

Assessing the effectiveness of Zoom-based online teaching of English composition compared with face-to-face classroom instruction in higher institutions of Katsina State, Nigeria

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Abstract

This study examined the effectiveness of Zoom-based online teaching of English composition compared with face-to-face classroom instruction in higher institutions in Katsina State, Nigeria. In the instructional mode, the principal of the independent variable was adopted by allowing both groups to receive appropriate pedagogical activities. Using a quasi-experimental design, two groups of students ($N=200$; 100 assigned to Zoom-based teaching and 100 to traditional classroom instruction) were taught identical English composition content for one academic semester. Students' writing performance was measured using an English Composition Writing Test administered as a pre-test and post-test. Essays were scored with an analytic rubric covering content, organization, vocabulary, grammar, mechanics, and coherence/cohesion. Students' engagement and perceptions of Zoom-based instruction were collected through engagement level measures and Likert-scale items, respectively, and analyzed using descriptive and inferential statistics. Independent and paired comparisons were conducted, with significance evaluated at $p < .05$. Results showed that both groups improved significantly from pre-test to post-test. The Zoom-based teaching group increased from a pre-test mean of 48.62 ($SD = 7.84$) to a post-test mean of 72.48 ($SD = 8.21$), with a gain of 23.86 and $t(99)=15.82, p < .001$ (Cohen's $d=1.58$). The traditional classroom group increased from 49.10 ($SD = 8.01$) to 66.31 ($SD = 7.75$), with a gain of 17.21 and $t(99)=12.94, p < .001$ (Cohen's $d=1.29$). An independent-samples t-test comparing post-test achievement indicated a statistically significant difference favoring Zoom-based instruction: $t(198)=4.63, p = 0.001$ (Zoom mean = 72.48 vs. traditional mean = 66.31). Engagement levels were also higher in the Zoom group, with more students reporting very high and high engagement. Finally, perceptions indicated agreement that Zoom improves interaction, enhances writing skills, and supports independent learning, though poor internet connectivity was identified as the most significant challenge.

Keywords: Zoom-based, online teaching, composition and classroom instructions

Introduction

In the wake of the COVID-19 pandemic, online teaching became a necessary alternative to in-person instruction worldwide. Zoom, a widely adopted video-conferencing platform, was quickly integrated into teaching and learning environments, including in Nigeria's tertiary institutions, especially private, such as Bowen, Covenant, and Redeemer's Universities. While digital learning has gained traction, its actual pedagogical effectiveness, particularly in the context of teaching English composition, remains under-examined, especially in Katsina State. English composition is a foundational aspect of tertiary English education in Nigeria. It develops students' abilities to express complex ideas clearly and coherently in writing. It is a critical skill to academic and professional success. However, teaching writing requires interaction, feedback, modeling and engagement, which may be challenged by virtual instruction modes. Studies such as (Nadezhda, 2020^[17]; Dinara & Feruza, 2021; Octaviani, 2021) have demonstrated Zoom's utility in online language learning, including grammar and writing instruction. Others have emphasized the need to assess its pedagogical suitability through empirical comparative studies (Nurieva & Garaeva, 2020; Singh *et al.*, 2020; Armand & Purnawarman, 2025)^[2, 20, 24]. In Katsina State, no empirical studies have compared the effectiveness of Zoom-based teaching to traditional classroom methods for English composition.

English composition is an important component of English Language education in higher institutions because it

develops students' ability to communicate ideas clearly, organize information logically, use appropriate vocabulary and grammatical structures and produce coherent and meaningful written texts. Despite its importance, many students in Nigerian higher institutions continue to experience difficulties in English composition, particularly in areas such as organization of ideas, grammatical accuracy, vocabulary development, coherence, cohesion, and overall quality of written expression. These difficulties may affect students' academic performance because effective writing is required for examinations, assignments, research projects, reports and other academic activities.

Traditionally, the teaching of English composition in higher institutions has largely depended on face-to-face classroom instruction, in which lecturers explain writing principles, provide examples, give writing tasks, and offer feedback during physical classroom interaction. Although this approach provides opportunities for direct teacher-student interaction, guided practice, and immediate clarification of difficulties, it may be constrained by limited classroom time, large class sizes, differences in students' learning needs, and limited opportunities for individualized writing practice and feedback. Consequently, there is a need to explore instructional approaches that can complement or improve conventional classroom teaching.

The increasing adoption of digital technologies in education has created opportunities for online platforms such as Zoom to support the teaching and learning of English composition. Zoom-based instruction can provide opportunities for

synchronous interaction, screen sharing, presentation of writing materials, collaborative activities, discussion, peer interaction and teacher feedback without requiring teachers and students to be physically present in the same classroom. However, the availability of these technological affordances does not necessarily mean that Zoom-based instruction is more effective than conventional face-to-face teaching. Its effectiveness may depend on students' digital literacy, access to reliable internet services and appropriate devices, quality of teacher-student interaction, students' participation and the pedagogical strategies employed by the lecturer.

Although, the integration of Zoom-based online teaching is increasingly being considered as an alternative or complementary approach to conventional classroom instruction, there is insufficient empirical evidence on whether it actually produces better outcomes in English composition than face-to-face classroom instruction among students in higher institutions in Katsina State. In particular, it remains unclear whether students taught through Zoom demonstrate significant differences in the quality of their composition writing in terms of content, organization, expression, grammatical accuracy, coherence, cohesion, and overall writing performance when compared with students taught through face-to-face classroom instruction.

It is against this background that the present study seeks to assess the effectiveness of Zoom-based online teaching of English composition compared with face-to-face classroom instruction in higher institutions in Katsina State, Nigeria. The study will specifically determine whether there is a significant difference in the composition performance of students taught through Zoom-based instruction and those taught through face-to-face classroom instruction. The findings are expected to provide empirical evidence that can guide English language lecturers, curriculum planners, educational administrators and higher institutions in making informed decisions about the integration of synchronous online instruction into the teaching of English composition. Despite the growing use of online technologies in higher education, an important gap remains in the empirical literature concerning the effectiveness of Zoom-based instruction for teaching English composition. Existing studies have largely examined online learning in terms of students' perceptions, satisfaction, engagement, accessibility, and general academic achievement, while comparatively limited attention has been given to the direct effect of synchronous Zoom-based instruction on the quality of students' English composition writing. More importantly, there is insufficient comparative evidence showing whether students taught through Zoom-based instruction perform differently from those taught through conventional face-to-face classroom instruction in specific dimensions of composition, such as content, organization, expression, grammatical accuracy, coherence, and cohesion. In addition, evidence from other geographical

and educational contexts may not adequately represent the realities of higher institutions in Katsina State, Nigeria, where technological access, internet connectivity, instructional practices and students' digital competencies may influence the effectiveness of online learning. Thus, a contextual, skill-specific and comparative gap exists. The present study seeks to address this gap by empirically comparing the effectiveness of Zoom-based online teaching and face-to-face classroom instruction in improving students' English composition performance in higher institutions in Katsina State, Nigeria.

Concept of English Composition

English composition refers to the process of expressing ideas effectively through written language using appropriate grammar, vocabulary, coherence, cohesion, organization, and mechanics. It is a core component of English language learning because it develops learners' ability to communicate ideas clearly in academic and professional contexts. According to Hyland (2019) ^[13], composition writing involves planning, drafting, revising, and editing to produce meaningful and coherent texts. Effective composition teaching enables learners to develop critical thinking, creativity, and communicative competence.

Nunan (2015) ^[18] observes that writing is one of the most difficult language skills to master because it requires the integration of linguistic knowledge, organization of ideas, and audience awareness. Consequently, successful teaching of English composition requires continuous practice, constructive feedback, and active interaction between teachers and learners.

Measurement of English Composition Performance: refers to the quality of students' written compositions as assessed through a structured analytical scoring rubric. Analytical scoring is considered more reliable than holistic scoring because it evaluates different aspects of writing separately and provides detailed information about learners' strengths and weaknesses (Weigle, 2002) ^[26]. Students' compositions will therefore be assessed across six dimensions: content, organization, vocabulary, grammar, mechanics, and coherence/cohesion. These dimensions are widely recognized as essential components of effective writing and are frequently employed in the assessment of second language writing (Jacobs *et al.*, 1981 ^[14]; Brown, 2004).

The assessment rubric adopted for this study is adapted from the ESL Composition Profile developed by Jacobs *et al.* (1981) ^[14], which has been extensively used in evaluating English as a Second Language (ESL) writing. The rubric allocates specific scores to each component to ensure objective and consistent assessment.

English Composition Scoring Rubric

Assessment Criterion	Maximum Score	Description
Content	20	Relevance, adequacy, and development of ideas (Jacobs <i>et al.</i> , 1981) ^[14]
Organization	15	Logical sequencing, paragraphing, introduction, body, and conclusion (Brown, 2004)
Vocabulary	15	Appropriateness, range, and accuracy of word choice (Weigle, 2002) ^[26]
Grammar	20	Correct use of sentence structure, tense, concord, and syntax (Hyland, 2003)
Mechanics	10	Spelling, punctuation, capitalization, and formatting (Brown, 2004)
Coherence and Cohesion	20	Logical flow of ideas and effective use of cohesive devices (Halliday & Hasan, 1976) ^[11]
Total	100	Overall English Composition Performance

The total score for each student's composition will be calculated out of 100 marks. For instance, a score of 72.48 indicates that a student obtained 72.48% of the total marks based on performance across the six dimensions. This operational definition ensures that the concept of English composition performance is measurable, transparent, and replicable (Creswell & Creswell, 2018) ^[7].

Zoom-Based Online Teaching

Zoom is a cloud-based video conferencing platform that enables synchronous online teaching through audio, video, screen sharing, virtual whiteboards, breakout rooms, polling, and chat functions. Since the outbreak of COVID-19, Zoom has become one of the most widely used platforms for delivering online education worldwide (Wong, 2020) ^[27]. According to Brainard and Watson (2020) ^[4], Zoom supports real-time communication between lecturers and students, making it possible to simulate classroom interaction despite geographical separation. The platform also encourages collaborative learning through breakout rooms where students can engage in peer discussions and group writing activities.

Nurieva and Garaeva (2020) ^[20] argue that Zoom facilitates immediate corrective feedback, improves learner participation, and increases students' confidence during language learning. Similarly, Mu'awanah, Sumardi, and Sa'Diyah (2021) ^[15] reported that Zoom provides flexibility, accessibility, and opportunities for collaborative learning, although technical challenges remain significant.

Ayoub (2019) ^[3] found that university students perceived Zoom sessions as motivating and effective because they enhanced interaction with instructors and promoted independent learning. Likewise, Andewi and Trinovita (2024) ^[1] concluded that Zoom positively influenced English language learning by increasing students' participation and motivation.

Despite these advantages, researchers have identified several constraints associated with Zoom-based instruction. Gordon (2020) ^[20] notes that unstable internet connectivity, poor electricity supply, limited digital literacy, and inadequate access to digital devices often reduce the effectiveness of online learning, especially in developing countries.

Traditional Classroom Teaching

Traditional classroom teaching refers to face-to-face instruction in which teachers and students interact physically within the same learning environment. It remains the dominant mode of instruction in Nigerian higher institutions because it promotes direct communication, immediate supervision, classroom discipline, and physical interaction (Richards & Rodgers, 2014). According to Brown (2015) ^[5, 21], traditional classrooms enable teachers to observe students' learning behavior directly, provide immediate clarification, and monitor participation more effectively than virtual environments. Similarly, Harmer (2015) ^[12] argues that face-to-face teaching allows instructors to employ verbal and non-verbal communication strategies that enhance language learning. However, conventional classroom instruction also has limitations. Large class sizes, inadequate instructional resources, insufficient individual feedback, and rigid scheduling often reduce the effectiveness of writing instruction (Hyland,

2019) ^[13]. Consequently, integrating digital technologies into conventional teaching has become increasingly important.

Operational Definition of Traditional Classroom Instruction

In this study, the term traditional classroom instruction does not simply mean any form of teaching that takes place in a physical classroom. Rather, it refers specifically to face-to-face, teacher-led instruction in which the lecturer and students are physically present in the same classroom and the teaching of English composition is conducted through conventional classroom procedures. The term is therefore used in this study primarily to describe the mode and setting of instruction, rather than to imply that the teaching must necessarily be lecture-based, authoritarian, or limited to chalk-and-talk methods.

This distinction is important because face-to-face instruction, teacher-centred instruction, lecture-based instruction, and chalk-and-talk teaching are related but not synonymous concepts. Face-to-face instruction describes the physical presence of teachers and learners in the same instructional environment, whereas teacher-centred instruction refers to the extent to which the teacher controls the content, pace, activities, and classroom interaction (Richards & Rodgers, 2014) ^[21]. Similarly, lecture-based teaching is a particular instructional method in which the teacher presents information to learners, while chalk-and-talk refers more specifically to the use of the board and oral explanation as major teaching techniques. Consequently, a face-to-face classroom can incorporate learner-centred activities, group work, peer interaction, discussion, questioning, and formative feedback without ceasing to be face-to-face instruction (Brown, 2004; Richards & Rodgers, 2014) ^[21].

The definition is particularly appropriate for the present study because the purpose is to compare two modes of instructional delivery Zoom-based synchronous instruction and face-to-face classroom instruction rather than to compare two completely different teaching philosophies. Both groups should therefore receive comparable composition content, learning objectives, writing tasks, instructional duration, and assessment procedures, while the principal difference lies in the mode through which instruction is delivered. Such control is important in experimental and quasi-experimental research because it helps reduce the possibility that differences in students' outcomes are caused by factors other than the independent variable (Creswell & Creswell, 2018) ^[7].

This formulation makes instructional mode the principal independent variable while allowing both groups to receive appropriate pedagogical activities.

Effectiveness of Zoom-Based Teaching in English Composition

Teaching English composition requires continuous interaction, guided writing practice, peer collaboration, and prompt feedback. Zoom provides several features that support these pedagogical requirements. Breakout rooms facilitate peer review activities, screen sharing enables teachers to demonstrate writing techniques, while chat functions promote collaborative editing. According to Seo (2021) ^[23], students participating in synchronous online

English classes demonstrated improved interaction and learning outcomes through collaborative group work conducted on Zoom. Nadezhda (2020) ^[17] also found that Zoom technology significantly improved students' writing and grammar skills because lecturers could provide immediate feedback during online sessions. Armand and Purnawarman (2025) ^[2], in a systematic review of Zoom in English language teaching, concluded that Zoom-based instruction enhances students' academic performance, motivation, collaboration, and learner autonomy when supported by appropriate instructional design and technological infrastructure. Nevertheless, Zhao *et al.* (2020) ^[28] observed that although online instruction can produce learning outcomes comparable to face-to-face teaching, its effectiveness largely depends on students' internet access, digital competence, and institutional support.

Students' Engagement in Online Learning

Student engagement refers to learners' behavioral, emotional, and cognitive involvement in classroom activities. Fredricks, Blumenfeld, and Paris (2004) ^[9] classify engagement into behavioral engagement, emotional engagement, and cognitive engagement. In Zoom-based learning environments, engagement may be enhanced through live discussions, breakout room activities, polling, multimedia presentations, and collaborative tasks. According to Souheyla (2021) ^[25], students participating in Zoom classes reported increased motivation and active participation compared with asynchronous online learning. Conversely, Mu'awanah *et al.* (2021) ^[23] found that poor internet connectivity, distractions at home, and limited technological competence sometimes reduced students' participation during Zoom sessions.

Challenges of Zoom-Based Online Teaching

Despite its educational benefits, several challenges affect the implementation of Zoom-based teaching in developing countries. These include unstable internet connectivity, inadequate electricity supply, high internet subscription costs, limited ICT facilities, insufficient digital literacy, and unequal access to digital devices (Singh *et al.*, 2020). Rozhdestvenska and Cherniavska (2022) ^[22, 24] emphasize that the effectiveness of Zoom depends on institutional investment in technological infrastructure and continuous professional development for lecturers. Without these supports, online instruction may widen educational inequalities rather than improve learning outcomes.

Theoretical Framework

This study is anchored on the Community of Inquiry (CoI) Theory developed by Garrison, Anderson, and Archer (2000) ^[10]. The theory explains that effective online learning occurs through the interaction of three essential elements: cognitive presence, social presence, and teaching presence. Cognitive presence enables students to construct meaning through reflection and critical thinking. Social presence promotes communication, collaboration, and interaction among learners, while teaching presence involves instructional design, facilitation, and feedback provided by the instructor.

Methodology and Data Collection

A quasi-experimental design will be used, employing two groups: an experimental group (Zoom-based instruction)

and a control group (traditional classroom instruction). Both groups will be taught identical content for one academic semester. Participants will include 200-level students from three state-owned higher institutions in Katsina State (CLGS, UMYU, FUDMA). Quasi-experiments will be used to select comparable classes from each institution. The research instruments will include pre-test and post-test essay. Lecturers (research assistants) will teach English composition to both groups using lesson plans prepared by the research team. The experimental group will use Zoom, while the control group will receive face-to-face instruction. Pre- and post-tests will measure improvement. Perceptions will be gathered through surveys and discussions. Descriptive statistics (mean, SD) and inferential tests (paired t-tests, independent t-tests, ANOVA) will be used to analyze student performance. Perception data will be analyzed using thematic and frequency analysis.

Sample Size

The study will comprise 200 participants, with 100 students assigned to the Zoom-based online instruction group and 100 to the face-to-face instruction group. The sample size will be determined through an a priori power analysis using a two-tailed independent-samples test, with a significance level of $\alpha = .05$, statistical power of .80, and a medium expected effect size ($d = .50$), following Cohen (1988) ^[6]. The analysis indicates a minimum sample of approximately 128 participants (64 per group). Therefore, selecting 200 participants provides a sufficient margin above the minimum requirement to account for possible attrition, incomplete responses, and other forms of data loss, while also providing balanced groups for reliable comparison. The two groups will receive equivalent English composition content and assessment, with the mode of instruction being the principal difference.

Research Instruments

The main instrument will be an English Composition Writing Test (ECWT) administered as a pre-test and post-test to both groups.

1. **Essay Topic:** Students will write a descriptive essay on a common topic, such as *"Describe a memorable place you have visited and explain what makes it memorable."*
2. **Word Limit:** Each student will write 300–350 words.
3. **Time Allowed:** Students will be given 60 minutes to complete the essay.
4. **Scoring Rubric:** Essays will be scored using an analytic rubric covering Content (25%), Organization (25%), Expression/Language Use (25%), and Mechanical Accuracy (25%), giving a total of 100 marks.
5. **Number of Raters:** Each essay will be independently assessed by two trained English Language lecturers.
6. **Inter-Rater Reliability:** Inter-rater reliability will be established using the Intraclass Correlation Coefficient (ICC) to determine the level of agreement between the

two raters. A coefficient of 0.70 or above will be considered acceptable.

7. **Validity:** The instrument will be subjected to content and face validity by at least three experts in English Language Education/Composition. Their recommendations will be used to revise the essay task

Results

Table 1: Comparison of Students' Pre-test and Post-test Scores

Group	N	Pre-test Mean (SD)	Post-test Mean (SD)	Mean Gain	t-value	p-value	Decision
Zoom-Based Teaching	100	48.62 (7.84)	72.48 (8.21)	23.86	15.82	0.000	Significant
Traditional Classroom	100	49.10 (8.01)	66.31 (7.75)	17.21	12.94	0.000	Significant

Interpretation: Students taught through Zoom-based instruction recorded a higher mean gain in English composition than those taught through traditional classroom methods.

Table 2: Independent t-test Comparing Post-test Achievement

Group	Mean	SD	t-value	p-value	Decision
Zoom-Based	72.48	8.21	4.63	0.001	Significant Difference
Traditional	66.31	7.75			

Interpretation: There was a statistically significant difference in the post-test achievement of students, with the

and scoring rubric before administration.

8. **Reliability:** A pilot test will be conducted with students who are similar to, but not part of, the study sample. The reliability of the scoring procedure will be established through the raters' scores and ICC, while the consistency of the rubric will also be examined before the main study.

Zoom group outperforming the traditional classroom group.

Table 3: Students' Level of Engagement

Level of Engagement	Zoom (n=100)	Traditional (n=100)
Very High	48 (48%)	29 (29%)
High	34 (34%)	38 (38%)
Moderate	13 (13%)	22 (22%)
Low	5 (5%)	11 (11%)

Interpretation: Students in the Zoom-based class demonstrated higher levels of engagement than those in the traditional classroom.

Table 4: Students' Perceptions of Zoom-Based Instruction (Likert Scale)

Statement	Mean	SD	Decision
Zoom makes learning English composition interesting.	4.31	0.68	Agree
Zoom improves interaction with lecturers.	4.12	0.73	Agree
Zoom enhances writing skills.	4.08	0.79	Agree
Zoom encourages independent learning.	4.25	0.65	Agree
Poor internet connectivity affects learning.	4.54	0.59	Strongly Agree

Table 5: Major Challenges of Zoom-Based Teaching

Challenge	Frequency	Percentage (%)	Rank
Poor Internet Connectivity	86	86.0	1st
High Cost of Data	81	81.0	2nd
Electricity Failure	76	76.0	3rd
Limited ICT Skills	58	58.0	4th
Lack of Digital Devices	44	44.0	5th

Post-Test Findings

An independent-samples *t*-test showed that students taught through Zoom performed significantly better on the post-test than those taught through the traditional classroom method, $t(198) = 4.63$, $p < .001$. The effect size was Cohen's $d =$ [insert calculated value], indicating a [small/moderate/large] practical effect. The 95% confidence interval for the difference in mean scores was [insert lower limit, upper limit].

Thus, the findings indicate that the superiority of the Zoom group was not only statistically significant but also had a measurable educational effect.

Based on the statistics you provided, the *t*-values in your table appear to be from paired-samples *t*-tests comparing each group's pre-test and post-test scores. Therefore, the appropriate degrees of freedom are 99 for each group.

I calculated the exact *p*-values, Cohen's d , and 95% confidence intervals as follows:

Table 6: Comparison of Students' Pre-test and Post-test Scores

Group	N	Pre-test Mean (SD)	Post-test Mean (SD)	Mean Gain	t(df)	Exact p-value	Cohen's <i>d</i>	95% CI for Mean Gain	Decision
Zoom-Based Teaching	100	48.62 (7.84)	72.48 (8.21)	23.86	15.82 (99)	< .001	1.58	[20.87, 26.85]	Significant
Traditional Classroom	100	49.10 (8.01)	66.31 (7.75)	17.21	12.94 (99)	< .001	1.29	[14.57, 19.85]	Significant

Interpretation

The Zoom-based teaching group demonstrated a statistically significant improvement from pre-test to post-test, $t(99) = 15.82$, $p < .001$, with a large effect size ($d = 1.58$). The 95% confidence interval for the mean gain was [20.87, 26.85], indicating that the improvement was substantial.

Similarly, the traditional classroom group showed a statistically significant improvement, $t(99) = 12.94$, $p < .001$, with a large effect size ($d = 1.29$). The 95% confidence interval was [14.57, 19.85].

Importantly, the Zoom group had a larger mean gain (23.86) than the traditional classroom group (17.21), and its effect size was also larger (1.58 versus 1.29). This suggests that the improvement associated with Zoom-based teaching was not merely statistically significant but also educationally substantial.

Recommendations

1. Higher institutions should adopt blended learning approaches that combine Zoom-based online teaching with traditional face-to-face instruction to maximize students' learning outcomes in English composition.
2. Institutional management should invest in reliable ICT infrastructure, including high-speed internet connectivity, stable electricity supply, multimedia classrooms, and digital learning facilities to support effective online teaching.
3. Government agencies such as the Federal Ministry of Education, TETFund, NUC, and NBTE should provide financial and technical support to tertiary institutions for the acquisition of digital teaching technologies and learning management systems.
4. Lecturers should receive regular professional development training on the effective pedagogical use of Zoom and other online teaching platforms, particularly in designing interactive writing activities and providing timely feedback.
5. Students should be provided with digital literacy training to improve their competence in using Zoom and other educational technologies for collaborative learning and academic writing.
6. Institutions should collaborate with internet service providers to provide affordable or subsidized internet access and educational data bundles for lecturers and students to reduce the financial burden associated with online learning.
7. English language lecturers should integrate Zoom features, such as breakout rooms, screen sharing, online quizzes, collaborative document editing, and real-time feedback, into composition lessons to promote active learning and improve writing proficiency.

Conclusion

The findings of this study indicate that Zoom-based online teaching is an effective instructional approach for teaching English composition in higher institutions of Katsina State. Although both Zoom-based and traditional classroom methods contributed to improvements in students' writing performance, the Zoom-based group demonstrated significantly higher achievement, greater classroom engagement, and more positive perceptions toward learning English composition. The interactive features of Zoom,

including real-time communication, screen sharing, breakout rooms, and immediate feedback, provided opportunities for collaborative learning and enhanced students' writing skills. At the same time, the study found that the effectiveness of Zoom-based instruction is influenced by infrastructural and technological factors, particularly internet connectivity, electricity supply, availability of digital devices, and the digital competence of both lecturers and students

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