



The Effectiveness of COW through the AI Writing Assistant Platform: Moderating Self-Efficacy and Digital Literacy in English Language

Efektivitas COW melalui Platform Asisten Menulis Berbasis AI: Moderasi Efikasi Diri dan Literasi Digital dalam Pembelajaran Bahasa Inggris

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Abstract

Writing skills are essential in English as a Foreign Language (EFL) learning, yet many high school students experience difficulties in generating ideas, organizing texts, and revising their writing effectively. Integrating Artificial Intelligence (AI) Writing Assistants with Collaborative Online Writing (COW) offers a promising approach to enhancing writing performance through collaborative and process-oriented learning. This study investigates the effectiveness of AI-assisted COW in improving students' English writing skills, with self-efficacy and digital literacy examined as moderating variables. A quantitative approach employing a quasi-experimental non-equivalent control group design was adopted. Participants consisted of eleventh-grade public high school students assigned to experimental and control groups. Data were collected through pre- and post-writing tests, self-efficacy questionnaires, and digital literacy questionnaires, then analyzed using inferential statistics and moderation regression analysis. The results revealed that students receiving AI-assisted COW achieved significantly greater improvements in writing skills than those in the control group, with a substantial effect size. Moreover, self-efficacy and digital literacy significantly strengthened the positive relationship between AI-assisted COW and writing achievement, indicating that students with higher levels of both variables gained greater learning benefits. These findings demonstrate that integrating collaborative online writing with AI technology effectively enhances EFL students' writing skills while highlighting the importance of fostering self-efficacy and digital literacy to maximize learning outcomes.

Kata Kunci:

Asisten Menulis
Berbasis AI;
Kolaborasi
Daring;
Literasi Digital;
Efikasi Diri;
Keterampilan
Menulis.

Abstrak

Keterampilan menulis merupakan salah satu kompetensi penting dalam pembelajaran Bahasa Inggris sebagai bahasa asing (EFL). Namun, banyak siswa sekolah menengah masih mengalami kesulitan dalam mengembangkan ide, mengorganisasi teks, dan merevisi tulisan secara efektif. Integrasi Artificial Intelligence (AI) Writing Assistant dengan Collaborative Online Writing (COW) menawarkan pendekatan yang menjanjikan untuk meningkatkan kemampuan menulis melalui pembelajaran kolaboratif dan berorientasi pada

proses. Penelitian ini bertujuan menguji efektivitas penerapan COW berbantuan AI dalam meningkatkan keterampilan menulis bahasa Inggris siswa, dengan efikasi diri dan literasi digital sebagai variabel moderator. Penelitian menggunakan pendekatan kuantitatif dengan desain kuasi eksperimen non-equivalent control group. Partisipan penelitian adalah siswa kelas XI sekolah menengah atas negeri yang dibagi menjadi kelompok eksperimen dan kelompok kontrol. Data dikumpulkan melalui tes menulis sebelum dan sesudah perlakuan, angket efikasi diri, serta angket literasi digital, kemudian dianalisis menggunakan statistik inferensial dan analisis regresi moderasi. Hasil penelitian menunjukkan bahwa siswa yang mengikuti pembelajaran COW berbantuan AI mengalami peningkatan keterampilan menulis yang secara signifikan lebih tinggi dibandingkan kelompok kontrol, dengan ukuran efek yang besar. Selain itu, efikasi diri dan literasi digital terbukti memperkuat hubungan positif antara COW berbantuan AI dan keterampilan menulis. Temuan ini menunjukkan bahwa integrasi pembelajaran menulis kolaboratif berbasis AI efektif meningkatkan keterampilan menulis siswa EFL sekaligus menegaskan pentingnya penguatan efikasi diri dan literasi digital untuk mengoptimalkan hasil pembelajaran.

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INRODUCTION

Background of the Problem

Learning English as a foreign language (EFL) in secondary schools is essential to prepare students for academic and communication needs around the world (Sun & Zhang, 2022). Writing skills are often considered the most complex of the language skills taught (Huang & Zhang, 2022). Developing ideas, organizing thoughts logically, and using English vocabulary and structures correctly are all skills necessary for writing (Qin et al., 2022). Writing procedures that use effective cognitive and metacognitive strategies help EFL students make decisions and organize their thinking (Sun & Zhang, 2022). Independent learning and improvement of the writing process are encouraged through the application of various strategies (Huang & Zhang, 2022). In addition, consistent practice allows students to become more confident in expressing their ideas in written form (Qin et al., 2022). Teachers also play an important role in guiding students to apply appropriate strategies during the writing process (Huang & Zhang, 2022). Through structured support and regular feedback, students can gradually improve the clarity, coherence, and accuracy of their writing (Sun & Zhang, 2022).

Writing skills in English remain a significant problem in the learning process at the secondary school level. Many students have difficulty translating ideas into writing, constructing logical paragraphs, and using correct grammar (Xu & Zhang, 2023). According to research conducted by Yu & Zhou (2022), EFL students often encounter various problems when writing. These problems include linguistic aspects such as grammar and vocabulary, affective aspects such as anxiety when writing, and cognitive aspects such as developing ideas (Rasool et al., 2023). As a result, the writing process becomes complicated and has an impact on overall writing ability. Insufficient practice and feedback can make it difficult for students to recognize and correct their mistakes

(Busse et al., 2023). Therefore, appropriate teaching strategies and continuous guidance are needed to help students gradually improve their writing competence.

English language learning at SMAN Paiton, Probolinggo, also experiences this problem. Writing instruction still focuses on the final product, such as grammatical accuracy and text structure, even though the writing process is still neglected. However, the regular use of a process-oriented approach to writing can improve the academic writing skills of EFL students. This has been proven through the stages of planning, drafting, revising, and editing, which have resulted in an improvement in the quality of students' writing from the initial research cycle to the final research cycle (Shen et al., 2023). In classroom practice, many students tend to concentrate only on producing a correct final text without fully understanding how ideas are developed step by step. As a result, they often struggle to organize their thoughts and express them clearly in written form. By guiding students through each stage of the writing process, teachers can help them become more confident and reflective writers (Ye & Liu, 2023). This approach also encourages students to see writing as a continuous activity that involves thinking, evaluating, and improving their work. Over time, consistent practice with process-based writing can foster greater independence, creativity, and critical thinking in students' academic writing (He & Gao, 2023).

In addition, because writing instruction is still mostly done individually, interaction and cooperation between students is relatively limited. However, collaborative learning is very important for improving the quality of language learning (Li, 2023). Collaborative learning in writing activities allows students to share ideas, give each other feedback, and improve their writing together (Chen et al., 2023). According to research (Alqasham, 2022), student engagement and active participation in the writing learning process increased significantly.

In recent years, advances in digital technology have opened up new avenues for learning English, including writing. AI writing assistant platforms are one of the most popular technologies. This technology is designed to provide automatic feedback on text clarity, sentence structure, grammar, and vocabulary choices. According to research conducted by Han & Li (2024), the use of AI technologies such as Grammarly and ChatGPT when teaching students to write English helps them find language errors and supports the writing revision process. As a result, the quality of students' writing has improved significantly.

AI writing assistants can help shift learning from product-oriented learning to process-oriented learning (Shen et al., 2023). According to them, the use of AI writing assistants in English language learning can improve writing feedback and increase student autonomy and self-reflection, so that the writing process focuses not only on the end result but also on the process. However, AI cannot be separated from pedagogical approaches. If technology is used without a clear learning design, students risk becoming dependent on AI and neglecting their own thinking processes. According to Song & Song (2023), artificial intelligence works well in language learning as a tool that supports students in thinking and writing. However, it does not function as a substitute for the active role of students.

In this case, one relevant approach is Collaborative Online Writing (COW). COW is a writing learning method that emphasizes cooperation between students in an online environment. Students work together in groups to write, plan, and revise texts collaboratively. According to Li (2023), collaboration in the writing process and the quality of students' writing are improved when students write collaboratively on digital platforms. When COW is combined with an AI writing assistant platform, students receive two types of support: social support through collaboration and technical support

through AI (Song & Song, 2023). This combination is expected to create a more interactive learning environment and support the optimal development of writing skills.

Notwithstanding, internal factors of students also influence the effectiveness of COW and AI-based learning. A significant factor is self-efficacy, which refers to a person's belief in their ability to complete a particular task. Self-efficacy influences students' motivation, perseverance, and their response to feedback in writing learning. Writing ability, motivation, and perseverance correlate with high self-efficacy (Allagui, 2024). Students use AI writing assistants. Students with high self-efficacy tend to use AI as a tool to improve and develop their writing, while students with low self-efficacy have the potential to passively rely on AI suggestions (Shahsavar et al., 2024). Therefore, self-efficacy is considered a moderating variable that can influence the effectiveness of COW implementation through AI writing assistant platforms.

Digital literacy is very important for technology-based learning, in addition to self-efficacy. Digital literacy includes using technology effectively, understanding digital information critically, and using technology ethically. Digital literacy is an important skill that enables students to use technology critically, effectively, and responsibly (McGrath et al., 2023). Thus, technology-based learning, including AI, can be used productively and meaningfully. Students' digital literacy influences their ability to understand and evaluate the feedback provided in AI-based writing learning. According to Yan & Zhang (2024), digital literacy plays an important role in students' ability to understand and evaluate the feedback provided in AI-based writing learning. Thus, technology can be used critically and responsibly as a tool to support writing learning.

Based on the above description, it can be concluded that the use of Collaborative Online Writing through an AI writing assistant platform does not only depend on the learning method, but is also influenced by students' self-efficacy and digital literacy. Success in English writing learning is influenced by the interaction between these three components. Therefore, this study aims to evaluate the effectiveness of COW using an AI writing assistant platform. This study examines how digital literacy and self-efficacy play a role in English writing learning at SMAN 1 Paiton, Probolinggo.

Identification of Problems

Writing is considered one of the most challenging skills in English as a Foreign Language (EFL) learning because it requires students to generate ideas, organize them coherently, and apply appropriate grammar, vocabulary, and mechanics. However, many senior high school students still encounter difficulties in producing well-organized and meaningful written texts. At SMAN 1 Paiton, English writing instruction continues to emphasize the final product rather than the writing process, resulting in limited opportunities for students to develop essential writing stages such as planning, drafting, revising, and editing. Furthermore, classroom writing activities are predominantly conducted individually, restricting students' opportunities to collaborate, exchange ideas, and provide constructive feedback to one another. Although Artificial Intelligence (AI) Writing Assistant platforms have recently been introduced as innovative tools capable of providing immediate feedback on grammar, vocabulary, sentence structure, and text organization, their integration into writing instruction remains limited and has not been optimally combined with collaborative learning approaches.

Collaborative Online Writing (COW) offers an alternative instructional approach by encouraging students to work together in planning, composing, revising, and improving their writing through online collaboration. When supported by AI Writing Assistant platforms, students receive both collaborative interaction and instant automated feedback, which may enhance the quality of the writing process. Nevertheless, the

effectiveness of this approach is likely influenced by students' internal characteristics. Students with higher self-efficacy tend to participate more actively, respond positively to feedback, and revise their writing more effectively, whereas those with lower self-efficacy may rely excessively on AI-generated suggestions. Likewise, digital literacy determines students' ability to utilize AI technology critically, evaluate automated feedback, and apply technological tools responsibly during the writing process.

Although previous studies have reported positive impacts of Collaborative Online Writing and AI-assisted writing tools separately, limited empirical evidence has examined the effectiveness of integrating Collaborative Online Writing through AI Writing Assistant platforms while considering self-efficacy and digital literacy as moderating variables in Indonesian EFL classrooms. Therefore, this study is conducted to investigate the effectiveness of Collaborative Online Writing through the AI Writing Assistant Platform in improving students' English writing skills and to examine whether self-efficacy and digital literacy strengthen or weaken the effectiveness of this instructional approach.

Formulation of the Problem

Based on the identification of the problems presented above, this study seeks to answer the following research questions:

1. Is Collaborative Online Writing (COW) through the AI Writing Assistant Platform effective in improving students' English writing skills?
2. Does self-efficacy significantly moderate the effectiveness of Collaborative Online Writing (COW) through the AI Writing Assistant Platform on students' English writing skills?
3. Does digital literacy significantly moderate the effectiveness of Collaborative Online Writing (COW) through the AI Writing Assistant Platform on students' English writing skills?

Objectives and Benefits of Research

Research Objectives

The primary objective of this study is to examine the effectiveness of Collaborative Online Writing (COW) through the AI Writing Assistant Platform in improving students' English writing skills. In particular, this study aims:

1. To investigate the effectiveness of Collaborative Online Writing (COW) through the AI Writing Assistant Platform in improving the English writing skills of eleventh-grade EFL students.
2. To examine whether self-efficacy significantly moderates the effectiveness of Collaborative Online Writing (COW) through the AI Writing Assistant Platform on students' English writing skills.
3. To examine whether digital literacy significantly moderates the effectiveness of Collaborative Online Writing (COW) through the AI Writing Assistant Platform on students' English writing skills.

Research Benefits

This study is expected to provide both theoretical and practical contributions to English language learning:

1. Theoretical Benefits

The findings of this study are expected to enrich the body of knowledge in English Language Teaching (ELT), particularly in technology-enhanced writing instruction. Furthermore, this study contributes to the existing literature by providing empirical evidence regarding the effectiveness of Collaborative Online Writing (COW) integrated with an AI Writing Assistant Platform while considering the moderating roles of self-efficacy and digital literacy in improving EFL students' writing skills.

2. Practical Benefits

For English teachers, the findings may serve as a reference for integrating Collaborative Online Writing and AI Writing Assistant platforms into writing instruction to create a more collaborative, interactive, and process-oriented learning environment. For students, this study is expected to improve writing performance, encourage active collaboration, strengthen self-efficacy, and enhance digital literacy in using AI technology critically and responsibly during the writing process. For schools, the findings may provide valuable information for supporting the implementation of technology-integrated English language learning and promoting the effective use of AI-based instructional tools. For future researchers, this study may serve as a useful reference for conducting further research on AI-assisted language learning, collaborative online writing, self-efficacy, digital literacy, and other variables related to English writing instruction.

THEORETICAL AND CONCEPTUAL FRAMEWORK

Theoretical Framework

This study is grounded in contemporary theories of technology-enhanced language learning and collaborative writing that explain the relationships among Collaborative Online Writing (COW), Artificial Intelligence (AI) Writing Assistant platforms, self-efficacy, digital literacy, and English writing skills.

Writing is a productive language skill that requires learners to generate ideas, organize information, apply appropriate grammar and vocabulary, and continuously revise their work. The process writing approach conceptualizes writing as a recursive process consisting of planning, drafting, revising, editing, and publishing rather than merely producing a final product. Through iterative feedback and reflection, learners progressively improve the quality of their writing. Recent research has demonstrated that AI-supported process writing enhances writing engagement and improves EFL learners' writing quality by facilitating systematic revision and continuous feedback (Shen et al., 2023; Yan & Zhang, 2024).

Collaborative Online Writing (COW) is grounded in collaborative learning, which emphasizes that knowledge is developed through interaction, shared responsibility, and peer negotiation during the learning process. Within COW, students collaboratively plan, draft, revise, and edit texts using digital platforms, enabling them to exchange ideas and provide constructive peer feedback. Empirical evidence indicates that online collaborative writing improves writing performance, learning engagement, writing motivation, and writing self-efficacy among EFL learners (Li, 2023; Alqasham, 2022). The integration of Artificial Intelligence (AI) Writing Assistant platforms further strengthens collaborative writing by providing immediate feedback on grammar,

vocabulary, sentence structure, coherence, and mechanics. AI therefore functions as a learning support tool that promotes reflection, autonomous learning, and continuous revision rather than replacing students' cognitive processes (Song & Song, 2023).

Self-efficacy represents learners' beliefs in their capability to accomplish academic tasks successfully. Higher levels of self-efficacy encourage students to demonstrate stronger motivation, greater persistence, more effective learning strategies, and more active engagement in writing activities. Recent studies have further shown that students with stronger writing self-efficacy benefit more from collaborative writing environments and AI-assisted writing because they use automated feedback more strategically during the revision process (Li, 2023; Song & Song, 2023). Therefore, self-efficacy is expected to strengthen the effectiveness of AI-assisted Collaborative Online Writing in improving English writing skills.

Digital literacy provides another important theoretical foundation for technology-enhanced writing instruction. It refers to learners' ability to access, evaluate, create, and communicate information effectively, critically, and ethically using digital technologies. In AI-supported writing instruction, students require adequate digital literacy to interpret AI-generated feedback, evaluate its relevance, and apply it appropriately during the writing process. Students with stronger digital literacy are therefore expected to gain greater benefits from AI-assisted Collaborative Online Writing because they are better able to integrate digital technologies into meaningful learning activities (McGrath et al., 2023; Yan & Zhang, 2024).

Based on these theoretical perspectives, this study assumes that Collaborative Online Writing through an AI Writing Assistant Platform positively influences students' English writing skills. Furthermore, the magnitude of this influence is expected to vary according to students' levels of self-efficacy and digital literacy, both of which function as moderating variables that strengthen the effectiveness of technology-assisted collaborative writing.

Conceptual Framework

This study examines the effectiveness of Collaborative Online Writing (COW) integrated with an AI Writing Assistant Platform in improving students' English writing skills. The independent variable is the implementation of Collaborative Online Writing integrated with an AI Writing Assistant Platform, while the dependent variable is students' English writing skills. In addition, self-efficacy and digital literacy function as moderating variables that influence the strength of the relationship between the independent and dependent variables (Sari & Han, 2024; Zhang & Zhang, 2024).

The implementation of AI-assisted Collaborative Online Writing is expected to enhance students' writing performance by facilitating collaborative interaction, providing immediate feedback, encouraging continuous revision, and promoting learner autonomy throughout the writing process (Li & Hebert, 2024; Yan & Zhang, 2024). However, the effectiveness of this instructional approach may vary among students due to differences in individual characteristics.

Students with higher levels of self-efficacy are expected to demonstrate greater confidence, persistence, and willingness to utilize AI-generated feedback during collaborative writing activities (Sari & Han, 2024). Likewise, students with higher levels of digital literacy are expected to make more effective use of AI technology by critically interpreting, evaluating, and applying AI-generated feedback in a responsible manner (Li & Hebert, 2024; Yan & Zhang, 2024).

Therefore, self-efficacy and digital literacy are hypothesized to strengthen the positive relationship between Collaborative Online Writing through an AI Writing Assistant Platform and students' English writing skills.

The conceptual relationships among the research variables are illustrated in Figure 1. The conceptual framework depicts the relationship between the independent and dependent variables, as well as the moderating roles of self-efficacy and digital literacy in strengthening the effectiveness of AI-assisted Collaborative Online Writing in improving students' English writing skills.

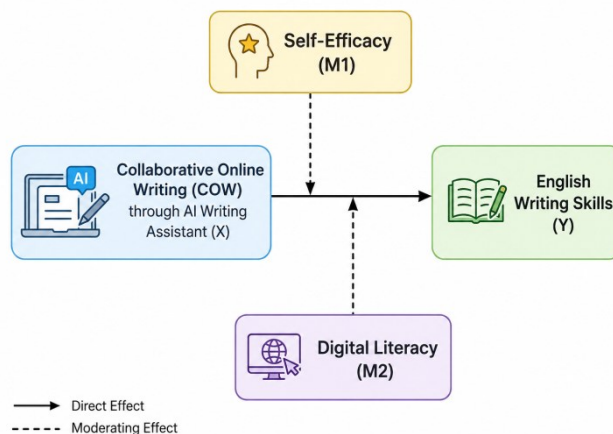


Figure 1. Conceptual Framework of the Study

As illustrated in Figure 1, Collaborative Online Writing (COW) integrated with an AI Writing Assistant Platform serves as the independent variable and is expected to have a positive effect on students' English writing skills as the dependent variable. This relationship is moderated by self-efficacy and digital literacy, both of which are expected to strengthen the effect of AI-assisted Collaborative Online Writing on students' writing performance. Accordingly, students with higher levels of self-efficacy and digital literacy are expected to gain greater benefits from the implementation of AI-assisted Collaborative Online Writing than those with lower levels of these competencies.

RESEARCH METHODS

A quantitative approach was used in this study. A quasi-experimental design was chosen for this study because the researcher could not randomize subjects individually but only use existing classes in the school. The two groups compared in this design were the experimental group and the control group. The students' initial abilities were tested at the beginning of the study. After that, the experimental group was given Collaborative Online Writing (COW) treatment through the AI Writing Assistant platform. The control group received traditional writing instruction.

After the treatment was completed, tests were given to both groups to measure the difference in their writing skill improvement. In addition, this study investigated the functions of digital literacy and self-efficacy as moderators. It is estimated that the effect of COW on AI assistance on students' writing skills is strengthened or weakened. Quasi-experimental designs are commonly applied in educational research when researchers cannot randomly assign participants but need to evaluate the effectiveness of instructional interventions in authentic classroom settings (Dabbous et al., 2023). This study was conducted at SMAN 1 Paiton, Probolinggo, during the even semester of this academic year. The selection of the research location was based on the fact that English writing instruction still focused on the final result (productivity).

As a result, the writing process, such as planning, drafting, revising, and reflecting, had not been optimally implemented. In addition, artificial intelligence (AI)-based technology in writing learning is still underutilized. Therefore, this school was evaluated to determine whether the AI-based collaborative learning model successfully improved students' writing skills. This study involved all students in class XI IPA 1 at SMAN 1 Paiton in the current academic year. Because the unit used as the sample was an existing class, the sampling technique used was cluster random sampling. Based on the English teacher's recommendation, two classes with comparable competencies were selected from the available classes. One class was designated as the experimental group, and the other class was designated as the control group. The total number of students in this study was approximately 60, with approximately 30 students in each class. Independent variables, dependent variables, and moderator variables are the three types of variables involved in this study.

The application of the Collaborative Online Writing (COW) model using the AI Writing Assistant platform is the independent variable, and the dependent variable is students' English writing ability. However, the two moderator variables are self-efficacy and digital literacy. Self-efficacy refers to students' belief in their ability to complete writing tasks, while digital literacy refers to how students use and evaluate technology effectively and responsibly. These two variables are considered to strengthen or weaken the relationship between the application of COW with AI assistance and the improvement of students' writing skills. Previous studies indicate that learners' self-efficacy and digital literacy influence how effectively students engage with technology-supported learning environments and utilize digital feedback during learning activities (Getenet et al., 2024; McGrath et al., 2023).

Writing tests, self-efficacy questionnaires, and digital literacy tests were used in this study. Before and after treatment, writing tests were used as pre- and post-tests to measure students' writing abilities. Students were asked to write texts in English on specific topics. A rubric was used to assess content, organization, vocabulary, grammar, and mechanics. This study also used a self-efficacy questionnaire to measure how confident students were in completing writing tasks in English.

This questionnaire contained statements about students' confidence in composing and revising texts, using artificial intelligence as a tool, and their motivation to improve the quality of their writing. In addition, this study used a digital literacy questionnaire to measure students' ability to use digital platforms, understand feedback from artificial intelligence, critically evaluate information, and apply ethics when using technology. A Likert scale was used for both questionnaires.

This study collected data through several stages. In the first stage, both groups were given a pre-writing test to determine the students' initial writing abilities. After that, the experimental group was given Collaborative Online Writing (COW) treatment, which was conducted through the AI Writing Assistant platform.

During this process, students collaborated with each other to plan, create, and revise their writing with the help of AI feedback. At the same time, the control group used conventional writing instruction that did not utilize AI or online collaborative learning. After the entire treatment series was completed, tests were administered to both groups to evaluate their progress in writing skills. Students also received self-efficacy and digital literacy questionnaires to obtain data on moderator variables.

First, the validity and reliability of the research tools were tested. Content validity is a validity test used to ensure that the components of the instrument are appropriate for the competencies being measured and relevant to the research objectives. An experienced English language education expert determined the content validity. To

ensure that the instrument could measure the research variables correctly, a reliability test was conducted.

The SPSS method was used to assess the reliability of the self-efficacy and digital literacy questionnaires. The instrument was declared reliable if the Cronbach's Alpha value was greater than 0.60. To make the assessment results more fair and consistent, the writing test used the inter-rater reliability technique. Instrument validation and reliability testing are essential procedures to ensure measurement accuracy and consistency in educational research (Ahmady et al., 2023).

Descriptive and inferential analyses were used to analyze the data in this study. Descriptive analysis identified the mean, minimum, maximum, and standard deviation of the pre- and post-test results. The purpose of this analysis was to show the overall improvement in students' writing skills.

The research hypothesis was tested through inferential analysis. Before testing the hypothesis, normality and homogeneity tests were conducted to ensure that the data met statistical assumptions. Normality tests used Kolmogorov-Smirnov and Shapiro-Wilk, and homogeneity tests used Levene. Separate t-tests were used to determine the differences between the experimental and control groups if the data were distributed homogeneously and normally. Inferential statistical procedures, including assumption testing and comparative analysis, are commonly applied to examine differences between groups in educational intervention studies (Dabbous et al., 2023). Moderated Regression Analysis (MRA) was used to evaluate digital literacy and self-efficacy as moderator variables. Moderation analysis is appropriate for examining whether the strength of relationships between variables changes based on the influence of additional variables (Hair et al., 2021). All tests were conducted at a significance level of 0.05.

RESULTS AND DISCUSSION

Results

Results of Descriptive Analysis of Pretests and Posttests

The data shows that the use of Collaborative Online Writing (COW) with the help of AI writing assistants improves the writing skills of students in the experimental class. Posttest scores are generally better than pretest scores.

A summary of the descriptive statistics for the pretest and posttest scores is presented in the following table:

Table 1. Results of Descriptive Analysis of Pretests and Posttests

Statistics	Pretest	Posttest
Number of Students (N)	30	30
Minimum Score	35	80
Maximum Score	60	95
Average	48,50	87,17
Standard Deviation	7,09	5,03

The results show that the average score of students increased from 48.50 on the pretest to 87.17 on the posttest. This increase indicates that students' writing skills improved significantly after using the AI Writing Assistant platform to learn COW. This finding suggests that the integration of technology in writing instruction can provide meaningful

support for students during the learning process. The platform likely helped students organize their ideas, improve grammar, and develop clearer sentence structures.

In addition, immediate feedback from the AI system may have encouraged students to revise and refine their work more effectively. The improvement also reflects increased student engagement and motivation when using interactive learning tools. Therefore, the use of an AI Writing Assistant can be considered an effective strategy to enhance students' writing performance and confidence in producing written texts.

Inferential Statistical Test Results

To test the difference in students' writing skills before and after the treatment, a paired sample t-test was used.

Table 2. Results of the Paired Sample t-Test for Writing Skills

Variable	N	Mean Pretest	Mean Posttest	Mean Difference	t	Sig. (p)
Writing Skills	30	48,50	87,17	38,67	29,00	0,000

The data in the table shows a clear difference between students' writing scores on the pretest and posttest; the average pretest score was 48.50, and the average difference was 38.67. With a significance of $p = 0.000$ ($p < 0.05$), the t-value was 29.00. After treatment, the mean difference showed a significant increase. The high t-value indicates that the difference occurred in most students, not just in a small group. With a significance value well below the 0.05 threshold, it can be concluded that there was a statistically significant improvement in writing skills after the implementation of AI-supported COW. This improvement did not occur by chance.

Table 3. Effect Size Test Results

Statistics	Value	Category
Cohen's d	5,29	Very Large Effect

The data in the table shows a Cohen's d value of 5.29, which falls into the very large effect category. This value indicates that the strength of the treatment's influence on improving writing skills is at a very high level. The significant effect size indicates that the change in scores is not only statistically significant, but also has practical significance in the context of learning. These values show that the application of Collaborative Online Writing with the help of AI has a significant effect on improving students' overall writing skills. In addition, the magnitude of Cohen's d value indicates that the difference between the pretest and posttest averages far exceeds the variation in scores within the group. In other words, there was a significant change in the overall distribution of student scores, not just a small shift in the average. This shows that the application of Collaborative Online Writing with the help of AI improved the writing skills of most students. This shows that the treatment can be assessed quantitatively and in the context of classroom learning implementation

*Students' Self-Efficacy Levels***Table 4.** Descriptive Statistics of Self-Efficacy

Self-Efficacy Indicators	Mean	SD
Confidence in completing writing tasks	3.82	0.50
Perseverance in revising writing	3.76	0.48
Confidence in using AI	3.89	0.46
Motivation to improve writing	3.93	0.43
Total Self-Efficacy	3.85	0.47

Students' self-confidence levels tend to be evenly distributed, according to the data in the table, with an overall average self-efficacy of 3.85 and a standard deviation of 0.47. The indicator of persistence in revising writing received the lowest average score of 3.76, indicating that students have an internal drive to improve the quality of their writing. On the other hand, the indicator of motivation to improve writing quality received the highest average score of 3.93.

his difference shows that even though students are highly motivated, consistency in revision still varies among students. On the whole, this data shows that students' self-efficacy levels are at a good level, and this can help AI-based learning run smoothly.

*Students' Digital Literacy Level***Table 5.** Descriptive Statistics of Digital Literacy (N = 60)

Indicator	Mean	SD
Ability to use digital platforms	3.91	0.44
Understanding of AI feedback	3.74	0.49
Critical evaluation of digital information	3.66	0.51
Ethics of technology use	3.95	0.42
Digital literacy	3.82	0.46

With a standard deviation of 0.46 and an average of 3.82, the data in the table shows that students' digital literacy skills are relatively similar. The critical evaluation of digital information indicator received the lowest average score of 3.66, indicating that students tend to use technology responsibly. The indicator of technology use ethics, on the other hand, received the highest average score of 3.95.

This shows that the ability to analyze and assess digital data still needs to be improved. Students' average digital literacy level is good and supports technology-based learning.

*Self-Efficacy Moderation Test***Table 6.** Moderated Regression Self-Efficacy (N = 60)

Variables	B	t	Sig.
AI-assisted COW	0.65	5.10	0.000
Self-efficacy	0.43	3.45	0.001
Interaction	0.34	2.88	0.006

According to the data in the table, the AI-assisted COW variable has a significant effect on writing ability, with a coefficient of 0.65 and a significance value of $p = 0.000$ ($p < 0.05$). The self-efficacy variable also has a direct effect on writing ability, with a coefficient of 0.43 and a significance value of $p = 0.001$. In addition, the interaction variable between self-efficacy and AI-assisted COW has a coefficient of 0.34 and a significance value of $p = 0.006$. These results indicate that self-efficacy is an important moderating factor. The positive interaction coefficient shows that the greater the influence of AI-assisted COW on students' writing ability, the greater their level of independence.

Digital Literacy Moderation Test

Table 7. Moderated Regression of Digital Literacy (N = 60)

Variables	B	t	Sig.
AI-assisted COW	0.63	4.98	0.000
Self-efficacy	0.39	3.20	0.002
Interaction	0.36	3.01	0.004

According to the data in the table, the AI-assisted COW variable has a coefficient of 0.63 with a significance of $p = 0.000$ ($p < 0.05$), and the digital literacy variable has a coefficient of 0.39 with a significance of $p = 0.002$. This shows that writing skills have a significant direct influence. Digital literacy and AI-assisted COW have a coefficient of 0.36 and significance $p = 0.004$. This shows that digital literacy plays an important role as a moderator. The positive interaction coefficient indicates that students' digital literacy is greater than AI-supported COW. Therefore, digital literacy enhances the relationship between the use of AI-assisted COW and students' writing learning outcomes.

Discussion

The results of the study show that improvements in students' English writing skills are significantly influenced by the use of Collaborative Online Writing (COW) with AI writing assistants. According to Yan & Zhang (2024), the use of AI-based writing tools such as ChatGPT in English language learning has been proven to improve writing quality due to automatic feedback that helps with revision and idea development. Additionally, as stated by McGrath et al. (2023), the use of AI-based writing tools supports students in understanding and utilizing digital technologies effectively. Thus, AI-based writing tools. The increase in pretest and posttest scores in the experimental group shows that online collaboration and AI support can create a more effective writing learning environment.

As indicated by the statistically significant increase in writing scores ($p < 0.05$) and the very large effect size (Cohen's $d = 5.29$), the treatment provided has practical and statistical significance. According to Li and Hebert (2024) research, collaborative learning combined with online learning can significantly improve students' writing skills through the process of revision and peer feedback. According to Dabbous et al. (2023) research, collaborative learning has been proven effective in improving students' learning outcomes through active engagement and structured instructional intervention. These results support the idea that writing learning methods that focus on process, collaboration, and the use of continuous feedback are more effective than methods that only focus on the final product of writing. With COW, students are actively involved in

the stages of planning, drafting, discussion, revision, and editing, so that the process of thinking and developing ideas becomes more organized.

The use of AI writing assistants in COW learning provides additional support by giving quick feedback on linguistic elements such as grammar, sentence structure, and vocabulary choices. This feedback helps students find mistakes and correct them themselves. Research conducted by Sari & Han (2024) found that the use of technology-based writing tools such as AI improves students' ability to think independently about how they write. According to research conducted by Yan & Zhang (2024), the application of artificial intelligence-based technology in English writing learning shows an improvement in students' writing skills by providing instant feedback on sentence structure and grammar. Therefore, AI functions as a cognitive tool that assists the revision process, not as a substitute for the role played by students in the thinking and writing process. This is in line with the idea of contemporary writing learning that uses technology as a tool to enhance students' reflection and autonomy in learning.

The results of this study indicate that, in addition to the learning model being effective, internal student factors, especially independence, are very important for technology-based writing learning. According to Getenet et al. (2024) research, the use of technology-based learning tools contributes positively to students' self-efficacy and engagement in technology-supported learning. The average self-efficacy scores of students in the good category indicate that most students have a fairly high level of confidence in their writing abilities. They are also more open to better feedback when revising their writing.

The results of the moderation regression analysis show that self-efficacy plays a significant role as a moderator in the relationship between the use of AI-assisted COW and writing skills. In other words, students with high levels of self-efficacy are more effective in using AI-assisted COW. Ineffective students have the potential to use AI passively and rely on automatic corrections without deep understanding; conversely, students who believe in their abilities tend to use it actively and reflectively, namely by selecting relevant suggestions and integrating them into the development of ideas and writing structure. According to Sari & Han (2024), the use of AI-assisted writing tools influences students' self-efficacy, self-regulation, and engagement in writing activities. However, to prevent passive dependence on technology, a balanced pedagogy is needed.

Digital literacy has been proven to play an important role as a moderating variable in addition to self-efficacy. The average digital literacy score of students is in the good category, indicating that most students have been able to use digital platforms well and responsibly. However, lower scores on the criteria for critical evaluation of digital information indicate that students' ability to assess and interpret AI feedback still needs improvement. Digital literacy also includes the cognitive ability to critically assess the credibility of digital information, according to another study by McGrath et al. (2023). Although students have basic skills in using technology, this evaluation ability is often lacking among students.

The results of the moderation test show that digital literacy significantly increases the influence of AI-assisted COW on writing skills. Students with high digital literacy are able to understand the function of AI as a tool, consider the suggestions provided, and adapt them to the context of the writing, which means they are better at writing than students with low digital literacy. Getenet et al. (2024) research found that digital literacy and self-efficacy influence students' ability to engage effectively with digital learning environments. These results indicate that the successful use of AI in learning depends on how sophisticated the technology is and how well students use it critically and logically.

This study shows that COW in collaboration with AI Writing Assistant is an effective writing learning method, especially when supported by high self-efficacy and good digital literacy. Research conducted by Yan & Zhang (2024) found that the use of artificial intelligence in developing English writing skills shows that artificial intelligence can help students compose texts, provide corrections, and offer relevant suggestions. However, the prerequisite is that students have sufficient digital literacy to understand and apply this feedback in their learning. To produce active, reflective, and process-oriented writing learning, these three components work together. Therefore, to improve English writing skills at the secondary school level, the focus should be placed not only on learning strategies but also on improving students' affective aspects and digital skills. This will allow for the maximum use of AI. According to research conducted by McGrath et al. (2023), the use of AI applications combined with improving students' digital competencies enhances their ability to use artificial intelligence effectively and responsibly.

Research Limitations

This study has several limitations that should be considered when interpreting the findings. *First*, the study was conducted in only one public senior high school, namely SMAN 1 Paiton, Probolinggo, involving a relatively limited number of eleventh-grade students. Therefore, the findings cannot be generalized to all EFL learners with different educational backgrounds and learning contexts.

Second, the study employed a quasi-experimental design using existing classroom groups rather than random assignment. Although this design is appropriate for educational research, differences in students' prior experiences and classroom characteristics may have influenced the research outcomes.

Third, the implementation of Collaborative Online Writing (COW) through the AI Writing Assistant Platform was conducted within a limited period of classroom instruction. Consequently, the study focused on students' short-term improvement in writing performance and did not investigate the long-term effects of AI-assisted collaborative writing on writing development.

Fourth, this study examined only two moderating variables, namely self-efficacy and digital literacy. Other learner-related factors, such as writing anxiety, learning motivation, critical thinking skills, cognitive engagement, collaborative interaction quality, and prior technological experience, were not included and may also influence the effectiveness of AI-assisted Collaborative Online Writing.

Finally, this study focused exclusively on English writing skills. Therefore, the findings cannot be directly extended to other English language skills such as speaking, reading, or listening, which may require different instructional approaches and learning environments.

Novelty/Contribution

This study offers both theoretical and practical contributions to English Language Teaching (ELT), particularly in technology-enhanced writing instruction. The primary novelty of this study lies in the integration of Collaborative Online Writing (COW) with an AI Writing Assistant Platform within a quasi-experimental framework. While previous studies have generally investigated Collaborative Online Writing and AI-assisted writing as separate instructional approaches, this study combines both

approaches into a single learning model designed to improve EFL students' English writing skills.

Another important contribution is the inclusion of self-efficacy and digital literacy as moderating variables. Rather than examining only the direct effect of AI-assisted Collaborative Online Writing, this study investigates how students' confidence in their writing ability and their digital competence strengthen or weaken the effectiveness of technology-assisted collaborative learning. This provides a more comprehensive understanding of why AI-supported writing instruction may produce different learning outcomes among students.

Practically, this study provides empirical evidence that integrating Collaborative Online Writing with AI Writing Assistant platforms can create a more collaborative, process-oriented, and technology-enhanced writing environment. The findings offer valuable guidance for English teachers, curriculum developers, and educational institutions in designing AI-supported writing instruction that not only improves students' writing performance but also promotes self-efficacy and digital literacy as essential competencies for twenty-first-century learning.

CONCLUSIONS AND SUGGESTIONS

Conclusion

This study demonstrates that the implementation of online collaborative writing (COW) supported by an AI Writing Assistant platform contributes positively to the improvement of eleventh-grade students' English writing skills. The difference between pre-test and post-test scores in the experimental group indicates a clear and meaningful increase, not only statistically but also in the learning process itself. Through collaborative writing activities combined with AI assistance, students were able to develop ideas more easily, identify errors, and revise their work in a more structured and guided manner.

The findings also reveal that the effectiveness of AI-assisted COW is not solely determined by the learning model or the technology used. Internal student factors play a significant role in shaping the learning outcomes. Self-efficacy, in particular, emerged as an important element influencing how students engaged with the writing process. Students who demonstrated higher confidence tended to participate more actively, showed persistence during revision, and made better use of AI-generated feedback. They did not merely accept corrections but attempted to understand and apply them to improve the quality of their writing. In addition, digital literacy was found to influence how effectively students interacted with the platform. Students with stronger digital skills were more capable of navigating the system, interpreting AI feedback critically, and applying the suggestions in a relevant context. In contrast, those with limited digital experience required more time to adapt and did not always benefit from the technology to the same extent. This indicates that digital readiness supports the successful integration of AI into the writing classroom.

The study shows that the success of AI-assisted collaborative writing is shaped by the interaction between instructional approach, technological support, students' confidence, and their digital competence. When these elements function together, the learning process becomes more supportive and the improvement in writing skills becomes more sustainable.

Based on these findings, several suggestions can be proposed. Teachers are encouraged to guide students not only in using AI tools but also in understanding how to interpret and apply feedback appropriately. Strengthening students' self-confidence should also

become part of classroom practice, as it influences their willingness to revise and improve their writing. Schools are advised to support the development of students' digital literacy through continuous exposure to technology-integrated learning. For future researchers, further studies may explore other contributing factors, such as learning styles, frequency of technology use, or long-term impacts of AI-assisted writing, to provide a more comprehensive understanding of how technology can support writing development.

Suggestions

Based on the findings of this study, several suggestions are proposed for English language teaching practice and future research.

First, English teachers are encouraged to integrate Collaborative Online Writing (COW) through AI Writing Assistant platforms into writing instruction. Rather than using AI merely as an automatic correction tool, teachers should guide students to utilize AI-generated feedback critically during the planning, drafting, revising, and editing stages. This approach can foster collaborative learning, improve students' writing quality, and promote greater learner autonomy.

Second, schools are recommended to provide adequate technological infrastructure and continuous support for technology-integrated learning. Professional development programs and training should also be provided to help teachers effectively implement AI-supported collaborative writing activities and maximize students' learning experiences.

Third, since self-efficacy and digital literacy were found to strengthen the effectiveness of AI-assisted Collaborative Online Writing, teachers should design classroom activities that not only improve students' writing competence but also develop their confidence in writing and their ability to use digital technology critically, ethically, and responsibly.

Finally, future researchers are encouraged to replicate this study with larger samples, different educational levels, and various EFL learning contexts to improve the generalizability of the findings. Further studies may also investigate other moderating or mediating variables, such as writing anxiety, learning motivation, critical thinking, collaborative engagement, or AI literacy. In addition, future research may examine the long-term impact of AI-assisted Collaborative Online Writing on students' writing development and compare different AI writing platforms to identify the most effective technology for English writing instruction.

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AUTHOR CONTRIBUTION STATEMENT

Firlia Nurul Anisa contributed to the conceptualization of the study, literature review, research design, data collection, data analysis, interpretation of the findings, and preparation of the initial manuscript. Mohammad Sofyan Adi Pranata supervised the research process, contributed to the refinement of the research methodology, critically reviewed and revised the manuscript for important intellectual content, and approved the final version of the manuscript for publication. Both authors have read and approved the final manuscript and agree to be accountable for all aspects of the work.

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