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# Reframing Writing Instruction through Integrating Problem-Based Learning and Formative Assessment for Academic Writing and 4C Skills

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**ABSTRACT**

**Purpose –** Students' writing and 4C skills (critical thinking, collaboration, communication, and creativity) remain underdeveloped. This is due to the limited use of innovative learning models and formative assessment—an educational process providing feedback during learning—in classrooms. This research examined whether integrating problem-based learning (PBL), an approach using real-world problems, with formative assessment can improve students' writing. The study also explored how this integration affects their writing and 4C skills.

**Methodology –** The study used a mixed-methods approach with an explanatory sequential design. The sample included fourth-semester students from the Writing in Professional Context course, specifically Class B. Researchers collected performance assessments and interviews and analyzed the data using both quantitative and qualitative methods.

**Findings –** Quantitative results showed that integrating PBL and formative assessment significantly improved students' writing skills. Qualitative results indicated that this integration also improved writing structure, coherence, diction, and argument development. The integration enhanced writing performance and fostered 4C skills (critical thinking, collaboration, communication, and creativity).

**Contribution –** This research advances writing pedagogy and 21st-century skills by guiding educators to adopt innovative, student-centered learning practices.

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## INTRODUCTION

The main argument is that, due to the 4.0 industrial revolution, education must produce qualified, adaptable human resources by applying innovative learning models. These models are essential for enhancing graduate competencies and developing 21st-century skills (Fatimah & Muamar, 2023; Sari & Prasetyo, 2021).

The 21st-century skills students must possess and develop are known as the 4Cs: critical thinking, collaboration, communication, and creativity. Developing these skills forms the foundation for students to adapt, think critically, and innovate amid rapid change. Therefore, schools and universities should create learning environments that support their development (Brata et al., 2023). Improving 4C skills is a strategic step toward producing quality graduates ready to compete globally (Partono et al., 2021).

However, considering the current reality, the application of 4C skills still faces challenges. Many educators are still oriented only towards mastery of subject matter, and existing evaluations still tend to measure academic outcomes (Lestari & Hindun, 2023; Partono et al., 2021). From the students' perspective, some still lack the ability to collaborate and think critically (Annisa et al., 2023). This condition indicates that learning is still dominated by a conventional teacher-centered approach that provides insufficient space for students to take an active role, explore ideas, and build knowledge independently.

Moreover, based on the researchers' observations, problems were also found in students' writing skills, particularly in producing argumentative academic writing. Students still experienced difficulties in presenting strong evidence or supporting data to support the claims or arguments they put forward (Patmasari et al., 2025; Patmasari et al., 2023). This phenomenon has been observed both nationally and globally. In Indonesia, several studies show that students' academic writing skills remain relatively low, particularly in argument development, paragraph coherence, and the use of formal academic language (Ananda et al., 2024; Nenotek et al., 2022). Similar conditions have also been reported globally, where EFL (English as a Foreign Language) students in several countries face challenges in developing logical arguments, supporting claims with empirical evidence, and maintaining consistency of ideas in academic writing (Morris et al., 2024; Mallahi, 2024).

Academic writing, particularly argumentative writing, is inherently a complex cognitive and social activity that requires integrating multiple higher-order skills. Writing is not merely a linguistic process but also a manifestation of critical thinking, as students are required to analyze issues, evaluate evidence, and construct logical arguments. In addition, writing involves creativity in generating ideas, organizing arguments, and presenting original perspectives. In collaborative learning contexts, writing also becomes a social practice, where communication and collaboration play crucial roles through activities such as peer discussion, feedback exchange, and co-construction of knowledge. Therefore, writing can be understood as a multidimensional task that simultaneously engages all components of the 4C skills. In this sense, difficulties in academic writing, such as weak argumentation, lack of coherence, and limited development of ideas, may reflect not only technical deficiencies in writing but also insufficient development of underlying 21st-century competencies.

The low writing skills of students not only reflect weaknesses in writing performance itself but also indicate that the underlying 4C skills, particularly critical thinking, communication, and creativity, have not yet developed optimally. Therefore, learning innovations are needed that can comprehensively address these issues. One alternative learning model that is considered capable of solving the problems described above is PBL. PBL is problem-based learning that addresses real-world problems, training students to think critically, creatively, and analytically (Hartono & Sari, 2022). PBL is also a form of collaborative learning, thereby training students' communication and collaboration skills (Hindriyani et al., 2020).

In PBL implementation, formative assessment is needed to provide feedback on student activities. Assessment plays an important role in learning. Formative assessment and formative feedback are integral to the learning process and key aspects of learning design (Irons & Elkington, 2022). Learning can be effective, efficient, and in line with expectations when carefully planned. One way to do this is to determine the learning

model to use in the learning process. Therefore, by integrating PBL and formative assessment, it is hoped that students' writing problems can be overcome and their 4C skills developed.

Research on PBL and formative assessment has been conducted extensively by researchers both domestically and internationally (Hidayah et al., 2021; Hidayati & Wagiran, 2020; Sarigoz, 2012; Pradita et al., 2021). In recent years, several studies have also shown the positive impact of PBL and formative assessment (Hasanah et al., 2023; Hartono & Sari, 2022; Alfiana et al., 2021; Kelley et al., 2019). In general, these studies show that PBL and formative assessment have a positive impact on the development of critical thinking, creativity, and problem-solving skills. However, a closer examination of prior studies reveals several important limitations. Most studies on PBL primarily focus on improving problem-solving and critical thinking skills, often employing experimental or quasi-experimental designs, but pay limited attention to its impact on academic writing as a complex literacy practice. Similarly, research on formative assessment tends to emphasize feedback effectiveness and general learning outcomes, frequently using survey-based or classroom-based evaluation methods, yet often positions writing as a secondary outcome rather than a central focus. In addition, studies addressing 21st-century skills commonly examine these competencies in isolation, such as critical thinking or creativity, without capturing the integrated development of the full 4C framework. Furthermore, only a limited number of studies have investigated the combined implementation of PBL and formative assessment, and existing research rarely examines their simultaneous effects on both academic writing and 4C skills, particularly in higher education contexts.

Unlike previous studies, this research used a mixed-methods, sequential explanatory design, combining quantitative and qualitative data to provide a more comprehensive understanding. This research also seeks to fill a research gap by examining the effects of integrating PBL and formative assessment on students' writing skills and on critical thinking, collaboration, communication, and creativity, which are at the core of 21st-century skills. Based on this description, the researchers were encouraged to investigate the effect of integrating PBL and formative assessment on students' writing and 4C skills. The results of this research are expected to be useful and enrich learning, particularly through PBL and formative assessment, thereby improving learning quality and student skills.

This research aims to examine whether integrating PBL and formative assessment can improve students' academic writing skills, particularly in argumentative writing, and to explore how this integration affects students' 4C skills. This study specifically focuses on undergraduate EFL students in higher education and employs a mixed-methods approach with a sequential explanatory design to capture both the measurable improvement in writing performance and the qualitative development of students' critical thinking, collaboration, communication, and creativity. Based on the background and problems described above, the research questions in this research are:

1. Can the integration of PBL and formative assessment improve students' writing skills?
2. How does the integration of PBL and formative assessment affect students' writing skills?
3. How does the integration of PBL and formative assessment affect students' 4C skills?

This research is important for several reasons. Theoretically, the results of this research are expected to enrich the body of knowledge on integrating PBL and formative assessment, particularly in the context of developing problem-based learning models supported by continuous assessment strategies. In practice, the findings of this research can inform educators and policymakers in determining effective learning and assessment approaches to improve students' 21st-century and academic writing skills. Meanwhile, on a professional level, this research is expected to encourage educators to implement more innovative, reflective, and student-centered learning models.

The novelty of this research lies in the simultaneous integration of the PBL approach and formative assessment in writing instruction in higher education, a combination that has rarely been empirically studied. This research not only emphasizes the problem-solving process and active student involvement, as in PBL, but also combines them with a continuous feedback mechanism, a characteristic of formative assessment. The integration of these two approaches is expected to produce a more comprehensive learning model that

simultaneously develops students' critical thinking, collaboration, communication, and creativity (4C skills), while strengthening the quality of their academic writing process.

## METHODOLOGY

### Research Design

This research employed a mixed-methods research design, specifically an explanatory design, in which initial quantitative data were collected and analyzed, followed by qualitative data that helped explain the quantitative results (Creswell & Creswell, 2018). Quantitative data refer to numerical information, such as scores or survey responses. Qualitative data refer to descriptive information, such as interview transcripts or written reflections. Problem-based learning is an instructional approach in which students work on real-life problems, while formative assessment is a process in which teachers provide ongoing feedback to improve students' skills. The research examined whether integrating problem-based learning and formative assessment improved students' writing skills and how this integration affected students' writing and 4C skills (critical thinking, communication, collaboration, and creativity). Researchers first collected and analyzed quantitative data, then collected and analyzed qualitative data to further describe and elaborate on the quantitative findings.

### Population and Sample

The population consisted of all fourth-semester students enrolled in the Writing in Professional Context course in the even semester of the 2023/2024 academic year. Furthermore, the research sample was selected using purposive sampling, which involves selecting participants based on specific criteria aligned with the research objectives. The sample consisted of 29 students in class B. This class was selected because it was easily accessible to the researcher, and the lecturer allowed the learning model and data collection process to be implemented effectively without disrupting regular lectures.

To support the quantitative data, this research also involved several interview participants. Nine students were selected for in-depth interviews based on specific criteria: active involvement in the learning process, reflective communication skills, and diversity in their writing skills. The purpose of selecting these participants was to obtain richer information about students' experiences in participating in PBL integrated with formative assessment. The interview data were used to strengthen and reinforce the quantitative findings.

### Data Collection

This research used two data collection methods: performance assessment and interviews. Performance assessment, also known as authentic or alternative assessment, is a type of assessment that emphasizes the process of students (debate, oral speech, etc.) or products (an essay, a research report, etc.) (Gay et al., 2012). In this regard, students were asked to write an argumentative essay. Furthermore, to examine the effects of integrating PBL and formative assessment on students' writing and 4C skills, the researchers conducted interviews. The researchers used open-ended questions to elicit broader or more in-depth responses from students about the effects of integrating problem-based learning and formative assessment on their writing and 4C skills.

### Data Analysis

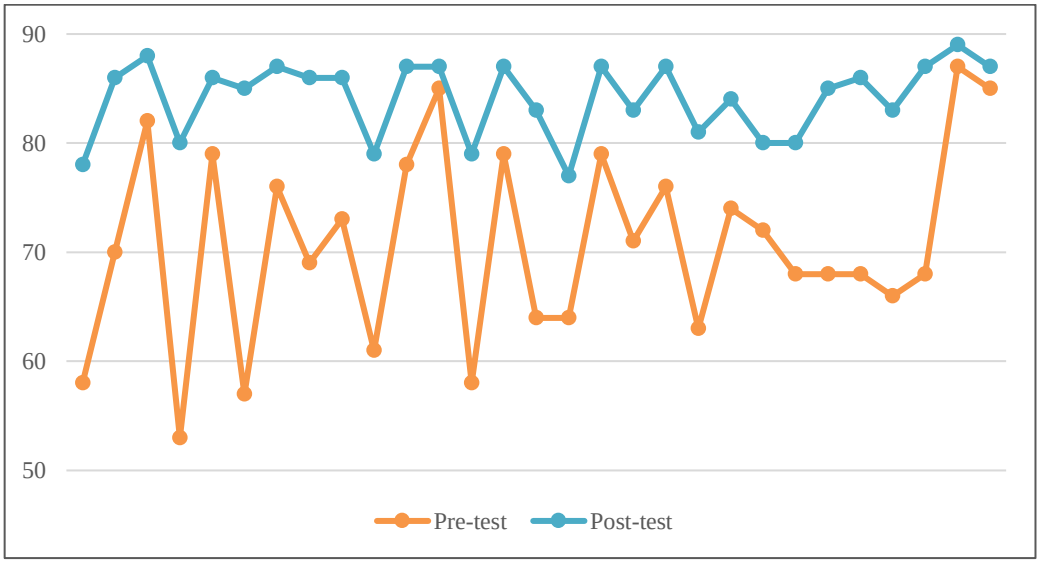
The data collected from this research were analyzed quantitatively and qualitatively. The quantitative research data from the argumentative essays were processed and analyzed statistically using the Statistical Package for the Social Sciences (SPSS). Meanwhile, other interview data were analyzed qualitatively using thematic analysis following the stages outlined by Braun & Clarke (2006). This analysis aimed to identify patterns of meaning and students' experiences in learning to write that integrated PBL and formative assessment.

## FINDINGS

### The Effect of Integrating PBL and Formative Assessment on Students' Writing Skills

***RQ1: Can the integration of PBL and formative assessment improve students' writing skills?***

The students' pre-test and post-test scores were analysed to examine any significant difference between them. Picture 1 presents a graphical representation of the pre-test and post-test scores of students.




**Picture 1.** Graph of students' pre-test and post-test scores

Picture 1 illustrates that the students' scores generally do not overlap. This indicates a difference between the two sets of scores. However, further statistical testing is required to verify whether there is a significant difference between students' pre-test and post-test scores. In addition to the graph, this difference is evident in the descriptive statistics table below.

**Table 1.** Descriptive statistics

| | N | Range | Min. | Max. | M | SD |
|---|---|---|---|---|---|---|
| Pre-test | 29 | 34 | 53 | 87 | 70.72 | 8.980 |
| Post-test | 29 | 12 | 77 | 89 | 84.14 | 3.430 |

Table 1 shows the descriptive statistics of the pre-test and post-test. The mean scores on the pre-test and post-test are 70.72 and 84.14, respectively. This means there is a difference in the mean scores of students between the pre-test and post-test. It can be said that writing skills have improved. Even so, parametric analysis is still needed to validate this.

In parametric analysis using a paired t-test, the data should be normally distributed to ensure the validity of the results. Therefore, the distribution of students' scores must be examined first.

**Table 2.** Normality test

| | Kolmogorov-Smirnov | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| | Statistic | Df | Sig. | Statistic | Df | Sig. |
| Pre-test | 0.070 | 29 | 0.200 | 0.979 | 29 | 0.819 |
| Post-test | 0.224 | 29 | 0.001 | 0.883 | 29 | 0.004 |

Based on Table 2, the pre-test significance value is greater than 0.05, indicating normality. The post-test value, however, is less than 0.05, so normality is not met. Thus, a nonparametric analysis using the Wilcoxon

matched-pairs test was used to examine differences in pre- and post-test mean scores. The following are the results.

**Table 3.** Wilcoxon matched-pairs test

| | Post-test – Pre-test |
|---|---|
| Z | -4.706 |
| Asymp. Sig. (2-tailed) | 0.000 |

Based on Table 3, the significance value (p-value) for both data is 0.000 (<0.05). This indicates a statistically significant difference between students' pre-test and post-test scores, showing that integrating PBL and formative assessment significantly improves students' writing skills.

***RQ2: How does the integration of PBL and formative assessment affect students' writing skills?***

To further explore the effect of integrating PBL and formative assessment on students' writing skills, the researchers conducted interviews with several students. Based on the interview results, four main themes emerged, indicating areas for development in writing skills: writing structure or organization, coherence and cohesion, diction or word choice, and argument development.

***Writing Structure or Organization***

Most students stated that through PBL integrated with formative assessment, they gained a better understanding of the structure or organization of academic essays. Students were able to write the introduction, body, and conclusion more clearly, in accordance with the writing objectives.

*"The introduction I wrote became clearer and more focused. I also gained a better understanding of what I should include in that section, such as background information, claims/arguments, and thesis statements." (S1)*

*"The conclusion I wrote is better because the paragraphs I wrote always start with a topic sentence and end with a concluding sentence." (S4)*

*"I have gained a better understanding of the structure of the essay I am writing. Therefore, the paragraphs I write are more cohesive, harmonious, and continuous." (S7)*

This finding shows that PBL and formative assessment help students write more systematically.

***Coherence and Cohesion***

An improvement in students' ability to maintain coherence between ideas in their essays was also reported. Students became better able to connect ideas between paragraphs and sustain a logical flow of writing.

*"My writing has become more organized and in line with the purpose of the essay." (S3)*

*"The ideas I write are interconnected, and the paragraphs I create are more organized." (S9)*

The integration of formative assessment provides students with opportunities to revise and improve the coherence of their ideas based on feedback from the lecturer and peers.

***Diction or Word Choice***

Notably, students demonstrated improvement in their selection of appropriate, varied, and contextually fitting words. The feedback process was key in helping them refine the clarity and accuracy of their language.

*"The language I use has become clearer and my word choice more varied." (S6)*

This advancement in diction illustrates how formative assessment helps students develop awareness of effective and formal word choices in academic writing.

***Argument Development***

PBL, students mentioned, requires them to write with strong reasoning and evidence. Over time, they have become accustomed to supporting their claims with evidence and to considering counterarguments to strengthen their writing.

> *"I have become accustomed to adding evidence to support the claims I write so that the arguments I develop are more logical." (S2)*
>
> *"I learned what counterarguments are and included them in the argumentative essays I wrote so that my arguments were stronger." (S5)*
>
> *"In this learning process, I have become accustomed to anticipating arguments that differ from my own arguments or opinions." (S8)*

Integrating PBL and formative assessment improves students' writing structure and critical thinking.

**The Effect of Integrating PBL and Formative Assessment on Students' 4C Skills**

***RQ3: How does the integration of PBL and formative assessment affect students' 4C skills?***

To determine how integrating PBL and formative assessment affects students' 4C skills, the researchers conducted interviews with several students. The results indicate that this integration positively impacts students' 4C skills, as explained below.

***Critical Thinking***

Through PBL, students learned to analyze problems, search for information, and gather evidence to support their conclusions. According to one student:

> *"During the learning process, we were given problems and had to find as much information as possible related to the problem and gather evidence to make strong arguments. That improved our critical thinking skills." (S1)*

Similar statements also emerged from another student:

> *"In learning, we analyze problems, assess and evaluate the evidence we obtain to draw conclusions. And that hones our critical thinking skills." (S2)*

In addition, formative assessment from the lecturer and peers plays an important role in improving students' critical thinking skills.

> *"In learning, we receive feedback from lecturers and friends so that we can identify our weaknesses." (S3)*
>
> *"The integration of PBL and formative assessment enables us to evaluate arguments and draw conclusions." (S4)*

***Collaboration***

Through group work and mutual feedback, collaboration develops, as shown by the interview results. Working together, sharing ideas, and taking joint responsibility for completing tasks are habits that students admit they are accustomed to.

> *"We work with our group members, discuss existing problems, share ideas, and take responsibility for completing the assigned tasks. All these things improve our collaboration skills." (S5)*

Peer review and peer feedback activities further strengthen collaboration.

> *"We give each other feedback and appreciate our friends' comments on our writing, making our collaboration more effective." (S6)*
>
> *"We work together to solve problems and discuss the results of our peers' reviews, so we feel that it is good collaboration." (S7)*

***Communication***

By promoting discussion, idea sharing, and feedback, the integration of PBL and formative assessment also improves students' communication skills. Engaging in these processes serves as an effective communication practice.

> *"We learn to accept criticism and input from peers, which helps our communication skills develop further." (S1)*

*"We discuss and share ideas in groups, which improves our communication skills." (S8)*

*"When we give feedback and receive input from the lecturer and peers, we engage in communication." (S9)*

***Creativity***

After participating in a learning experience that integrated PBL and formative assessment, students also showed increased creativity. With the space to explore, refine, and develop ideas innovatively, they demonstrated this growth.

*"We were given the freedom to innovate and develop ideas, so we felt that our creativity skills improved." (S2)*

*"We were given the opportunity to improve our writing, so after receiving comments and feedback, our creativity grew." (S3)*

*"In learning, we reflected on ideas and explored problems. This honed our creative thinking skills."*

Overall, the interview results indicate that integrating PBL and formative assessment positively impacts students' 4C skills, making them more critical, collaborative, communicative, and creative.tions.

## DISCUSSION

### The Effect of Integrating PBL and Formative Assessment on Students' Writing Skills

***RQ1: Can the integration of PBL and formative assessment improve students' writing skills?***

The integration of PBL and formative assessment provides a more dynamic and holistic approach to improving students' writing skills. The integration of PBL and formative assessment not only allows students to learn through direct experience but also provides opportunities to receive constructive feedback that can improve the quality of their writing. In this research, the researchers integrated PBL and formative assessment through several strategic steps. The first step was to identify relevant, contextual problems. After that, students were divided into several groups to write and solve the problems given. Formative assessment was carried out by providing mutual feedback between groups to improve the quality of their ideas or writing. In addition, the lecturer provided periodic feedback on students' drafts to ensure students understood what needed improvement. Lastly, a clear writing rubric was used to help students understand the assessment criteria for their writing.

Furthermore, the students' test results graphically show a difference between the pre-test and post-test scores. From the descriptive statistics, the mean score for students at the pre-test was 70.72, while at the post-test, it reached 84.14. The post-test mean score was higher than the pre-test mean score. The difference between the post-test and pre-test scores was 13.42. In addition, the Wilcoxon matched-pairs test showed that the significant value (0.000) was greater than 0.05. There was a difference in the students' mean scores before and after integrating PBL and formative assessment. This shows that integrating PBL and formative assessment can improve students' writing skills.

The results of this research align with those of Sari et al. (2021), who reported that PBL has a significant impact on students' writing skills. In addition, the results of this research align with those of Setlight et al. (2023) and Dwisnu (2021), who found significant improvements in students' writing skills following PBL instruction. On the other hand, Saleem et al. (2020) argue that students' writing skills improve when they receive formative assessments during the learning process. The study by Trismayanti (2021) also shows that the application of formative assessment is effective and beneficial for improving writing skills. Based on the findings of several previous studies and this research, it appears that PBL and formative assessment have a positive impact on students' writing skills. This study demonstrates that their integration produces a stronger and more structured impact. Thus, this research contributes new empirical evidence that combining PBL with formative assessment leads to greater improvement than applying each approach separately.

***RQ2: How does the integration of PBL and formative assessment affect students' writing skills?***

The writing aspect refers to the elements that make effective, high-quality writing. In the context of learning writing, this aspect includes the ability to organize ideas in a structured, logical, and communicative

way. Based on the students' responses, the researchers identified four main sub-aspects that are influenced by the integration of PBL and formative assessment, namely: (1) writing structure or organization, (2) coherence and cohesion, (3) diction or word choice, and (4) argument development.

*Writing Structure or Organization*

Most students stated that integrated PBL and formative assessment helped them better understand essay structure. They felt able to write more focused introductory paragraphs by clearly stating background information, claims/arguments, and thesis statements. In the body paragraphs, students mentioned that they were better able to develop ideas logically by including supporting evidence. In addition, the conclusion was better structured, as it reaffirmed the main argument.

*Coherence and Cohesion*

Students also emphasized that their writing became more coherent and continuous. They were able to connect ideas across paragraphs logically, making the overall meaning of the writing easier to understand. This shows that integrating formative assessment provides a reflective opportunity to improve the relationship between ideas during the revision process.

*Diction or Word Choice*

In terms of language, students stated that their diction became more varied and contextually appropriate. The feedback process from the lecturer and peers helped them choose words that were more appropriate, formal, and effective in an academic context.

*Argument Development*

Students reported improved ability to develop strong, evidence-based arguments and a better understanding of how presenting counterarguments strengthens their position. The PBL approach, which requires critical thinking and evidence-based solutions, improved the quality of their written arguments.

Overall, this research indicates that integrating PBL and formative assessment significantly improves students' writing skills. These findings support the results of Samad et al. (2024), which show that formative assessment can improve students' writing organization, grammar, vocabulary, and writing conventions. These results also align with those of Dastgeer & Afzal (2015), who found that PBL is effective in improving writing skills by actively engaging students in critical thinking and problem-solving.

Furthermore, the findings of this research align with those of Yulitriana & Emeral (2024), who found that the majority of students have a positive view of PBL because this approach increases their involvement and responsibility in learning. In addition, Zia et al. (2019) also found that formative assessment helps students improve their writing skills through opportunities for reflection and continuous learning.

Thus, it can be inferred that integrating PBL and formative assessment not only strengthens the structure and cohesion of students' writing but also fosters analytical, reflective, and collaborative thinking skills that are essential to the development of academic writing. However, this study goes further by demonstrating how each writing component is specifically enhanced through the interaction between PBL and formative assessment, rather than treating them as separate instructional strategies.

**The Effect of Integrating PBL and Formative Assessment on Students' 4C Skills**

***RQ3: How does the integration of PBL and formative assessment affect students' 4C skills?***

*Critical Thinking*

PBL challenges students to identify and solve real-world problems. In this process, they are required to analyze problems in depth, seek relevant information and evidence, and present their findings in logical writing. Students argued that PBL honed their critical thinking skills because they were encouraged to identify and search for information related to the given problem, collect evidence and evaluate it, and draw appropriate

conclusions. These findings support previous studies that also reported that PBL helps improve and develop critical thinking skills (Manuaba et al., 2022; Wenno et al., 2021; Rubiyanti et al., 2020).

On the other hand, formative assessment, which provides continuous feedback during the learning process, allows students to reflect on and improve their writing. They stated that they were able to identify weaknesses in their writing and formulate stronger arguments after receiving constructive feedback. In addition, they stated that formative assessment supports the development of their critical thinking skills because comments from the lecturer and peers guide them in further improving their writing.

Furthermore, integrating PBL and formative assessment exposes students to complex challenges and provides in-depth feedback. According to Fahmi et al. (2023), developing PBL-based formative assessment is needed to improve critical thinking skills. Students stated that this integration developed their critical thinking skills because they conducted in-depth problem analyses and received feedback that highlighted their writing's strengths and weaknesses. They also believed they could better evaluate arguments and draw logical conclusions based on available information. These findings align with Hartono & Sari (2022), who found that PBL with formative assessment significantly affects critical thinking skills. Therefore, integrating PBL and formative assessment is significant for developing students' critical thinking skills.

*Collaboration*

PBL emphasizes group work, and in this situation, students are expected to work together with their group members to solve the problems given. According to the students, PBL can develop collaboration skills because in PBL, they must collaborate to solve complex problems. In addition, they added that in PBL, they share ideas and responsibilities and discuss solutions. This makes their communication more effective. The results of this research also support the findings of Ariyanto et al. (2019), who found that PBL can help students develop work skills, both individually and in groups. Similarly, Gunawan (2023) concluded that implementing PBL is effective in improving collaboration skills.

Meanwhile, students also stated that formative assessment supports the development of their collaboration skills. Formative assessment, which involves student interaction, enables students to work together to solve the problems given. In addition, according to them, peer review and peer feedback enable them to provide feedback to one another. They work together to give and receive feedback and to see their friends' perspectives, thereby developing their collaboration skills. Waluyo & Panmei (2024) also reported similar findings, namely that peer feedback creates an environment conducive to exchanging ideas, collaborating, and sharing ideas.

Furthermore, integrating PBL and formative assessment enhances teamwork effectiveness by providing opportunities for students to give each other feedback. Students stated that integrating PBL and formative assessment made group collaboration more effective and structured. They became accustomed to working together, dividing tasks, and discussing their progress within the group. They were also able to reach agreements and respect their group members' opinions. Based on the previous description, integrating PBL and formative assessment effectively improves students' collaboration skills.

*Communication*

In PBL, students must communicate effectively to discuss ideas and share information within their groups. Through group discussions, students also learn to express their thoughts. They say that PBL enables them to express their opinions with logical reasoning. They believe that all these things can develop their communication skills. The results of Robi et al. (2023) and Nurfajriah et al. (2022) also show that using PBL improves communication and helps overcome communication difficulties.

In addition, students also stated that formative assessment encouraged them to communicate more intensively with the lecturer and classmates. In receiving feedback, they had to ask for clarification, which honed their communication skills. Giving peer feedback and receiving constructive input from friends can deepen students' communication skills (Allison & Morris, 2024). Students also have a positive perception of the lecturer's verbal feedback (Agricola et al., 2020). The integration of PBL and formative assessment allows

students to share reflections and feedback with one another. Students stated that their ability to convey ideas and accept criticism was further honed through the integration of PBL and formative assessment. It can be inferred that integrating PBL and formative assessment significantly enhances students' communication skills.

*Creativity*

PBL provides students with opportunities to think creatively when finding solutions. Students said that PBL provides them with space and freedom to innovate and develop ideas. In PBL, they can also exchange creative ideas. They believe that this can develop their creativity. The results of this study are also in line with previous studies that reported that PBL is effective in increasing creativity (Sumarno, 2023; Hasanah et al., 2023; Hidayah et al., 2021; Ramadhani et al., 2020; Ulger, 2018).

On the other hand, formative assessment also provides students with the opportunity to refine their ideas before submitting their final papers. According to students, their creativity flourishes because they are given the chance to revise their writing. Other findings show that feedback in formative assessment can improve soft skills, including creative thinking (Alt et al., 2023). Creative thinking is the ability to produce original and useful responses (Redifer et al., 2021). The integration of PBL and formative assessment encourages students to be more creative in problem-solving. Students added that they developed greater creativity and innovation because they were given the opportunity to explore in PBL and to reflect on their creative ideas during formative assessment. Overall, integrating PBL and formative assessment helps students develop their creativity by providing real challenges that require creative thinking, collaboration, and innovative problem-solving. This study provides integrated evidence that combining the two approaches leads to more comprehensive skill development.

The findings of this study have both theoretical and practical implications and offer clear, novel contributions to the field. First, this study contributes a new integrated framework combining PBL and formative assessment, demonstrating how experiential problem-solving and continuous feedback can function synergistically rather than independently. Second, the study provides empirical evidence of the impact of this integration not only on students' academic writing quality but also on the development of 21st-century skills, particularly the 4C skills (critical thinking, creativity, collaboration, and communication).

Theoretically, the results support constructivist learning theory by demonstrating that knowledge is actively constructed through students' engagement in PBL and their reflective processes facilitated by formative assessment. The integration of these approaches underscores the importance of combining experiential learning with continuous feedback, reinforcing feedback's central role in fostering higher-order thinking and improving writing skills. Moreover, this study extends the existing literature by positioning formative assessment not merely as an evaluative tool but as an integral component of problem-based learning environments.

Practically, the findings suggest that writing instruction should be designed to incorporate authentic problem-solving tasks that encourage meaningful engagement. In addition, continuous formative feedback needs to be embedded throughout the writing process to support ongoing improvement. The study also underscores the importance of systematically structured peer feedback to enhance collaboration and critical reflection among students. Furthermore, the use of clear, explicit assessment rubrics is essential for guiding students in revising their work effectively and achieving better writing outcomes. Importantly, the integrated PBL–formative assessment approach offers a practical model for educators aiming to simultaneously improve academic writing and foster essential 4C skills in classroom contexts.

Despite its contributions, this study has several limitations. First, the sample size was relatively limited and drawn from a single context, which may affect the generalizability of the findings. Second, the study relied partly on students' self-reported responses, which may introduce subjectivity. Third, the absence of a control group limits the ability to compare the effectiveness of the integrated approach with other instructional methods. Finally, the study focused on short-term improvement and thus does not capture the intervention's long-term impact on writing development and 4C skills.

## CONCLUSION

Based on statistical analysis, the pre-test and post-test data showed a significance value of 0.000 (<0.05). This indicates a statistically significant difference between the students' scores. Thus, it can be inferred that integrating PBL and formative assessment can improve students' writing skills. Furthermore, based on the interview results, it can be concluded that integrating PBL and formative assessment has a positive effect on four main aspects of students' writing: writing structure or organization, coherence and cohesion, diction, and argument development. This approach simultaneously strengthens students' technical writing and critical thinking skills. Furthermore, the integration of PBL and formative assessment not only has a positive impact and influence on students' writing skills, but also improves and develops students' 4C skills, namely critical thinking, collaboration, communication, and creativity. Students become more critical in their thinking, more collaborative in working together, more communicative in interacting, and more creative in generating ideas and solutions. These results highlight the effectiveness of embedding iterative feedback within problem-based tasks as a unified pedagogical strategy that enhances both disciplinary competence and transversal skills.

Given the limitations, the researchers suggest conducting further research over a longer period to obtain more varied results. In addition, the sample can be expanded not only to one class but to several classes, even at other universities. Furthermore, this research has not explored in depth the 4C skills in terms of the aspects that are indicators of the achievement of each skill, so future researchers are expected to identify the 4C skills of students in greater depth by adding questionnaires and interview questions related to the aspects that are indicators of the achievement of each skill.

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