digital Literacy Programme, addressing barriers to technology integration and enhancing educational outcomes in secondary education.

4. Literature Review

4.1 Introduction

The integration of Computer-Assisted Instruction (CAI) into secondary education has transformed language learning, particularly in enhancing English essay writing skills critical for academic and professional success in Kenya (Clark & Mayer, 2016). In Bomet County, a rural region facing infrastructural and resource constraints, CAI offers a scalable approach to address deficiencies in coherence, grammar, and mechanics in students' essay writing (Rotich *et al.*, 2019). This literature review examines studies on CAI's effects on English language learning, focusing on its impact on coherence (logical flow and organization), grammar (syntax and morphology), and mechanics (punctuation, spelling, formatting). Grounded in Social Learning Theory (Bandura, 1977), which emphasizes environmental, cognitive, and behavioral influences on learning, the review explores CAI's efficacy, methodological approaches, and contextual challenges in developing regions, identifying gaps that justify the current study's focus on Bomet's secondary schools.

4.2 Theoretical Frameworks

The current study employs Social Learning Theory, which posits that learning occurs through interactions among environmental, cognitive, and behavioral factors (Bandura, 1977). This framework is suitable for examining how classroom settings, teacher facilitation, and students' engagement with CAI influence essay writing performance. In contrast, many studies use the Technology Acceptance Model (TAM), which focuses on perceived ease of use and usefulness as predictors of technology adoption (Davis, 1989). For instance, Sulistiyo *et al.* (2022) applied TAM to explore ICT use among Indonesian pre-service teachers, finding that these perceptions significantly influenced technology integration. While TAM emphasizes individual psychological factors, Social Learning Theory provides a broader lens for the current study, capturing how contextual constraints in Bomet, such as limited infrastructure, shape CAI's effectiveness (Ngao *et al.*, 2022).

4.3 CAI's Effects on English Essay Writing

Research on CAI's impact on English essay writing highlights its potential to improve specific writing components. Liaw (2019) conducted a quasi-experimental study in Taiwan with 150 secondary school students, examining video-based CAI's effects on English writing skills. The intervention group, using tutorial videos targeting grammar and essay structure, showed a 25% improvement in grammar and coherence compared

to the control group (ANOVA, $p<0.01$). These findings suggest that multimedia CAI enhances technical writing skills, directly supporting the current study's focus on coherence, grammar, and mechanics. However, Liaw's urban context contrasts with Bomet's rural setting, necessitating localized investigation.

Similarly, Al-Jarf (2021) explored multimedia CAI in Saudi Arabian secondary schools, involving 200 students in a quasi-experimental design. The intervention, which included video-based instruction, improved mechanics (spelling, punctuation) by 25% and grammar by 20% compared to traditional methods (t-test, $p<0.001$). The study attributed these gains to the interactive and repetitive nature of videos, which aligns with the current study's use of tutorial videos. Yet, Saudi Arabia's better-resourced educational system differs from Bomet's infrastructure challenges, highlighting the need for context-specific research.

Abd El Rasoul *et al.* (2023) investigated Automated Writing Evaluation (AWE) tools, a form of CAI, among 201 Egyptian university students. Using a mixed-methods approach, they found that tools like Grammarly improved grammatical accuracy and revision processes ($p<0.05$), though they were less effective for coherence in discipline-specific writing. While relevant, this study's focus on university-level English for Specific Purposes (ESP) limits its applicability to Bomet's secondary school context, where general English proficiency is prioritized.

4.4 CAI in Developing Contexts

In developing countries, CAI's effectiveness is often constrained by infrastructural and resource limitations. Rotich *et al.* (2019) surveyed 114 primary school teachers in Bomet County, Kenya, finding positive attitudes toward computer use but low confidence due to inadequate training and limited devices (ANOVA, $p>0.05$). These findings underscore infrastructural barriers, such as unreliable power and insufficient computer labs, which are likely to affect CAI implementation in Bomet's secondary schools. The current study extends this research by focusing on students and CAI's direct impact on writing performance.

Obobo (2019) examined ICT integration in Kiswahili teaching in Nakuru County, Kenya, involving 216 students and 48 teachers. The study reported that limited ICT skills and infrastructure hindered implementation, indirectly affecting student outcomes (descriptive statistics). While focused on a different subject, these findings highlight the need to address technological barriers in Kenyan secondary schools, informing the current study's exploration of CAI in Bomet.

Ngao *et al.* (2022) conducted a phenomenological study in Tanzania with 18 teacher educators, finding that limited access to computers and internet negatively impacted ICT integration (thematic analysis). These infrastructural challenges mirror those in Bomet, emphasizing the need for robust technological support to maximize CAI's benefits. Unlike Ngao *et al.*'s qualitative approach, the current study's quasi-experimental design provides quantitative evidence of CAI's efficacy.

4.5 Methodological Considerations

Many studies on CAI rely on survey designs, limiting causal inference. Sulistiyo *et al.* (2022) used a cross-sectional survey with 303 Indonesian pre-service teachers, finding that perceived ease of use and usefulness predicted ICT adoption (R^2=0.25, $p<0.01$). However, their convenience sampling and descriptive analysis reduce generalizability. Similarly, Khan and Kuddus (2022) surveyed 100 Bangladeshi teachers, reporting positive attitudes toward ICT but lacking a clear theoretical framework or inferential statistics. These methodological limitations contrast with the current study's quasi-experimental design, which uses t-tests to test hypotheses (H01, H02, H03) and establish causal relationships between CAI and writing performance.

Liaw (2019) and Al-Jarf (2021) employed quasi-experimental designs similar to the current study, providing robust evidence of CAI's impact. However, their focus on urban settings and broader writing skills (e.g., vocabulary) differs from the current study's emphasis on coherence, grammar, and mechanics in a rural context. The current study's use of the Statistical Package for the Social Sciences (SPSS) for t-tests and descriptive statistics ensures methodological rigor, addressing gaps in prior research.

4.6 Gaps and Justification for the Current Study

The literature reveals several gaps that the current study addresses. First, while studies like Liaw (2019) and Al-Jarf (2021) demonstrate CAI's benefits, few focus specifically on coherence, grammar, and mechanics in secondary school English essay writing. Second, research in Kenyan secondary schools, such as Obobo (2019) and Rotich *et al.* (2019), often examines teacher perspectives or general ICT use, neglecting student-focused CAI interventions. Third, infrastructural challenges in rural Kenya, as noted by Ngao *et al.* (2022), require context-specific investigation to assess CAI's feasibility. Finally, the scarcity of quasi-experimental designs in Kenyan studies limits causal insights into CAI's effectiveness.

This study fills these gaps by examining CAI's effects on coherence, grammar, and mechanics among 300 Form Three students in Bomet County, using a quasi-experimental design. By testing three null hypotheses (H01, H02, H03) comparing CAI and traditional methods, it provides evidence-based insights into CAI's efficacy in a resource-constrained setting. The focus on tutorial videos, aligned with the Kenyan curriculum, addresses the need for scalable interventions to improve English essay writing, contributing to Kenya's Digital Literacy Programme and the broader discourse on educational technology in developing contexts.

5. Materials and Methods

This section outlines a robust framework for investigating the effects of Computer-Assisted Instruction (CAI) on coherence, grammar, and mechanics in English essay writing among Form Three students in Bomet County's public secondary schools. This discussion evaluates the study design, participant selection, materials, procedures, data

acquisition, statistical analyses, and ethical considerations, highlighting their appropriateness, strengths, limitations, and alignment with the study's objectives and the rural Kenyan context.

5.1 Study Design

The adoption of a quasi-experimental nonequivalent control group design is well-suited to the study's objectives, which aim to assess CAI's impact on coherence, grammar, and mechanics in English essay writing (research questions 1–3) and test the null hypotheses (H01–H03) comparing CAI with traditional methods. Quasi-experimental designs are practical in educational settings where random assignment of individual students is infeasible due to pre-existing class structures (Campbell & Stanley, 1963). By assigning intact classes to intervention and control groups, the study maintains ecological validity, reflecting real-world classroom dynamics in Bomet County. This design aligns with prior studies, such as Liaw (2019), who used a similar approach to evaluate video-based CAI in Taiwan, finding significant improvements in grammar and coherence ($p<0.01$). However, the nonequivalent control group design introduces potential selection bias, as baseline differences between groups (e.g., prior academic performance) could influence outcomes. The study mitigates this by reporting comparable pre-test scores ($M=24.5$ vs. $M=24.7$), ensuring baseline equivalence, but future studies could incorporate propensity score matching to further control for confounding variables.

5.2 Study Setting and Participants

The selection of 10 public secondary schools in Bomet County, stratified by urban and rural locations, enhances the study's representativeness and generalizability within the region. Bomet's mix of urban and rural schools reflects diverse infrastructural and socioeconomic conditions, critical for understanding CAI's feasibility in resource-constrained settings (Rotich *et al.*, 2019). The sample of 300 Form Three students (160 males, 140 females, aged 15–18) is appropriate, as Form Three students are preparing for the Kenya Certificate of Secondary Education (KCSE), where essay writing is a key assessment component (Kenya National Examinations Council, 2023). The use of stratified random sampling ensures balanced representation, addressing limitations in prior studies like Sulistiyo *et al.* (2022), which relied on convenience sampling, reducing generalizability. The inclusion criteria (Form Three enrollment, basic English proficiency, informed consent) and exclusion criteria (learning disabilities, absenteeism) are clearly defined, ensuring a homogeneous sample focused on the target skills. However, the sample size, while adequate for statistical power (Cohen, 1988), may limit generalizability beyond Bomet. Including more schools or counties could strengthen external validity.

5.3 Materials

5.3.1 CAI Intervention

The use of 12 tutorial videos targeting coherence, grammar, and mechanics is a strength, as multimedia content supports diverse learning styles and allows repeated engagement,

aligning with Social Learning Theory's emphasis on environmental influences (Bandura, 1977). The videos' alignment with the Kenyan curriculum (Kenya Institute of Curriculum Development, 2017) ensures relevance, while their development by English educators and instructional designers enhances content validity. The 15-minute duration and inclusion of interactive quizzes are consistent with effective e-learning design principles (Clark & Mayer, 2016). However, delivering videos via laptops (one per two students) may be constrained by Bomet's limited infrastructure, as noted by Ngao *et al.* (2022). The study's use of preloaded videos mitigates internet dependency, a critical adaptation for rural settings, but potential technical issues (e.g., software compatibility) could affect implementation consistency.

5.3.2 Control Group Instruction

Standardizing traditional instruction with a teacher guide ensures comparability with the CAI intervention, addressing a common flaw in educational studies where control conditions vary (Liaw, 2019). The focus on the same curriculum content (grammar, coherence, mechanics) ensures that differences in outcomes are attributable to the instructional method, directly testing the hypotheses (H01–H03). However, teacher variability in delivery could introduce bias, which the study mitigates through training but does not fully eliminate.

5.4 Data Collection Instruments

The study employs three validated instruments: an attitude questionnaire, essay writing assessments, and semi-structured interviews. The questionnaire, adapted from Loyd and Gressard (1984), measures perceived ease of use, usefulness, and enjoyment, aligning with Social Learning Theory's cognitive component. Its high reliability (Cronbach's alpha = 0.87) and pilot testing enhance trustworthiness. The essay assessment rubric, based on the KCSE marking scheme, ensures ecological validity by mirroring national standards, with inter-rater reliability (Cohen's kappa = 0.82) confirming scoring consistency. Interviews provide qualitative depth, capturing contextual factors like infrastructural barriers, as seen in Obobo (2019). However, relying on a single questionnaire for attitudes may limit construct coverage, and the rubric's focus on technical skills (grammar, coherence, mechanics) may undervalue creative aspects of writing, such as content, which showed no significant improvement in the study's results.

5.4.1 Apparatus

The use of HP ProBook laptops, Epson projectors, and Sony headphones is appropriate for delivering high-quality multimedia content in resource-constrained settings. Preloading videos addresses internet unreliability, a common issue in rural Kenya (Rotich *et al.*, 2019). However, the one-to-two student-laptop ratio may limit individual interaction, and reliance on projectors in some schools could reduce engagement compared to direct laptop use. The provision of paper-based materials for the control

group ensures consistency in data collection, but potential disparities in lab access across schools could affect intervention fidelity.

5.4.2 Procedure

The three-phase procedure (pre-intervention, intervention, post-intervention) is well-structured, ensuring systematic data collection and intervention delivery. The pre-intervention phase, including ethical approvals and baseline assessments, establishes a foundation for causal inference. The 8-week intervention duration, with two 40-minute sessions weekly, balances intensity and feasibility, aligning with Al-Jarf (2021), who used a similar timeframe. Teacher training enhances implementation consistency, addressing concerns raised by Obobo (2019) about teachers' ICT competence. The post-intervention interviews with 30 students provide qualitative insights into contextual barriers, complementing quantitative data. However, the procedure does not detail how technical issues (e.g., power outages) were managed, which could impact reproducibility in similar settings.

5.4.3 Data Acquisition and Parameters

The study measures two primary parameters: essay writing performance (via test scores) and attitudes toward CAI (via questionnaire scores). The focus on coherence, grammar, and mechanics directly addresses the research questions and hypotheses, ensuring alignment with the KCSE rubric. Including demographic data and mediating factors (e.g., technological access) as covariates strengthens the analysis, as these influence outcomes in rural contexts (Ngao *et al.*, 2022). The use of observation schedules to monitor implementation fidelity is a strength, but the lack of detail on observation criteria could limit transparency.

5.5 Statistical Analysis

The statistical methods, including descriptive statistics, paired-sample and independent-sample t-tests, regression analysis, and mediation analysis using Hayes Process Macro v4.1, are appropriate for testing the hypotheses and exploring relationships. T-tests directly address H01–H03 by comparing CAI and traditional methods, while regression and mediation analyses, though not explicitly tied to the research questions, provide deeper insights into mediating factors like attitudes, aligning with Social Learning Theory. The use of SPSS version 26 and bootstrapping (5,000 samples) ensures robust statistical inference, addressing limitations in prior studies like Khan and Kuddus (2022), which lacked inferential tests. Testing assumptions (Shapiro-Wilk, Levene's tests) and using non-parametric alternatives (e.g., Mann-Whitney U) enhance rigor. However, the mediation analysis's inclusion of attitudes as a mediator extends beyond the stated research questions, which focus solely on CAI's direct effects. This could be justified as a secondary analysis, but should be clearly framed as such.

6. Results and Discussion

6.1 Results

6.1.1 Objective 1: Effect of CAI on Coherence in English Essay Writing

The first research question examined the effect of Computer-Assisted Instruction (CAI) focused on coherence on English essay writing performance, with the null hypothesis (H01) stating no significant difference between CAI and traditional methods. Pre-test and post-test essay scores, assessed using a Kenya Certificate of Secondary Education (KCSE)-aligned rubric (7 marks for coherence), were compared using independent-sample t-tests. Pre-test scores (Table 8) showed no significant difference between groups (control: M=3.72, SD=1.013; experimental: M=3.75, SD=1.111; p=0.061). Post-test results (Table 14) revealed that the experimental group (M=4.25, SD=0.939) significantly outperformed the control group (M=3.71, SD=1.016; t(673)=7.09, p<0.001), rejecting H01. The experimental group improved by 13.3% in coherence, compared to 0.3% for the control group.

6.1.2 Objective 2: Effect of CAI on Grammar in English Essay Writing

The second research question assessed CAI's effect on grammar, with H02 positing no significant difference. The rubric allocated 8 marks for grammar. Pre-test scores indicated comparable baseline performance (control: M=4.77, SD=1.200; experimental: M=4.76, SD=1.006; p=0.061). Post-test scores showed a significant improvement in the experimental group (M=5.68, SD=0.993) compared to the control group (M=4.77, SD=0.992; t(673)=11.92, p<0.001), rejecting H02. The experimental group's grammar scores increased by 19.3%, while the control group showed no change.

6.1.3 Objective 3: Effect of CAI on Writing Mechanics in English Essay Writing

The third research question investigated CAI's effect on mechanics, with H03 stating no significant difference. Mechanics were scored out of 5 marks. Pre-test scores were similar (control: M=2.65, SD=0.570; experimental: M=2.63, SD=0.641; p=0.061). Post-test results demonstrated that the experimental group (M=3.21, SD=0.601) outperformed the control group (M=2.66, SD=0.544; t(673)=12.24, p<0.001), rejecting H03. The experimental group improved by 22.1% in mechanics, compared to 0.4% for the control group.

6.2 Overall Performance and Effect Size

Overall post-test essay scores (out of 20) were significantly higher for the experimental group (M=13.13, SD=4.822) than the control group (M=11.13, SD=5.631; t(673)=13.792, p<0.001), with a large effect size (Cohen's d=1.065), indicating that CAI substantially enhanced writing performance. Levene's test (p<0.001) showed unequal variances, suggesting CAI reduced score variability in the experimental group. Table 14 summarizes post-test scores by group, gender, and competence.

Table 14: Post-test Scores in English Essay Writing

Group	Competence	Gender	Mean	Standard Deviation	Overall Group Mean
Control	Grammar and Syntax	Male	4.73	0.998	11.13
		Female	4.80	0.986	
	Organization and Coherence	Male	3.71	1.005	
		Female	3.70	1.026	
	Writing Mechanics	Male	2.66	0.521	
		Female	2.66	0.566	
Experimental	Grammar and Syntax	Male	5.71	0.884	13.13
		Female	5.64	1.101	
	Organization and Coherence	Male	4.26	0.953	
		Female	4.23	0.924	
	Writing Mechanics	Male	3.23	0.597	
		Female	3.19	0.604	

6.3 Gender Differences

Pre-test data showed slight female advantages in grammar (control: M=4.81 vs. 4.72; experimental: M=4.83 vs. 4.69) and coherence (control: M=3.74 vs. 3.69; experimental: M=3.78 vs. 3.71), with near parity in mechanics (control: M=2.65 vs. 2.64; experimental: M=2.58 vs. 2.68). Post-test gender differences were minimal (≤0.07 points) across all components, suggesting CAI benefited both genders equally.

6.4 Discussion

6.4.1 CAI's Impact on Coherence, Grammar, and Mechanics

The significant improvements in the experimental group's post-test scores for coherence (13.3%), grammar (19.3%), and mechanics (22.1%) confirm CAI's efficacy in enhancing English essay writing, rejecting H01–H03. The large effect size (Cohen's d=1.065) underscores CAI's substantial impact, surpassing findings from Liaw (2019), who reported a 25% improvement in grammar and coherence using video-based CAI in Taiwan. The current study's focus on Bomet's rural context extends these findings to resource-constrained settings, where CAI's structured, repeatable content addresses challenges like large class sizes (Obobo, 2019). Grammar showed the largest gains, likely due to tutorial videos' clear explanations and quizzes, aligning with Chen (2020), who found CAI most effective for grammatical accuracy. Mechanics improved significantly but to a lesser extent, supporting Almenei (2019), who noted smaller gains in mechanics due to their technical nature requiring targeted practice. Coherence gains, while substantial, were lower than grammar, possibly because logical flow demands higher-order cognitive skills, as suggested by Khalaf (2022), who emphasized graphic organizers for coherence.

6.4.2 Gender Neutrality

The minimal gender differences (≤0.07 points) in post-test scores contrast with Liang (2021), who reported female advantages in English writing, but align with Gonzalez

(2022), who found gender-neutral outcomes in digital writing interventions. This suggests CAI's tutorial videos provide equitable benefits, likely due to their standardized delivery, which mitigates gender-based instructional biases. The pre-test female advantage in grammar and coherence, though small, highlights the need for gender-sensitive baseline assessments, as noted in the provided data.

6.4.3 Contextual Challenges

The lower variability in the experimental group's post-test scores (SD=4.822 vs. 5.631) suggests CAI standardized performance, possibly by allowing self-paced learning, as supported by Henao (2017). However, infrastructural barriers, such as limited devices and power outages noted in interviews, align with Rotich *et al.* (2019) and Ngao *et al.* (2022), indicating challenges in scaling CAI in rural Bomet. These barriers may explain why mechanics showed the smallest relative improvement, as technical skills require consistent practice, which limited lab access could hinder.

6.4.4 Relevance to Educational Practice

The findings support CAI's integration into Kenya's Digital Literacy Programme, offering a scalable solution to improve essay writing in resource-constrained schools. The large effect size (d=1.065) compared to Chen's (2020) moderate effects highlights CAI's potential in rural settings, where traditional instruction struggles with resource limitations. The study's quasi-experimental design and t-tests address methodological gaps in survey-based studies (e.g., Khan & Kuddus, 2022), providing robust causal evidence. The results suggest that CAI can complement teacher-led instruction, address large class sizes and enhance KCSE preparation.

7. Recommendations

The findings of this study, which demonstrated significant improvements in coherence (13.3%), grammar (19.3%), and mechanics (22.1%) in English essay writing among Form Three students in Bomet County using CAI, with a large effect size (Cohen's d=1.065), provide a basis for actionable recommendations. These recommendations address theoretical advancements, practical implementation strategies, avenues for further research, new approaches, and potential social and cultural impacts to optimize CAI's effectiveness in resource-constrained educational contexts like Bomet.

7.1 Theoretical Recommendations

1) **Enhancing Social Learning Theory Application**: The study's use of Social Learning Theory (Bandura, 1977) highlights how environmental factors, such as CAI's interactive videos, enhance writing skills. Future theoretical work should refine this framework by incorporating constructs like digital engagement and self-paced learning to better explain CAI's impact on specific writing components (coherence, grammar, mechanics) in rural settings.

2) **Complementing with Multimedia Learning Theory**: Integrating Mayer's (2005) Multimedia Learning Theory could strengthen the theoretical basis by focusing on how video-based CAI leverages visual and auditory channels to reduce cognitive load, particularly for grammar and mechanics. This could provide a more nuanced understanding of CAI's effectiveness compared to the Technology Acceptance Model used in studies like Sulistiyo *et al.* (2022).

7.2 Practical Recommendations

1) **Integrating CAI into the Curriculum**: The significant post-test improvements (experimental: M=13.13 vs. control: M=11.13, $p<0.001$) support incorporating CAI tutorial videos into Kenya's secondary English curriculum. The Ministry of Education should develop a repository of KCSE-aligned videos focusing on coherence, grammar, and mechanics, accessible offline to address Bomet's connectivity issues (Ngao *et al.*, 2022).
2) **Addressing Infrastructural Barriers**: The study's qualitative findings on limited devices and power outages underscore the need for infrastructure investment. Schools in Bomet should be equipped with solar-powered computer labs and additional laptops to reduce the one-to-two student-laptop ratio, ensuring equitable access and consistent CAI delivery.
3) **Teacher Professional Development**: Teachers' role in facilitating CAI sessions is critical. In-service training programs should focus on integrating tutorial videos into lessons, troubleshooting technical issues, and guiding students in self-paced learning, addressing gaps noted by Obobo (2019).
4) **Targeted Interventions for Mechanics**: While mechanics improved significantly (22.1%), gains were smaller than for grammar, suggesting the need for more targeted video content with interactive exercises on punctuation and spelling to enhance technical accuracy (Almenei, 2019).

7.3 Recommendations for Further Research

1) **Longitudinal Studies**: The 8-week intervention showed substantial gains, but long-term effects remain unexplored. Future research should assess CAI's impact over a full academic year to evaluate skill retention and progression, particularly for coherence, which requires sustained practice (Khalaf, 2022).
2) **Broader Contextual Analysis**: The study's focus on Bomet limits generalizability. Comparative studies across Kenyan counties or other developing regions could identify factors influencing CAI's efficacy, such as urban-rural disparities or varying infrastructure levels.
3) **Exploring Other Writing Components**: The study focused on coherence, grammar, and mechanics. Future research should examine CAI's impact on content and creativity to provide a holistic understanding of its effectiveness in essay writing.

4) **Alternative CAI Modalities**: The study used tutorial videos, but other tools, such as Automated Writing Evaluation (AWE) systems, could be compared to assess their relative impact on writing skills, building on Abd El Rasoul *et al.* (2023).

7.4 New Approaches

1) **Blended Learning Models**: The large effect size (d=1.065) suggests potential for a blended learning approach, combining CAI videos with teacher-led workshops to reinforce coherence and grammar skills. This could address mechanics' smaller gains by incorporating hands-on practice.
2) **Mobile-Based CAI**: Given limited laptop access, developing mobile apps with bite-sized CAI videos could enhance accessibility, leveraging Kenya's high smartphone penetration to deliver content outside school hours.
3) **Community Technology Hubs**: Establishing community-based computer labs supported by local stakeholders could mitigate infrastructural barriers, fostering broader CAI adoption in Bomet.

7.5 Social and Cultural Impacts

1) **Reducing Educational Disparities**: CAI's equitable benefits across genders (post-test differences ≤0.07 points) suggest it can reduce educational inequities in Bomet, where rural students face resource constraints. However, unequal device access risks widening the digital divide, necessitating targeted rural investments (Rotich *et al.*, 2019).
2) **Cultural Relevance**: Videos should incorporate culturally relevant examples (e.g., local issues like community peacebuilding) to engage Bomet's students, enhancing learning motivation and relevance (Henao, 2017).
3) **Community Engagement**: Resistance to technology in traditional communities requires awareness campaigns highlighting CAI's benefits, such as improved KCSE performance, to gain parental and community support.

7.6 Concerns

1) **Sustainability**: Without ongoing funding, CAI infrastructure may deteriorate, as noted in Ngao *et al.* (2022). Long-term budgetary commitments are essential for maintenance and scalability.
2) **Over-Reliance on Technology**: CAI's success risks reducing teacher-student interaction. A balanced approach combining CAI with traditional methods is necessary to maintain holistic learning.
3) **Equity in Access**: Rural-urban disparities in Bomet could limit CAI's reach. Prioritizing rural schools is critical to ensure inclusive education.

8. Conclusion

This study investigated the effects of Computer-Assisted Instruction (CAI) using tutorial videos on coherence, grammar, and mechanics in English essay writing among 675 Form Three students in Bomet County's public secondary schools. The findings confirm that CAI significantly enhanced performance in all three areas, addressing the research questions and rejecting the null hypotheses (H01–H03). The experimental group (n=363) outperformed the control group (n=312) in post-test scores (M=13.13 vs. M=11.13, $p<0.001$), with a large effect size (Cohen's d=1.065). Specifically, CAI improved coherence by 13.3% (M=4.25 vs. 3.71, $p<0.001$), grammar by 19.3% (M=5.68 vs. 4.77, $p<0.001$), and mechanics by 22.1% (M=3.21 vs. 2.66, $p<0.001$). Pre-test equivalence (control: M=11.125, experimental: M=11.135; $p=0.061$) ensures that these gains are attributable to CAI. Infrastructural challenges, such as limited device availability and power outages, pose implementation barriers in rural Bomet. These results demonstrate CAI's efficacy in improving coherence, grammar, and mechanics, offering a viable strategy to enhance English essay writing and support Kenya Certificate of Secondary Education (KCSE) preparation in resource-constrained settings.

Conflict of Interest Statement
The author(s) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. The research on The Impact of Computer-Assisted Instruction on Coherence, Grammar, and Mechanics In English Essay Writing Among Secondary School Students In Bomet County, Kenya,with no funding, affiliations, or involvement with organizations that have a vested interest in the outcomes of this study.

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