Developing 4C skills through scientific writing for labor readiness

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Abstract

The evolving demands of the labor market require technical skills, critical thinking, creativity, collaboration, and effective communication skills (4C skills). One supporting aspect of 4C skills is writing ability, which can assist students in effectively presenting information, expressing opinions, and communicating well. This community service activity aims to improve students' ability to produce quality scientific writing, develop 4C skills, and contribute to reducing unemployment through readiness to face the labor market. The workshop implementation method includes a preparation stage, an online workshop stage, and an evaluation stage. The results of the pre-test (M=80.00, SD=12.06) and post-test (M=87.83, SD=10.85) showed a p-value <0.001, indicating that the workshop activity successfully increased participants' knowledge and understanding of good scientific writing.

Keywords: Scientific writing; 4C skills; Writing ability

Pengembangan keterampilan 4C melalui penulisan karya ilmiah untuk kesiapan kerja

Abstrak

Tuntutan pasar kerja yang semakin berkembang tidak hanya membutuhkan keterampilan teknis, tetapi juga kemampuan berpikir kritis, kreativitas, kolaborasi, dan komunikasi yang efektif (keterampilan 4C). Salah satu penunjang keterampilan 4C adalah kemampuan menulis, yang dapat membantu mahasiswa dalam mempresentasikan informasi secara efektif, mengungkapkan pendapat, serta berkomunikasi dengan baik. Kegiatan pengabdian ini bertujuan untuk meningkatkan kemampuan mahasiswa dalam menghasilkan karya tulis ilmiah yang berkualitas, mengembangkan keterampilan 4C, dan berkontribusi dalam mengurangi pengangguran melalui kesiapan menghadapi pasar tenaga kerja. Metode pelaksanaan workshop mencakup tahap persiapan, tahap workshop online, serta tahap evaluasi. Hasil pre-test (M=80.00, SD=12.06) dan post-test (M=87.83, SD=10.85) yang menunjukkan nilai p-value <0,001 yang menunjukkan kegiatan workshop berhasil meningkatkan pengetahuan dan pemahaman peserta terkait menulis karya ilmiah yang baik.

Kata Kunci: *Karya tulis ilmiah; Keterampilan 4C; Kemampuan menulis*

1. Introduction

Unemployment represents a persistent and multifaceted socio-economic challenge confronting nations worldwide (Setiawan et al., 2024). Its impact extends beyond mere economic indicators, influencing social stability, public health, and the overall well-

being of communities. Therefore, thoroughly understanding its contributing factors and developing effective mitigation strategies remain a high priority for policymakers and researchers alike. Within the Indonesian context, the open unemployment rate in February 2024 was reported at 4.82% of the total labor force, representing a significant segment of 149.38 million individuals actively seeking employment opportunities. While this figure reflects a marginal improvement, indicated by a decrease of 0.63% compared to the corresponding period in February 2023, the persistent presence of unemployment necessitates a deeper examination of the underlying structural and individual factors contributing to this ongoing societal concern.

The roots of unemployment in Indonesia are complex and interconnected, stemming from various sources. One key challenge lies in the perceived lack of both soft skills and technical (hard) skills among job seekers, often rendering them ill-prepared for the specific demands of the modern, rapidly evolving job market. This skills deficit is further compounded by structural imbalances in the supply and demand of labor, characterized by regional disparities, sectoral shortages, and mismatches between the qualifications possessed by job seekers and the requirements articulated by employers. Furthermore, inequalities in access to quality education, comprehensive vocational training programs, and targeted professional development opportunities perpetuate the cycle of unemployment and limit individuals' ability to acquire the competencies needed to compete effectively in the labor market. Compounding these factors, asymmetries in access to information regarding available job openings, emerging industry trends, and relevant career pathways, along with persistent concerns about inadequate wage levels that often fail to provide sufficient compensation for the workloads and responsibilities inherent in many occupations, further exacerbate the vulnerabilities of job seekers and contribute to the overall unemployment rate (Permadhy & Sugianto, 2020). Inadequate educational infrastructure, marked by insufficient school facilities, limited access to relevant learning resources, and a general lack of supportive and enriching learning environments, diminishes student motivation and hinders the development of essential skills necessary for future employment prospects. These factors, coupled with broader environmental conditions that may not adequately support educational attainment and skill acquisition, create complex challenges for individuals seeking to enter or advance within the Indonesian workforce.

A high unemployment rate has far-reaching consequences, extending beyond individual economic hardship and impacting the broader societal fabric. It significantly hinders progress toward achieving Sustainable Development Goal (SDG) 8, which promotes sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all (Ponto, 2023). Widespread unemployment undermines public purchasing power, leading to a decline in the consumption component of the gross domestic product (GDP), a key indicator of national economic health (Sejati, 2020). This decrease in economic activity further reduces government tax revenues, potentially restricting public spending for essential development and social welfare programs, thereby impeding broader efforts to improve the quality of life for all citizens.

The imbalance between labor supply and demand contributes to a skills gap (Hasibuan & Handayani, 2021), where companies struggle to find qualified employees and job seekers lack appropriate opportunities. This mismatch underscores the need for targeted interventions to align educational curricula with industry needs better and enhance the

employability of Indonesian graduates. Compounding the issue is the increasing prevalence of automation. Rapid technological advancements are displacing workers lacking the skills to adapt to new roles and operate alongside advanced technologies (Harahap, 2019). This necessitates continuous upskilling and reskilling initiatives to equip the workforce with the expertise required to thrive in a rapidly changing technological landscape. The 21st-century labor market increasingly demands a wider skill set beyond technical expertise, encompassing critical thinking, creativity, collaboration, and effective communication (Mashudi, 2021). To ensure graduates are well-prepared for the dynamic nature of the modern economy, developing these 21st-century skills, including soft skills (Sugeng & Suryani, 2023), and a strong foundation in core competencies. The "4Cs" – communication, collaboration, critical thinking, and creativity – have emerged as a widely recognized framework for defining the essential skills for success in the 21st century (Cahyaningtyas et al., 2023; Soepriyanto, 2018).

Cultivating the 4Cs in students is essential for enhancing academic performance, career preparation and effectively addressing challenges in the professional world (Harmelia et al., 2023; Ru'iya et al., 2024). These skills support students' intellectual development (Pramudita et al., 2021), fostering the capacity for critical analysis and innovative problem-solving. They promote unconventional thinking (Sembiring et al., 2023), encouraging students to challenge assumptions and generate original solutions. Moreover, these skills facilitate the practical expression of ideas and information, enhancing written and oral communication abilities and enabling effective teamwork (Sanjayanti et al., 2020). Fostering collaborative synergy and promoting shared understanding. Writing proficiency, in particular, plays a foundational role in developing the 4Cs, assisting students in presenting information effectively, articulating their opinions persuasively, and communicating clearly and concisely across various contexts (Sholikha & Fitrayati, 2021).

Beyond its role in cultivating the 4Cs, strong writing skills are also critical for completing academic assignments and achieving overall academic success. Writing a thesis or dissertation allows students to apply their knowledge and 4C skills (Purnamasari, 2023), presenting research findings, analysis, and arguments clearly and systematically through scholarly work (Zahro' et al., 2025). As such, the final assignment transcends its role as a mere graduation requirement. It is a comprehensive portfolio demonstrating the student's academic competencies, analytical abilities, and communication skills to potential employers. Therefore, developing strong writing skills to develop language proficiency, communicate effectively, and produce high-quality written work is needed to cultivate these essential competencies.

However, writing scholarly work presents several challenges, encompassing theoretical, practical, and personal aspects (Khoiri, 2024). From a theoretical standpoint, a writer must comprehensively understand the principles and best practices of academic writing. This includes mastering elements such as logical argumentation, rigorous analysis, stylistic conventions, and effective use of evidence. Beyond theoretical knowledge, practical application is crucial. Writers must practice regularly to refine their skills and develop fluency in their writing. The research process also presents practical difficulties for students. These difficulties include a lack of understanding of scholarly writing conventions, such as citation styles and formatting guidelines (Nurgiansah, 2020), challenges in forming productive collaborations with suitable research partners, and challenges in developing coherent and well-supported arguments that align with the

research topic and address the urgency of the research problem (Budhyani & Angendari, 2021).

To address these challenges and support student success, the project team conducted a series of sustained academic writing support activities through workshops. These workshops gave students the skills and knowledge necessary to navigate the complexities of scholarly communication and produce high-quality written work. This approach is supported by prior research, which indicates that training in scientific writing can enhance 21st-century skills, fostering critical thinking, problem-solving, and practical communication abilities. Moreover, scientific writing promotes student independence (Kraus et al., 2022) by empowering students to take ownership of their research and deepen their understanding of research methodologies (Hand et al., 2021). Through academic writing workshops, students can increase their interest in and attention to writing scientific articles, improve their understanding of proper citation practices, and increase their knowledge of publishing articles in reputable journals (Rahman et al., 2023). Assignments and feedback from experienced mentors in this workshop will allow participants to improve their writing. With these assignments, students will become more proficient in writing scientific papers (Sutriawan et al., 2023).

Table 1. Workshop activities

No	Activity Stage	Activities
1	Activity design	The workshop's initial tasks included preparing the required documents to conduct it and creating a timeline for the event.
2	Participant recruitment	A poster containing a registration form for the workshop was distributed. Registration was closed as soon as a quota of 100 participants was reached.
3	Online workshop delivery	The workshop was conducted online through Zoom Meeting, with five sessions from June 2, 2024, to August 17, 2024.
4	Workshop content	The online workshop included the following topics: a. Identifying quality literature b. Using Mendeley c. Avoiding plagiarism d. Identifying research ideas and writing introductions e. Literature review f. Research methods g. Results and discussion, conclusions h. Bibliography i. Tips presentation and thesis review
5	Participant assignments	Participants were assigned tasks corresponding to the material covered in each session to ensure the program's relevance and effectiveness. Personalized feedback was provided for each assignment.

2. Method

This academic writing workshop was conducted online via Zoom Meeting. The participants (n = 78) were undergraduate students from several Indonesian universities, including Universitas Negeri Malang, UIN Maulana Malik Ibrahim Malang, Universitas Jember, Universitas Lambung Mangkurat, and Universitas Merdeka Malang. The project activities comprised preparation and materials development, workshop

implementation, assignment completion with feedback, and pre-and post-training assessment.

The initial phase involved preparing and developing all workshop materials. The project team discussed the workshop schedule and identified subject matter experts to present the prepared materials. Upon reaching an agreement on the schedule and securing presenters, the workshop commenced.

Participants completed assignments related to the presented material to ensure alignment with the learning objectives, and personalized feedback was provided for each submission. Pre-tests and post-tests were administered before the initial session and after the final session to measure changes in participants' knowledge and skills. Table 1 summarizes the program components.

3. Results and Discussion

3.1. Analysis of materials and quiz results for each session

3.1.1. *Session 1: Identifying quality literature and using mendeley*

The first academic writing workshop session was held online via Zoom Meeting on June 2, 2024, focusing on identifying quality literature and using Mendeley (Figure 1). Two speakers presented the workshop. The first speaker, Ani Wilujeng Suryani, S.E., M.Acctg. Fin., Ph.D., addressed "Identifying Quality Literature." This material is fundamental to academic writing, as literature provides reliable references for researchers. High-quality literature enables researchers to obtain valid information and data for their scholarly work (Riswanto et al., 2023).

The second speaker, Nabila Septiani, S.E., discussed "Using Mendeley," highlighting the benefits of this reference management tool for researchers. The presenter emphasized the importance of Mendeley in simplifying the citation process and demonstrated its functionality. Using Mendeley saves users time constructing bibliographies and facilitates easier and more organized referencing (Aswar & Faraz, 2023; Hidayatullah et al., 2022). The workshop incorporated interactive elements, including a discussion session following the presentations.
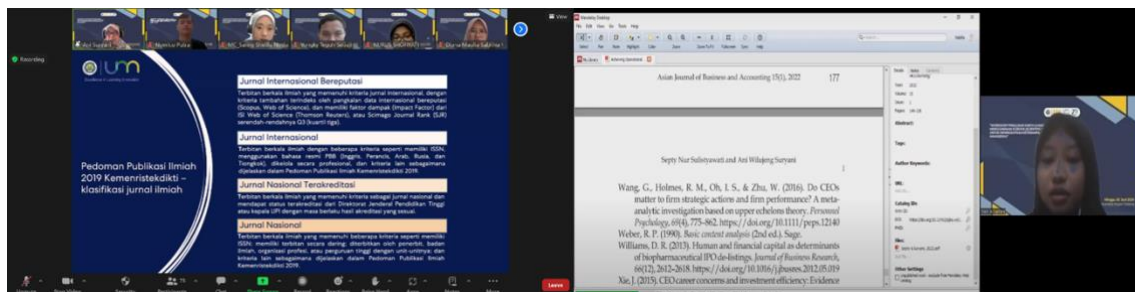

Figure 1. Mendeley workshop

To assess participants' understanding of the presented material, they completed a quiz using the Quizizz application, which provided a more engaging and interactive learning experience and allowed participants to view their scores immediately. In the first session's quiz (Figure 2), 66 participants actively engaged. The average score accuracy across the 10 questions was 65% (Table 2). To incentivize participation and recognize

achievement, the project team provided rewards in the form of mobile phone credits to the three participants with the highest quiz scores.

Table 2. Quiz results for session 1

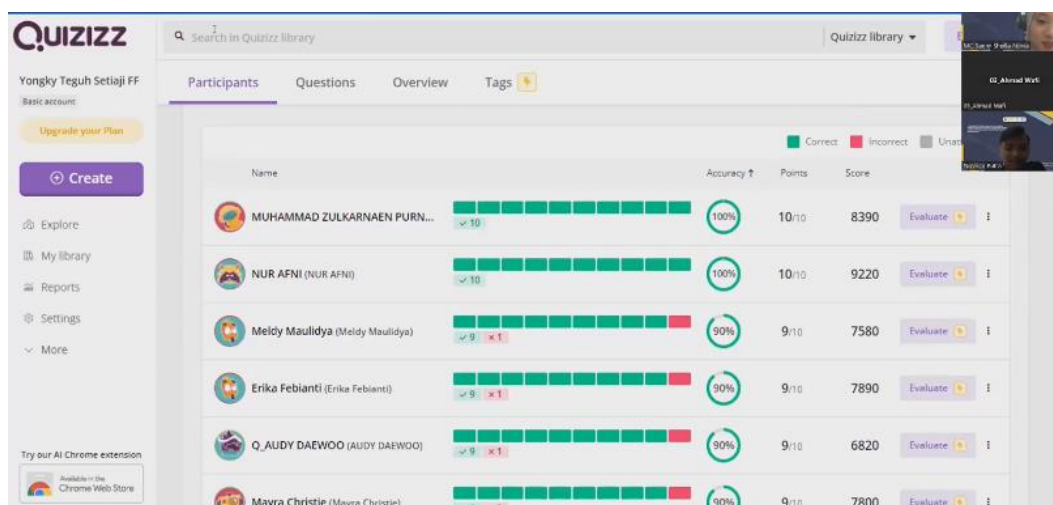| Description	Result
Participating students	66
Number of Questions	10
Average score accuracy	65%

Figure 2. Quizizz results for workshop session 1

3.1.2. *Session 2: Avoiding plagiarism and identifying research ideas & writing introductions*

The second academic writing workshop session was held online via Zoom Meeting on June 8, 2024, focusing on avoiding plagiarism, generating research ideas, and writing introductions (Figure 3). Two speakers presented during this session. The first speaker, Ika Putri Larasati, S.E., M. Com, Ak., addressed the topic of "Avoiding Plagiarism." This is a crucial topic, as plagiarism is unethical and carries significant consequences. Plagiarism involves failing to cite sources when using others' work (Maulana & Darmawan, 2023), and is an important element in research ethics and academic integrity (Zimba & Gasparyan, 2021). Prior research suggests that avoiding plagiarism enhances the value of published research by ensuring originality (Mehta et al., 2022). Therefore, students must understand and avoid plagiarism by acknowledging others' work, providing appropriate citations, and using original ideas in their research.
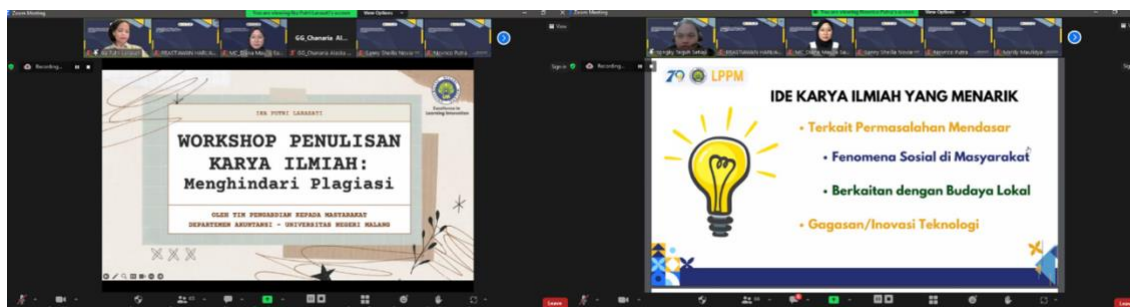

Figure 3. Avoiding plagiarism workshop

The second speaker, Yongky Teguh Setiaji, S.Pd, discussed "Identifying Research Ideas & Writing Introductions," explaining the relationship between research ideas and

introductions. Research ideas provide the foundation for the introduction, which should elaborate on the chosen topic and justify the research (Syaputra et al., 2021). The workshop featured interactive discussions following each presentation.

The second session quiz (Figure 4), had 50 participants. The average score accuracy across the 10 questions was 74% (Table 3), representing an increase from the previous session. The three participants with the highest quiz scores received mobile phone credit as a reward.

Figure 4. Quizizz results for workshop session 2

Table 3. Quiz results for session 2

Description	Result
Participating students	50
Number of questions	10
Average score accuracy	74%

3.1.3. *Session 3: Literature review and research methods*

The third academic writing workshop session was held online via Zoom Meeting on June 22, 2024, focusing on literature review and research methods (Figure 5). Two speakers led the session. Endah Nur Amalina, S.Pd, discussed "Literature Review," focusing on constructing a comprehensive review. This material is essential, as the literature review provides the foundation and rationale for research topics and titles (Ridwan et al., 2021). By mastering the process of literature review, researchers can create accurate and appropriate reviews based on established guidelines (Aprilyada et al., 2023).

Nuriah Muyassaroh, S.Pd., then presented on "Research Methods," covering types, characteristics, procedures, and writing structures. The presentation included examples to illustrate the use and differences between various research methods, allowing students to select methods appropriate for their research carefully. A strong understanding of research methods enables students to plan research effectively, collect and analyze data accurately, use relevant sources, and construct robust arguments in their research (Liriwati, 2023). The workshop incorporated interactive elements, including question-and-answer sessions.
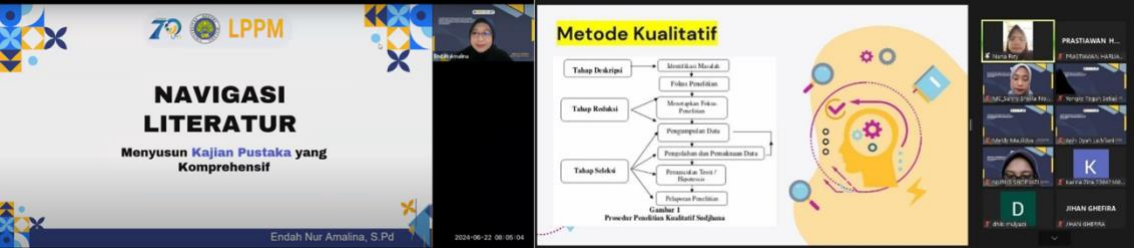
Figure 5. Literature review and research method workshop

Table 4. Quiz results for session 3

Description	Result
Participating Students	31
Number of Questions	10
Average Score Accuracy	75%

Thirty-one participants took the third quiz (Figure 6), on "Literature Review and Research Methods. The Participants achieved an average score accuracy of 75% (Table 4). As recognition for their efforts, the top three participants with the highest scores received mobile phone credit from the project team.

Figure 6. Quizizz results for workshop session 3

3.1.4. *Session 4: Results, discussion, conclusions, and bibliography*

The fourth academic writing workshop session was held online via Zoom Meeting on July 6, 2024, focusing on results, discussion, conclusions, and bibliographies (Figure 7). Anindyah Lutfiani, SE., led the session. The presentation explained the content and offered tips on writing results and discussion sections, enabling participants to understand what these sections should include. The speaker also outlined the differences between results and discussion sections in qualitative, quantitative, and developmental research.

In addition to presenting the results and discussion material, the speaker explained the contents and tips for composing conclusions and provided examples of well-written conclusions. The presentation concluded with a discussion of reference management software, such as Mendeley, EndNote, and Zotero, to assist researchers in creating citations and bibliographies.

As in previous sessions, a Quizizz was administered at the end of the session to assess comprehension of the material (Figure 8). Thirty-two participants completed the quiz, achieving an average score accuracy of 75% (Table 5). The project team rewarded the three participants with the highest scores.

Figure 7. Workshop session 4

Table 5. Quiz results for session 4

Description	Result
Participating Students	32
Number of Questions	10
Average Score Accuracy	75%

Figure 8. Quizizz results for workshop session 4

3.1.5. *Session 5: Thesis presentation tips and final assignment review*

The fifth workshop session was held online via Zoom Meeting on August 17, 2024, focusing on thesis presentation tips and final assignment reviews (Figure 9). Two

speakers led the session. Yongky Teguh Setiaji, S.Pd., presented "Thesis Presentation Tips," covering presentation preparation, practice, handling questions, and post-presentation evaluation. Participants who had attended the workshop and revised their proposals were encouraged to enter academic writing competitions. The presentation covered essential aspects of the thesis presentation. Ika Putri Larasati, S.E., M. Com., presented "Final Assignment Review," which addressed common errors identified by the review team. The presentation covered the following errors: introductions starting too broadly, problems not supported by data, lack of justification for the research problem, failure to identify the research benefits, and inadequately detailed methods sections.
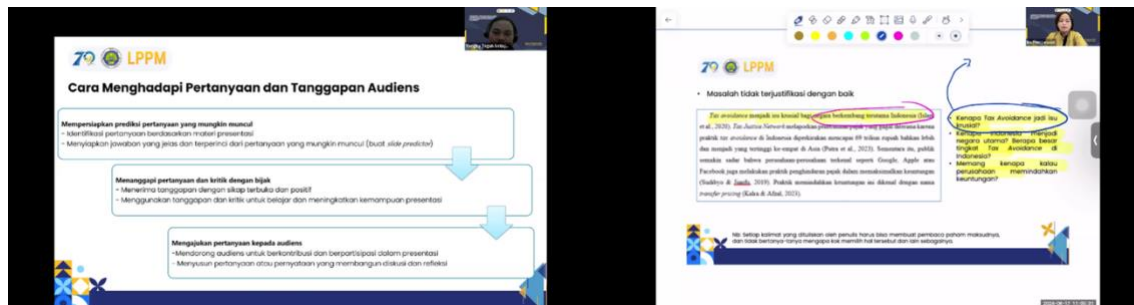

Figure 9. Workshop session 5

Participants who actively engaged with the assignments and submitted them received awards from the project team. Based on the proposal reviewers' evaluations, the top three participants were selected to receive certificates of achievement and special prizes. The final session concluded with an awards ceremony and a feedback session. The top three participants reported that the workshop provided engaging and valuable writing instruction. They noted that the assignments enhanced their writing skills.

3.2. Analysis of academic writing assignments

In addition to the workshop sessions, the project team assigned tasks to provide participants with practical training and experience. Assignments were given progressively throughout the sessions, with deadlines for completion. Completed assignments were submitted via Google Classroom, reviewed by the project team, and returned to participants for revision. The top three assignments were recognized at the end of the sessions, and participating students received rewards.

3.2.1. *Writing the introduction*

One of the key assignments in the workshop was the writing of introductions. This assignment was intended to build a strong foundation for the overall academic writing process. It enabled participants to formulate research questions, identify gaps in the existing literature, and develop specific research objectives. The assignment also honed critical thinking and logical argumentation skills. In short, the introduction is not merely the opening section of a scholarly work but a reflection of the author's understanding of the research topic.

The writing of the introduction was the first assignment given to participants during the workshop. Participants were asked to write ideas based on the themes given by the project team. Participants could use a provided template to facilitate the writing process. Completed assignments were submitted via Google Classroom, reviewed by the project team, and returned to the participants with feedback and corrections.

3.2.2. *Writing the literature review*

Following the introduction assignment, participants were tasked with writing a literature review, which involved collecting primary and secondary sources. The references were cited and presented as research findings, abstracted, and interpreted to generate new knowledge for concluding (Darmalaksana, 2020). This assignment provided tips for writing a literature review, which included summarizing various journals, books, and other documents to describe prior and current information about the research topic.

Writing a literature review involved identifying two or three keywords in the research title, focusing on key research ideas, and searching databases for sources (within the last 10 years). Participants then needed to identify reliable sources, either through university libraries or journal articles, and seek articles relevant to the research topic. Finally, the participants had to systematically and quantitatively summarize the themes present in the articles. Following these steps produces a well-written literature review.

3.2.3. *Writing the methods section*

The third and final assignment involved composing the research methods section. This assignment followed the third workshop session, which covered research methods. Armed with the knowledge gained from the Zoom Meeting session, students were expected to demonstrate an understanding of how to determine the appropriate research methods. This understanding enables students to plan research effectively, collect and analyze data accurately, use relevant sources, and develop strong arguments (Liriwati, 2023; Moskovitz et al., 2024).

Feedback was provided for the methods section through evaluation and proposal revisions. Furthermore, the three best proposals were selected to appreciate participants who successfully completed the assignments. This recognition encouraged participants to continue learning and developing other scholarly works.

3.3. Analysis of knowledge change

To assess participants' understanding of the workshop material, the project team administered pre-tests and post-tests containing questions relevant to the topics covered. The pre-test, administered before the workshop, assessed participants' baseline knowledge. The post-test, administered at the end of the workshop, measured the gains in knowledge and understanding. Both tests consisted of 10 multiple-choice questions designed to measure participants' comprehension levels.

Figure 10 shows the distribution of pre-test and post-test scores. The pre-test data indicated that 20% of participants scored below 70, while 80% scored above 70. This reflects a relatively low prior understanding of academic writing, attributable to participants' limited knowledge of proper writing conventions and limited practice. The post-test, administered at the end of the fifth session, showed a different pattern. 4% of participants scored less than 70, while 96% scored above 70. The histogram demonstrates that the workshop effectively enhanced participants' understanding of sound academic writing practices.

Data collected from the pre-tests and post-tests were analyzed using a paired t-test. This statistical test compares the means of two related groups. The paired t-test was used to examine the differences between pre-and post-training scores. The post-test results

showed an average score of 87.83 (Table 6), significantly higher than the pre-training score.
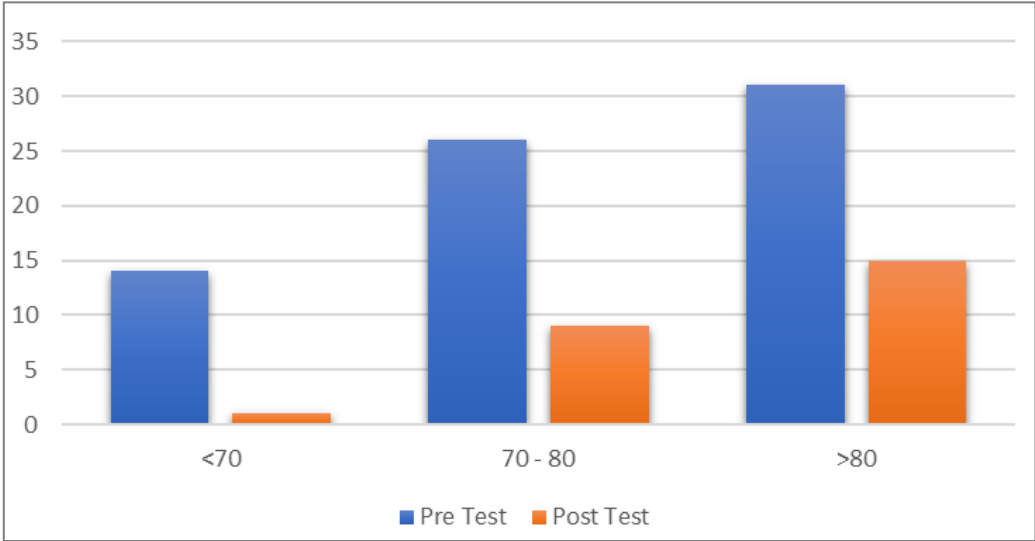

Figure 10. Distribution of pre-test and post-test scores

Table 6. Descriptive statistics for pre-test and post-test scores

	N	Min	Max	Mean	Std. Deviation	p-value
Pre-test	23	20	100	80.00	12.06	0.001
Post-test	23	40	100	87.83	10.85	

The significant difference between pre-test and post-test scores (Table 6) demonstrates that the workshop effectively improved participants' understanding and knowledge. This improvement will enable participants to produce higher-quality scholarly works, construct systematic arguments, and utilize relevant references. The enhancement of participants' skills and understanding aligns with prior research, which suggests that scientific writing can build knowledge through the elaboration of rationale (Sauer & Seuring, 2023; Silveira et al., 2022) and testing research questions (Leong et al., 2018; Oriokot et al., 2011). Moreover, scientific writing can increase student motivation, attention, and competencies, particularly in problem-solving (Makri & Neely, 2021; Mulyaningsih et al., 2022). Participants are expected to apply sound writing principles, ensuring that their work meets academic standards and contributes meaningfully to their respective fields.

4. Conclusion

This project aimed to improve participants' knowledge and understanding of effective academic writing, fostering essential 4C skills. These skills are vital for students as they enter the workforce, where soft skills are highly valued in addition to technical expertise. This project was conducted online through five Zoom Meeting sessions. Results indicated that the participants experienced improved writing skills, as demonstrated by their performance on assignments and the comparison of pre-test and post-test scores. Future projects should consider conducting the workshop in person, as the direct interaction between participants and instructors can provide benefits that are not easily

replicated in an online setting. In a face-to-face environment, participants have increased opportunities for discussion and can receive direct feedback, creating a more intensive and interactive learning environment.

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Activity implementation: AWS, IPL, PH, NPF, SSN, DMS; Article preparation: AWS, PH, NPF, SSN, DMS; Analysis of community service impact: AWS, IPL; Presentation of results: SSN, DMS; Article revision: AWS, PH, NPF.

Conflict of Interest

All authors declare no financial or non-financial conflicts of interest related to this article.

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