Incorporating Mobile Platforms into Self-Regulated Writing Activities to Promote Students' Performance, Writing Quality, and Perceptions

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***Abstract*—Self-Regulated Writing Activities (SRWA) are well reckoned for professional, pedagogical, and practical contributions to classroom practices. Collaborative writing as one stage of these instructional designs has not received significant attention, and the implementation of Mobile Platforms-Based Collaborative Writing (MMCW) should be investigated further for its urgency in language learning. Therefore, the current study examines the impact of MMCW incorporation into SRWA to promote students' performance, delving into the students' writing quality after classroom intervention and exploring students' perception of using mobile platforms in SRWA. The study employed a mixed method, which consisted of quantitative research, one group pre- and post-test experimental design and semi-structured interviews for qualitative research, which involved twenty students from a private university in Indonesia. The Wilcoxon signed-rank test was used to analyze the tests, document analysis to writing quality, and thematic analysis to interview. The results show an impressive difference in students' writing from the pre-test to the post-test. The increase in students' writing quality is demonstrated in linguistic diversity, mechanical details, development of ideas, writing formation, and language use. Moreover, students positively perceive implementing mobile platforms into self-regulated writing activities. The implications and recommendations of the study are also discussed.**

***Keywords*—academic writing, collaborative learning, mobile learning, self-regulated learning**

I. Introduction

Self-Regulated Writing Activities (SRWA) have emerged as a promising approach to improving English writing ability in educational contexts [1]. These strategies have been demonstrated to assist students in taking charge of their writing process by organizing, supervising, and assessing their work, having a good impact on several writing-related abilities [2, 3]. Guo *et al.* [4] show that SRWA improves writing structure, word utilization, and grammar. Zhou and Hiver [5] indicate that SRWA, especially self-assessment techniques, increase students' self-efficacy in writing by encouraging a positive belief in their capacity to do their best. The autonomous and engaging writing experience empowers students to nurture their participation in classroom activities, ultimately contributing to significant progress in English writing skills for foreign language learners [6]. Numerous studies have demonstrated the efficacy of SRWA in enhancing students' writing abilities. For example, research reveals that students who participate in SRWA produce more structured and logical essays than those who do not [7].

Additionally, SRWA mediation assists students in developing their metacognitive skills, which are the reflection skills for their thinking [8]. These abilities are necessary for good writing because they let students track their development, pinpoint their areas of weakness, and modify their work accordingly. In addition to the pedagogical benefits, SRWA has practical advantages for teachers. For example, they assist teachers in differentiating education and offering challenging students more focused assistance. Moreover, the activities enable students to exhibit their comprehension of writing ideas through original writing, and they support teachers in conducting more authentic assessments of their students' learning [9]. Finally, SRWA have also professional implications for teachers. Through the use of SRWA in their classrooms, teachers exhibit their dedication to the highest standards of teaching writing. SRWA can also develop teachers' professional knowledge and competencies since the activities force them to rethink the writing process [10].

Collaborative writing, an essential step in self-regulated writing activities, offers many potential advantages within the writing classroom, as demonstrated in recent studies [11–13]. Research on wiki-based collaborative writing, such as [14], shows that it is beneficial in raising writing proficiency among foreign language university students. Collaborative writing promotes better content organization and job fulfillment through peer engagement and shared responsibility [1]. This collaborative atmosphere stimulates negotiation of language use, resulting in increased vocabulary, grammar, and overall writing accuracy [15]. Furthermore, group writing can reduce nervousness and boost self-esteem, especially for students who might struggle to complete assignments independently [16]. Also, it fosters metacognitive awareness since students practice coregulation, working together to oversee and control their writing processes [17]. Besides the cognitive impact, the positive involvement during the occurring process has been observed dynamically [18]. Additionally, research suggests that the process helps students become more proficient in managing feedback, interacting with peers, and self-correction [19]. Essentially, writing teachers may establish a dynamic learning environment where students feel engaged and challenged to writing growth and succeed more in academic writing by including collaborative writing as a step in SRWA.

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Concern about the fast growth of digital tools and Web 2.0 apps over the past ten years, the landscape of writing instruction has been vastly transformed by the emergence of Technology-Assisted Writing Collaboratively (TECW) and Utilization of Computers in Collaborative Writing (CMCW), leading to significant contributions to the teaching and learning process in writing classes [20]. Studies like Ubaldo have demonstrated the favorable effects of TECW platforms, such as Google Docs, on EFL students' writing outcomes [21]. For example, the platform's real-time co-editing function encourages active participation and shared responsibility during writing. Saeed and Alharbi [22] mention that this collaborative environment develops better critical thinking and idea negotiation, in which students learn to negotiate difficult concepts and hone their arguments through peer engagement. Moreover, CMCW resources such as e-platforms and online forums facilitate asynchronous collaboration, expanding the reach of education beyond traditional classroom settings and encouraging self-regulated learning via iterative revision cycles and peer evaluation [23]. The flexibility and accessibility of these tools empower students to take ownership of their writing growth, establishing a learner-centered atmosphere that traditional, teacher-centric methods sometimes struggle to achieve [24]. As a result, TECW and CMCW provide priceless opportunities to improve writing instruction in modern classrooms, encouraging group projects and individual skills growth.

TECW and CMCW have been essential components of successful writing pedagogy for many years. However, with the advent of mobile technology, a new age known as Mobile-Mediated Collaborative Writing (MMCW) has begun. Utilizing the accessibility and ubiquity of smartphones and tablets, this novel approach, studied in studies such as [25], creates dynamic and captivating writing environments. MMCW systems like collaborative document editors and real-time messaging applications let students engage together on writing duties anytime, anywhere, generating a sense of constant connection and sharing purpose [26]. Because of this immediacy, it makes brainstorming sessions, peer reviews, and revision cycles easier, enhancing critical thinking and problem-solving abilities [27]. MMCW then enhances student autonomy and self-regulation as learners take responsibility for their writing schedules and collaborative strategies inside the mobile space [28]. Additionally, the adaptability of MMCW facilitates a range of engagement styles and asynchronous contributions that meet the needs of individual students. It also promotes inclusion in the classroom [29]. MMCW offers tools to improve group instruction and make students competent writers in a mobile-first society.

While the benefits of mobile-mediated collaborative writing for students are gaining recognition, incorporating mobile platforms into self-regulated writing activities remains inconclusive in global and Indonesian educational settings. Also, existing studies often focus on broader outcomes like writing performance or motivation, neglecting the specific influence of mobile platforms and artificial intelligence [30] in self-regulation analytical framework [31] on the quality of writing, like grammar, vocabulary, and fluency [32]. Moreover, the unique affordances of mobile technology, such as real-time interaction, multimedia integration, and accessibility, are rarely explored concerning their potential for skill development [33, 34]. Addressing this gap is critical to fully evaluate the effectiveness of integrating mobile platforms on collaborative writing for enhancing students' linguistic proficiency. The research aims to bridge the gap by examining how mobile-mediated collaborative writing activities can support students' writing in self-regulated writing activities. By delving deeper into the intricate relationship between the combination of collaborative writing skills and self-regulatory development, the study provides valuable insights for educators seeking to leverage the potential of mobile technology to foster and empower foreign language students' process and self-regulation learning to take control of their writing journey. In professional and academic undertakings, it provides great potential to improve student's writing skills, digital literacy, and collaborative abilities by integrating mobile-mediated collaborative writing into self-regulated writing tasks. The study would like to answer the following research questions:

1) Is there any significant difference in students' writing performance before and after incorporating mobile platforms into self-regulated writing activities?
2) How is the quality of students' writing after mobile platforms integration into SRWA?
3) How do students perceive the mobile platform incorporation into SRWA?

II. Literature Review

This literature review presents the current status of the field study. It looks at how the integration might help foreign language students become more proficient writers, take control of their writing process, and feel confident while writing for academic purposes. In an attempt to improve students' writing abilities, many studies have focused more on promoting Self-Regulated Learning (SRL) activities instead of integrating MMCW with self-regulated writing exercises. We examine how the benefits of group learning combined with the adaptability of mobile devices might encourage helpful peer criticism, information sharing, and metacognitive development—all of which positively affect students' writing skills.

A. Self-Regulated Learning (SRL) and Academic Writing Performance

SRL is an important topic in writing, primarily due to the impact on students' outcomes in English as a foreign/second language. Several studies have investigated the correlation between SRL and writing outcomes. Peeters *et al.* [35] report that students' use of strategies of SRL and their academic achievements are significantly and positively correlated with the enhancement of computer-supported collaborative learning. SRL also influences academic writing, focusing on becoming primary controllers, self-initiators, and self-starters, preventing distractions, hurdles, challenges, and adversity [36]. In light of these contributions, implementing various SRL-writing-based instruction models is a valuable option for teachers aiming to enhance students writing performance [37–39]. For instance, Bai and Wang [40] demonstrate that

the self-regulated Reading-to-Write (R2W) approach, under self-regulation conditions, significantly enhanced writing skills.

Noticing that writing is often perceived as a complex and challenging task [41, 42], language teachers are recommended to equip students with strong self-regulation abilities to confidently handle any challenges in the writing process [43]. Moreover, it is crucial to elaborate on the interplay of factors influencing the optimum contribution of SRL to students' writing, including motivational beliefs [44] and growth mindset [45], to foster self-regulated writers in all three phases of the writing process. During these stages, students optimize their self-directed strategies for positioning writing materials and reviewing sample compositions before beginning a new assignment. While concentrating on writing development and quality, writing ideas and objectives are composed, and concepts are transformed into text. Their writing is evaluated and edited in the assessment stage using self and peer-assessment processes [46, 47].

Zimmerman theory of Self-Regulation Learning (SRL), a triadic process comprising foretaught, performance, and evaluation is adapted to address writing instructions. In the foretaught phase, students define precise writing objectives, gather necessary materials, and organize ideas [46]. The performance phase allows students to put their thoughts into written form through text-generating processes and use self-monitoring techniques to ensure writing is well punctuated, structured, and composed with appropriate words [48]. The evaluation phase provides the opportunity to review writing based on feedback or self-evaluation [49]. Addressing the diverse needs of English as a foreign/second language writing, comprehensive instructions should comprise multidimensional aspects, including cognitive [50], metacognitive [51], socio-behavioral [52], and motivational regulation [53]. Zhou and Hiver [5] define these aspects with the following operational actions. First, the cognitive element covers text processing and course memory, signifying the use of linguistic expertise to improve or revise written discourse and the voluntary recall of writing skills or knowledge from previous instruction. Second, the metacognitive aspect includes monitoring, evaluating, and idea planning, carried out to guide the writing process and organize also generate ideas before writing. The socio-behavioral aspect coincides with peer learning and feedback handling, which encourages students' collaboration in writing, and proactive acceptance of teacher or peer feedback. Lastly, motivational regulation includes enhancing interest, motivating self-talk, and emotional control during writing. Previous studies report that these four multidimensional aspects have a good impact on students' achievement in writing, reading, and mathematics at the elementary level in the Australian education context [54]. Moreover, the explicit instructions offer positive students' perspectives in response to their assessment and process of writing [3].

Self-regulated writing instructions, proposed by Harris *et al.* [55], have been integrated into writing classroom practices: (1) Activating background knowledge comprises teachers and students, promoting the integration of prior knowledge into the present material. (2) Discussing writing strategies encourages conversations about how students could apply specific techniques to achieve particular writing objectives, including writing more proficiently and flexibly. (3) Modelling the strategy entails teachers demonstrating an effective writing process, using think-aloud, self-talk, and self-instruction techniques. (4) Memorizing the strategy urges teachers and students to summarize the technique in mnemonic sentences for easier recall. (5) Supporting the strategy offers opportunities for teachers and fellow students to provide prompts, encouragement, constructive criticism, and direct assistance. (6) Independence work focuses on the students' ability to adopt the technique for a variety of tasks. In the context of this study, stages one through five are implemented due to the pedagogical benefits and effectiveness offered by collaboration work [13]. Previous studies have also shown the significant impact of peer interactions, teacher guidance, and supportive materials [56–58].

B. Mobile Platforms into Collaborative Writing

Collaborative Writing (CW) for English as an EFL/ESL students has offered significant pedagogical benefits for writing performance [13, 59]. Li and Zhu [60] report that activities, including interaction and discussion in collaborative writing positively influenced writing outcomes. Other studies have also demonstrated that dynamic and positive engagement among members participating in collaborative activities results in higher-quality written work [18]. In classroom practices, CW indicates that students' competency can be enhanced through peer handling, feedback management, and self-correction [19]. As current needs of the teaching and learning process, the role of artificial intelligence provides positive contributions to the CW process both in online and face-to-face meetings [61, 62]

According to Storch [13], developing Web 2.0 technologies like Google Docs and Wikis enabled collaborative text creation and sharing activities, leading to unique literacy practices. These practices are becoming increasingly important in the teaching and learning process. From the conceptual theories of Technology-Enhanced and Computer-Based Collaborative Writing (TECW/CMCW), mobile devices have recently gained popularity as a preferred tool for learning support due to their features and user-friendliness [33]. Li [63] explains that Wikis and Google Docs, facilitating text collaboration and sharing activities, have given rise to new reading and writing techniques. One of the fundamental benefits of Web 2.0 tools is the ability of students to collaborate on text creation without being constrained by time or physical location. These programs also enable effective communication with co-authors online throughout the entire writing process, including co-writing, revising, and editing. Charoenchaikorn [64] corroborates that the utilization of Google Docs in collaborative writing allows students to discuss language use, establish plans, and edit documents, as well as provide and receive criticism using the comment feature.

Several platform features such as Google Docs, Wiki, and Blog are necessary to create a conducive atmosphere for writing classes and effectively implement MMCW in classroom activities benefiting both teachers and students. Previous studies have shown that applications should provide

various modes of convenient group interactions, including synchronous, inexpensive, convenient communication, remark, and discussion [65], asynchronously [66, 67] face-to-face meetings [68]. User-friendliness is another crucial factor in addition to nurturing classroom writing enjoyment. Abrams [69] defines Google Docs as the most favorable platform for writing due to its simplicity, stability, and availability. Selcuk *et al.* [70] state that the Facebook social media application offers beneficial features for collaborative writing such as chat discussion, video call, and resources sharing. Convenient writing and revising are also essential features for MMCW, as the writing process often entails multiple iterations. Various applications, such as Wiki, Google Docs, and Ether Pad, allow multiple users to write, edit, and revise simultaneously [71].

III. Materials And Methods

A mixed method investigation was employed in a university context to look into how mobile platforms integration into SRWA framework affects students' performance, writing quality, and their perceptions. A convenience sampling method was used to determine twenty participants who agreed to participate in the study. Tests of opinion essays, students' writing documents, and interview were collected during eight meetings that made up the data analysis. Every facet of the methodological framework would be covered in full in this section, offering a clear and concise information for comprehending the study procedure and its outcomes.

A. Research Design

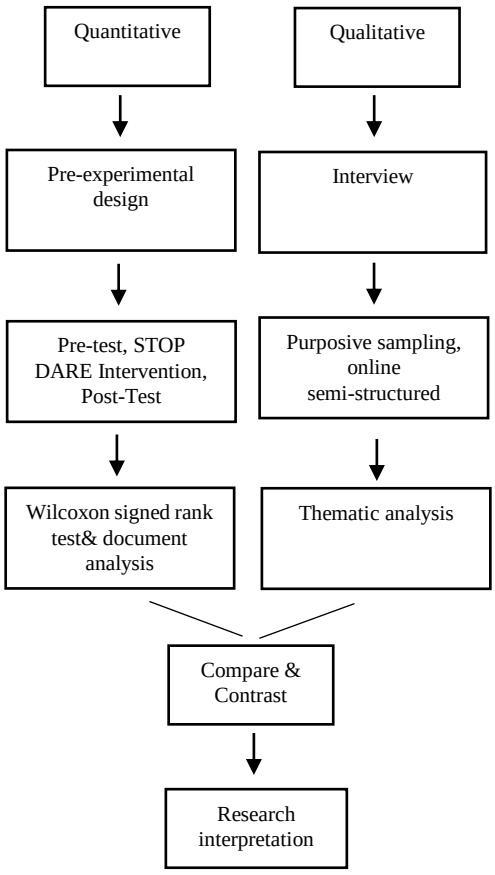

Fig. 1. Research flowchart.

This study employed a mixed method consisted of one-group pre-test and post-test quantitative research design. The aim was to investigate the effectiveness of incorporation of mobile platforms into self-regulated writing activities on students' essay writing skills. The qualitative research design includes, their document analysis to delve into their quality of writings and the qualitative research concerned on the semi-structured interviews during the data collection. Twenty sophomore students enrolled in a writing class which participated in assessing the effectiveness of a specific teaching intervention focused on enhancing their opinion essay writing skills. The research collected mixed both quantitative and qualitative data to gauge the impact of the intervention and their perceptions on classroom practices. The research started with pre-test, pedagogical intervention, and post-test of opinion essay. While in qualitative data, we interviewed participants from the result of the pre-test consisting of low, intermediate, and high-level students as it is indicated in Fig. 1.

B. Research Setting and Participants

This study was conducted in the Faculty of Teacher Training and Education (FTTE), presenting English as an obligatory course for pre-service teachers. This English course is presented in a hybrid learning mode. The university is a private institution with a multibackground-students profile, including gender, culture, language, and ethnicity. Moreover, the participants consisted of faculty members accompanied by sophomore students, namely four males and sixteen females who enrolled in the writing class as an academic needs course for their fulfillment of learning. In a further section, six selected students were identified (purposive sampling) to attend semi-structured interviews as indicated in Table 1.

Table 1. Research participant of interview section

Participant code	Gender	Proficiency
S1	Female	Low
S2	Female	High
S3	Male	High
S4	Female	Moderate
S5	Male	Low
S6	Female	Moderate

C. Data Collection

The research consisted of quantitative phase and qualitative phase data collection. In the quantitative phase, data collection, and pre-test and post-test were administered to the participants in order to evaluate the effectiveness of mobile platforms incorporation into self-regulated writing activities in enhancing students' writing performance and their writing quality. The pre-test was conducted during the first-class session, while the post-test was carried out after pedagogical mediation. Both tests had similar tasks of opinion essay, time allowed for completion (50 minutes), the word length of the composition (250–300 words), and the collaborative writing format (pair work). The pedagogical interventions as shown in Table 2.

Table 2 shows that the teachers provide a real-time collaborative platform for both tests to compose opinion essays. In the pre-test (M1), students are instructed to write an

essay (M2) on a blank virtual worksheet, using their background knowledge of essay writing and knowledge of the platform. In the pedagogical intervention (M3–7), several mobile platforms were used to accommodate stages of self-regulated writing activities in promoting students' writing both in face-to-face and online learning modes. In the post-test (M8), the virtual worksheet is attached to instructional or procedural steps, guiding students from the initial stage to the submission process.

Table 2. Pedagogical intervention of mobile platforms incorporation into self-regulated writing activities

M	Stages	Learning mode	Mobile Platforms
1	Pre-test	Face-to-Face	Google Docs, PowerPoint presentation
2	Activate students' background knowledge of opinion essay	Online	Zoom applications, Google forms, Google slides
3	Discuss the writing strategy	Face-to-Face	Google slides, YouTube, and Canva
4	Model the writing strategy	Face-to-Face	Google slides, YouTube, and Canva
5	Memorise the writing strategy	Online	Google docs and Google meet
6	Support the writing strategy	Face-to-Face	Google Docs, Canva, PowerPoint Presentation
7	Activity continuation of supporting stage	Online	Google Docs, Canva, PowerPoint Presentation
8	Post-test	Face-to-Face	Google Docs

D. Data Analysis

Data collection was systematically conducted through intervention and interviews, and all the essays from students were analyzed using a quantitative approach while the qualitative data were analyzed using thematic analysis. The progress of writing performance was calculated by comparing pre-test and post-test scores. After obtaining both sets of scores, the Wilcoxon signed rank test using SPSS 23, was conducted to assess differences in scores. These differences helped to determine the effectiveness of mobile platform incorporation into self-regulated writing activities for improving students' writings. In addition, the selected essays were graded using the "ESL Composition Profile," a rubric for scoring essays adopted from Hartfiel *et al.* (1985). This rubric focuses on various writing elements, including content, organization, mechanics, vocabulary, and language use. It is designed with a minimum score of 2 and a maximum score of 30 to evaluate the essays holistically. The criteria within the rubric are classified into several indicators, namely very poor, fair to poor, good to average, and excellent to very good. To assess the writings, raters were selected based on professional expertise, years of experience (at least one year of teaching writing), and availability. In addition to the thematic analysis, individual semi-structured interviews were recorded, transcribed, and then translated into English for further data analysis. Member checking processes were employed to further evaluate the interview data's accuracy. Furthermore, to ensure accuracy, the interview questions were explained to the participants during the interview session. The transcripts of the interviews were also provided to the students so that they could review the accuracy of the information.

IV. Result and Discussion

The following paragraph delves into the central issue of our research, exploring the quantitative and qualitative outcomes of incorporating mobile platforms into self-regulated writing activities of students and describing the subsequent changes and perceptions in their academic writing performance. We provide a nuanced view of how mobile platforms affect the many facets of student writing by looking at descriptive statistics in addition to quantitative outcomes. In addition, we also provide the students' perceptions on their new experiences of mobile platforms incorporation into SRWA. The practice allows us to construct a complete picture of how effective mobile platforms are in incorporation into self-regulated writing activities in response to their writing performance, quality, and perceptions.

A. Results

1) Does the integration of mobile platforms into self-regulated writing activities significantly improve efl students' performance?

A quantitative approach with SPSS was used to calculate the difference between pre-test and post-test scores in order to assess the effectiveness of MMCW incorporation into self-regulated writing activities in enhancing writing performance. The tests comprised several steps of non-parametric statistical analysis, including score categorization, rank analysis, and non-parametric Wilcoxon signed rank test. Score categorization was utilized to analyze students' performance in the pre-test and post-test of academic writing, as shown in Table 3.

Table 3. Writing scores of pre-tests and post-tests

No	Scores Category	Pre-Test (%)	Post-Test (%)
1	Low	20	0
2	Intermediate	30	30
3	High	50	70

Table 3 presents that students' academic writing essays are categorized into three, namely low, moderate, and high. It is observed that 20 percent of students (in pairs) had low scores in opinion essays for the pre-test, while there is no data for the post-test. Students in the moderate tier show a consistent score of 30 percent in the post-test. In the high tier, 70 percent and 50 percent are respectively obtained for the post-test and pre-test. These results indicates that there is an improvement in students' opinion writings from the pre-test to the post-test. In addition to writing scores, further analysis reveals that 0 (zero score) for negative rank found which means that there is no research participant who decrease their scores from pre-to post-test. In positive rank, it is figured out that the M=5.50 and ties is 0 which means there is no similar scores between pre-test and post-test.

Furthermore, the value of the Wilcoxon signed-rank test statistic equals –2.814 and that the p-value equals 0.005

which is less than 0.05 (0.005<0.05), this indicates that there is a significant difference between the pre-test and post-test of opinion essay in academic writing after incorporation mobile platforms in self-regulated writing activities, this means that H_0 is not accepted (there is no significant difference after incorporating mobile platforms into self-regulated writing activities to promote students' writing).

2) How is the quality of students' writing after incorporating mobile platforms into SRWA intervention?

The essays from both the pre-test and post-tests were evaluated by two writing raters, each of them with at least one year of work experience in a university writing center. The essays were assessed using a standardized rubric commonly used to evaluate academic essays, as presented in the following table.

Table 4. Descriptive statistics of students' opinion essay

Variable	Pre-Test		Post-Test	
	M	SD	M	SD
Rater's essay evaluation	71.2	8.42	80.8	9.95
Content	16.8	2.35	20.6	2.27
Organisation	16.5	1.35	17.7	0.48
Vocabulary	17.6	2.84	18.6	2.98
Language Use	16.7	2.67	19.6	3.66
Mechanics	3.40	0.67	4.30	0.82

Table 4 points out that the average scores between the essays in the pre-test and post-test are expected to be significantly different. Five aspects of essays are identified concisely for both tests. The most significant increase resulting from the pedagogical mediation of MMCW within the self-regulated writing activities is observed in the content of the students' essays. It is evident that the post-test provides significantly better results (M = 20.6 SD = 2.27) compared to the post-test (M = 16.8 SD 2.35), with an average difference score of 3.80 after the implementation of the pedagogical intervention. The usage of language in the opinion essays also indicate impressive increase, with an average score difference of 2.90 between the pre-test (M = 16.7) and post-test (M = 19.6). Moreover, moderate effects are observed in the vocabulary and organization aspects of the essays. The students' vocabulary improves from the pre-test (M = 17.6) to the post-test (M = 18.6), and the organization aspect also shows a slight increase, with the pre-test (M = 16.5, SD = 1.35) and post-test (M = 17.7, SD = 0.48) indicating an average score of 1.2. Conversely, the lowest level of improvement occurred in the mechanics, with consistent results in both the pre-test (M = 3.40, SD = 0.67) and post-test (M = 4.30, SD = 0.82). This indicates that students' understanding of mechanics is already well-established both before and after pedagogical intervention. Overall quality of students' writing increase impressively which is indicated from pre-test and post-test.

3) How do students perceive on mobile platforms incorporation into SRWA?

The research question is pinpointed to answer on EFL students' perceptions in mobile platforms in SRWA during writing class. Based on interview data, we found four classified data to be elaborated in Table 5.

Table 5. Students' perceptions of mobile platforms incorporation into self-regulated writing activities

	Experiences	Challenges	Strategies
Pedagogical	Utilization of mobile platforms in composing collaborative writings, editing, self-assessing, and commenting	Recognition of mobile platforms used in pedagogical frameworks	Tutorial watching, peer learning, and practice
Technological	Comprehension of operating platforms in classroom practices to compose good writing collaboratively	Students' grit and adaptivity of learn technology for classroom practices	Peer learning, practice, and trial-error simulation
Individual	• Students' joyment of writing collaboratively inside and outside classroom activities • differentiated learning pace in hybrid mode	Students' time management to accomplish all steps in writing process Students' learning loss due to the pandemic Covid-19 so that they need learn everything from the beginning (linguistics, critical thinking, and creativity)	Students' survival on the writing process, peer learning, and expert discussion
Institutional	Positive campus facilitation and effort in nurturing the digital mode of learning Feasibility of self-report assessment for students	Lack of internet connection, academic resources, 1on 1 teacher's supervision	Facilities upgrade to technology savvy learning, self-access learning centre, and academic resources subscription as plan

Table 5 informs us about students' experiences on implementing mobile platforms into the framework of SRWA. The research data reveal students' experiences, challenges, and strategies in their classroom activities. Regarding pedagogical viewpoints, students experience new things in the utilization of mobile platforms in the framework of SRWA instead of their survival of recognizing the technology items for their learning through tutorial watching, classroom discussion and more practice to be savvy technology users. In addition, technological experience shows that students are adaptive enough in comprehending to operate new mobile platforms used in self-regulated writing activities. It is indicated that they try their best to do trial-error simulations to accomplish good writing as part of their goal setting.

Moreover, about the individual experiences, it is figured out that incorporating mobile platforms into self-regulated writing activities nurtures students' writing joyment and is relevant to their needs in terms of adaptive learning atmosphere and differentiated learning pace. It is captured that they can tackle COVID-19 learning loss through

engaging self-regulated writing activities, peer learning and teacher-student discussion. Lastly, institutional challenges reveal lack of internet connection, academic resources, and teacher supervision are found during classroom practices. The campus responded these challenges through facilities upgrading, self-access learning center provision, and open access academic resources which is briefly mentioned by the interviewee. In terms of experience, [S3] mentioned, "*I am very pleased to operate the features of Google docs in writing collaboratively with my mate. I can interact, discuss, and revise our works […] the quality of our writing" [S3]*

Beside new experiences, students also faced challenges in implementing mobile platforms incorporation into SRWA during the writing process. These challenges included difficult time management, learning loss, and awareness which is all represented in the comment below.

I felt that I suffered learning loss due to the Covid-19 Pandemic; firstly it was so stressful […] procedures on how to write opinion essay, it helped me very much [S1]

To cope with their challenges, students seemed to decide their learning strategies in mobile platforms incorporation into SRWA through platform practice, professional development watching, and self-practice outside the classroom hours. [S6] mentioned that "*I was struggling on using the features on Google docs in the beginning […] as well as the comments. And finally, I can do that for my writing process" [S6]*

B. Discussion

This study investigates the effectiveness of the mobile platforms' incorporation into self-regulated writing in classroom practices and explores students' perceptions on implementing it. The results show that both the quantitative and qualitative research findings are indeed beneficial.

There is an improvement in writing skills after the pedagogical intervention of incorporating mobile platforms into SRWA. Students become more comprehensive in essay writing after classroom mediation and incorporate more writing aspects into their works than before. These results are consistent with [38, 72–74] which indicate subsequent improvements of vocabulary, organizations, content, and language use in their writings.

Students also demonstrate growth in writing proficiency, as evidenced by the alteration in post-test writings. Incorporating mobile platforms into self-regulated writing activities is an explicit writing instruction that benefits students' performance. Polermo and Wilson [75] supported the idea that explicit writing instructions are beneficial for students in composing argumentative essay, signifying the importance of direct instructions in writing processes for classroom activities. Besides, explicit instructions are also effective in promoting writing performance [42] and self-regulation learning [76]. The results are relevant to previous studies in the following ways. Firstly, pedagogical intervention contributes to academic performance, particularly in writing skills at all levels of education. Self-regulated writing activities, particularly those about MMCW, are beneficial for writing outcomes from elementary levels [77, 78] through senior high school [79], and into tertiary education [80]. Secondly, the incorporation of technology had become a crucial need in the contemporary educational era, as it provides ease and flexibility. Previous studies have utilized various platforms to make classroom activities more meaningful and relevant to students' needs. Pertaining to technological needs, students are requested the enhancement of their capacities to facilitate classroom activities [81] to conduct collaborative writing, presentations, and assessments.

The incorporation of mobile platforms into self-regulated writing activities presents a comprehensive strategy that aligns with multiple fundamental psychological concepts, which could provide noteworthy advantages for EFL students. First of all, this intervention encourages students to collaborate and take charge of their writing process, which is in line with the self-determination theory's focus on intrinsic motivation and ownership [40]. Second, social engagement and peer learning are fostered by the real-time feedback and collaborative editing capabilities provided by mobile platforms used in classroom practices. Through shared knowledge and a range of viewpoints, these activities can improve metacognitive awareness [82]. Reflective practice is also made possible by the asynchronous and synchronous nature of MMCW, which lets students go back and edit their works at their own pace and develop a better awareness of their strengths and shortcomings [83]. An atmosphere that supports self-regulated learning is produced by the integration of autonomy, social contact, and reflection which raises student engagement and elevates writing abilities. However, it is crucial to acknowledge individual differences in learning styles and technological literacy, and further research is needed to explore the specific psychological mechanisms at play and tailor MMCW incorporation into SRWA interventions to diverse student populations.

V. Conclusion

In conclusion, this study aims to evaluate how effectively MMCW in self-regulated writing activities in enhancing students' writing performance and assess the quality of students' outcomes after the pedagogical intervention. Statistical analysis and measurement were conducted to address these objectives and obtain adequate results. Firstly, a non-parametric test reveals that the post-test of essays improve after pedagogical intervention, indicating that classroom activities comprising writing treatments, have an impact on writing performance. The study consisted of eight meeting interventions conducted within the framework of self-regulated writing activities, including activating background knowledge, discussing the writing strategy, as well as modeling, memorizing, and supporting the writing strategy. Collaborative writing with the enhancement of mobile devices was also expatiated, with a particular focus on supporting the writing strategy to foster collaborative work in opinion essays.

Five components of writing were assessed, including content, organization, language use, vocabulary, and mechanics. Based on the descriptive statistics for each aspect of writing, the average score for students' writing after pedagogical intervention improved from a "fair to poor"

status to "good to average". This indicates that the pedagogical intervention is a fruitful approach for English writing class. To do so, actualizing capacity-building programs for individuals and institutional socialization are recommended to revitalize the integration of mobile-mediated collaborative writing activities as one of the innovative models in writing class.

This study has several limitations despite offering valuable insights. A one-group pre-post design was adopted due to the exploratory nature of the study, with the primary objective of investigating whole-class writing training in a realistic setting. While the pedagogical intervention contributed to writing performance, the absence of a control group or group that received a different type of explicit instruction made it impossible to draw definitive conclusions. Moreover, the use of AI-powered tools in various stages of writing, from brainstorming and drafting to editing and proofreading did seemly not perform as well in classroom practices instead the use of learning media only. The current study focuses on the students' perceptions on how their experiences, challenges, and strategies run in the teaching and learning process, but the faculty members' perceptions are also demanded to provide insight and feedback as the classroom facilitator.

Future studies are recommended to explore the impact of explicit writing training on various genres for students at a similar educational level. Potential interactions between reading and writing could be investigated by conducting formative or summative assessments of reading proficiency, both before and after intervention. Nonetheless, the results were encouraging, implying that, in addition to whole-class instructions by the classroom teacher, explicit writing strategy instructions were also needed for higher education students. In the process of writing, incorporating artificial intelligence and concurrently students' self-regulation strategies are brilliant idea to fulfil students' needs to boost students' performance including generating ideas, correcting grammar, creativity, and critical thinking. The last not but the least, the holistic perceptions from faculty members is pretty required to gain the insightful perspectives and pedagogical provisions for the upcoming teaching and learning process.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Data collection and analysis, writing original draft, preparation, writing revision and editing (Ratnawati); Conceptualization, research preparation, supervision (Mukminatien), Responses to reviewers' comments, methodology, supervision, data instrument validation (Basthomi); research preparation, mobile platforms decision, data collection coordinator (Laksmi). All authors had approved the final version.

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