



Research Article

Does mini-research project improve the scientific writing skill in biotechnology class?

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KEYWORDS

ABSTRACT

This study aims to evaluate the effectiveness of mini-research projects in improving students' scientific writing skills in biotechnology classes. A descriptive research method was employed to observe students' motivation and learning outcomes in the form of mini-research scientific writings. Data was collected through assessments of students' scientific writing before and after the project implementation. The results indicate that at least two groups exhibited high motivation aligned with their scientific writing performance, achieving scores above 80. The conclusion suggests that mini-research can stimulate students' motivation in scientific writing of mini-research findings, demonstrating that mini-research projects can be an effective strategy for developing students' scientific writing and communication skills.

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1. INTRODUCTION

The ability to effectively communicate scientific findings through the medium of written reports is a cornerstone of success in the biotechnology industry (Shults, 2008). This skill is paramount for researchers, developers, and professionals alike, as it underpins the dissemination of knowledge, collaboration, and the translation of scientific discoveries into practical applications (Hyland, 2016). While traditional educational models have primarily focused on theoretical knowledge acquisition, there is a growing recognition of the critical importance of developing practical skills, such as effective communication, within scientific disciplines (Hoidn & Kärkkäinen, 2014).

Project-based learning (PjBL) has emerged as a promising pedagogical approach to address this need (Husamah & Pantiwati, 2014; Ilma et al., 2022; Sumarni et al., 2021; Wijayati et al., 2019). By centering learning on real-world problems and empowering students to take ownership of their learning process, PBL has the potential to cultivate a range of skills,

including critical thinking, problem-solving, collaboration, and communication. However, the specific impact of PBL on the development of writing report skills, particularly within the context of biotechnology, remains an area requiring further investigation (Aghayani & Hajmohammadi, 2019; Hasani et al., 2017; Mulyani & Sobari, 2023).

Previous research has demonstrated the efficacy of PjBL in enhancing students' engagement, motivation, and overall learning experiences (Arya & Harjono, 2023; Natalia, 2016; Swasono, 2020). Moreover, studies have indicated positive correlations between PjBL and the development of higher-order thinking skills (Eliyasni et al., 2019; Prananda et al., 2020; Santoso et al., 2021). However, the extent to which PjBL can effectively improve students' ability to produce well-structured, informative, and persuasive scientific reports, specifically within the domain of biotechnology, requires more rigorous empirical examination.

A comprehensive understanding of how PjBL impacts writing report skills in biotechnology is essential for several reasons. First, it can inform the development of more effective instructional strategies that equip students with the necessary communication competencies to succeed in the biotechnology industry. Second, by identifying the specific elements of PjBL that contribute to improved writing, educators can optimize the implementation of this approach in their classrooms. Third, this research can provide valuable insights for curriculum developers and policymakers who seek to enhance the overall quality of biotechnology education. One of the implementations of PjBL by using Mini-research project. The mini-research project is a practical, research-based approach that can enhance students' scientific writing abilities. Beyond writing practice, mini-research also equips students with the skills to effectively communicate their research findings through scientific presentations.

This study aims to contribute to the growing body of knowledge by investigating the relationship between PjBL model by using mini-research project and the development of writing report skills in biotechnology students. Furthermore, the study will delve into the underlying mechanisms through which mini-research project influences writing skills, exploring how it fosters critical thinking, information organization, and the ability to construct coherent arguments.

2. METHOD

This study employs a descriptive research design to explore the impact of project-based learning (PjBL) on student learning outcomes in writing report skills for biotechnology class. A descriptive research design is suitable for this study as it aims to provide a detailed account of the phenomenon without making causal inferences. The participants in this study are twenty biology education students enrolled in biotechnology class during the 2023/2024.

Table 1. Rubric of the writing report skill

| No | Rubric | Possible Score | | | | |
|----|--|----------------|-----|-----|-----|---|
| | | A | B | C | D | E |
| 1 | Title (10 points) | | | | | |
| | Interesting Title | 4 | 3 | 2 | 1 | 0 |
| | English Title | 4 | 3 | 2 | 1 | 0 |
| | Names of Group members and affiliation | 2 | 1.5 | 1 | 0.5 | 0 |
| 2 | Abstract (20 points) | | | | | |
| | Informative (Intro, Aim, Method, Result, and Conclusion) | 10 | 8 | 6 | 3 | 0 |
| | No more 250 words | 10 | 8 | 6 | 3 | 0 |
| 3 | Introduction (10 points) | | | | | |
| | There is description of problems | 3 | 2 | 1.5 | 1 | 0 |

| | | | | | | |
|---|--|-----|-----|-----|-----|---|
| | Synthesis the former research | 2 | 1.5 | 1 | 0.5 | 0 |
| | Gap analysis/ state of the art | 3 | 2 | 1.5 | 1 | 0 |
| | Aim of the reserach | 2 | 1.5 | 1 | 0.5 | 0 |
| 4 | Methods (10 points) | | | | | |
| | Research methodology | 3 | 2 | 1.5 | 1 | 0 |
| | Sampling technique | 2 | 1.5 | 1 | 0.5 | 0 |
| | Research Procedure | 3 | 2 | 1.5 | 1 | 0 |
| | Data analysis | 2 | 1.5 | 1 | 0.5 | 0 |
| 5 | Result (10 points) | | | | | |
| | Description of the results | 5 | 4 | 3 | 2 | 0 |
| | Correct figure/ table/ diagram format | 5 | 4 | 3 | 2 | 0 |
| 6 | Discussion (20 points) | | | | | |
| | Interpretation of the result | 10 | 8 | 6 | 3 | 0 |
| | Comparison of the data with former study | 10 | 8 | 6 | 3 | 0 |
| 7 | Conclusion (10 points) | | | | | |
| | Contains a brief summary of result | 10 | 8 | 6 | 3 | 0 |
| 8 | References (10 points) | | | | | |
| | Correct format of citation (APA Style 7th edition) | 5 | 4 | 3 | 2 | 0 |
| | Meet minimun quantity reference number | 5 | 4 | 3 | 2 | 0 |
| | Total score | 100 | | | | |

Five mini-research groups were formed, each of which was given the opportunity to use three mentoring sessions for validation and consultation. However, this activity was not mandatory. The purpose of this was to assess the motivation of each student per group to discuss their research findings. Data on student learning outcomes in writing descriptive texts within a biotechnology class were gathered through document analysis (Rubrics can be seen in Table 1). These data were qualitatively analysed using descriptive methods. The research involved collecting student writing samples, processing the data through a detailed examination, and interpreting the findings to describe student performance in writing experimental reports, and conclude the phenomenon.

3. RESULTS AND DISCUSSION

Motivation student to attend the mentoring session

The implementation of mentoring sessions was conducted in three stages, with attendance being voluntary for all students within each group. As illustrated in Figure 1, a general trend emerged where a majority of students actively participated in the second session, specifically to validate the findings of their mini-research projects. Notably, all students from the five groups were present during this particular session. In contrast, the initial mentoring session experienced significantly lower attendance rates among the student body. In line with research conduct by Martin and Dowson (2009) that students who demonstrate a high level of engagement, as evidenced by consistent and active participation, tend to exhibit greater motivation towards their academic pursuits. This heightened motivation can directly impact various skills, including writing (Süğümlü et al., 2019). By actively seeking guidance and

feedback during mentoring sessions, students not only enhance their writing abilities but also develop a deeper understanding of the subject matter, fostering a more intrinsic drive to excel in their academic endeavours (Brooks et al., 2012; Troia et al., 2023).

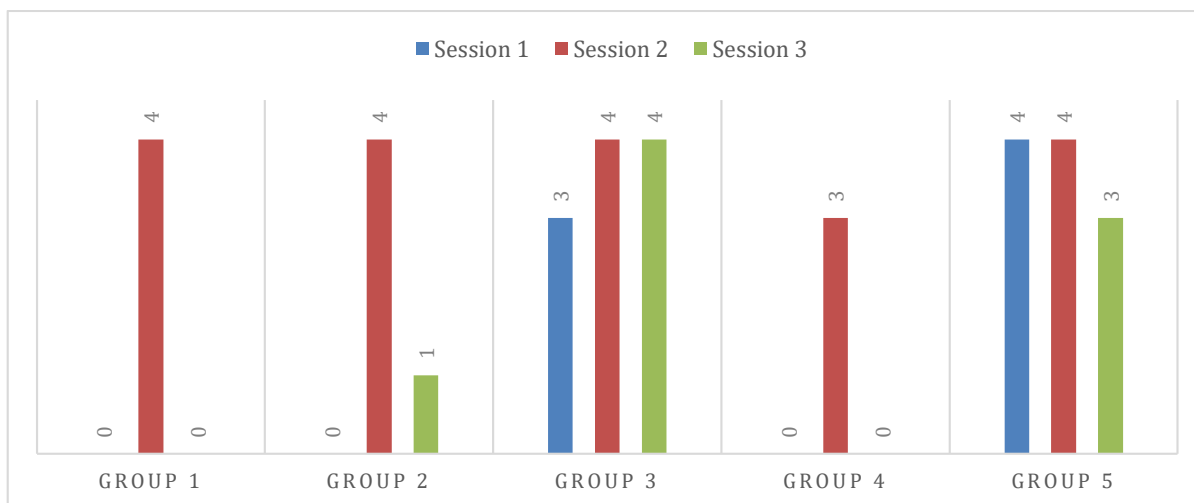


Figure 1. student attendance for mentoring session

Scientific writing skills of Student based on mini-research project

Table 2. Student's scientific writing skills

| No | Group | Title | Score | | | | | | | Total | Final Score |
|----|---------|-------|----------|--------------|---------|---------|------------|------------|------------|-------|-------------|
| | | | Abstract | Introduction | Methods | Results | Discussion | Conclusion | References | | |
| 1 | Group 1 | 6 | 9 | 4 | 8 | 10 | 11 | 8 | 7 | 63 | 63% |
| 2 | Group 2 | 6 | 9 | 3.5 | 8 | 9 | 14 | 8 | 9 | 66.5 | 66.5% |
| 3 | Group 3 | 10 | 10 | 8.5 | 9 | 10 | 18 | 10 | 10 | 85.5 | 85.5% |
| 4 | Group 4 | 6 | 9 | 7.5 | 8 | 9 | 14 | 8 | 9 | 70.5 | 70.5% |
| 5 | Group 5 | 6 | 10 | 8.5 | 10 | 10 | 18 | 10 | 10 | 82.5 | 82.5% |

Among the five groups participating in the mini-research project, only two groups managed to attain scores above 80, equivalent to an A grade (Can be seen in Table 2). This observation can be attributed to the active engagement of groups three and five in consulting their written work. These two groups, in particular, utilized the three biotechnology class meetings for guidance and monitoring of their research findings, demonstrating a proactive approach to improving their work. This consistent engagement with the instructor likely contributed significantly to the enhanced quality of their research reports and ultimately, their higher scores. In contrast, the other groups, with less frequent consultations, may have encountered challenges in refining their research and writing, resulting in lower overall assessments. By providing individualized feedback, guidance, and support, mentoring sessions offer a crucial platform for students to refine their writing skills (O'Dowd et al., 2020). Bird (2001) said that mentors can help students develop a clear and logical structure, enhance their ability to articulate complex ideas, and master the conventions of scientific writing. Furthermore, mentoring fosters critical thinking and problem-solving skills, essential components of effective scientific communication. Through regular interaction with mentors, students gain

confidence in their writing abilities and develop a deeper understanding of the writing process, leading to significant improvements in the overall quality of their scientific work (Kabataş Memiş & Çakan Akkaş, 2020; Suwono et al., 2017; Swasono, 2020; Troia et al., 2023).

An analysis of the eight assessment categories in the mini-research reports reveals that most groups have yet to fully complete the discussion section. This section carries a significant 20% of the overall score, reflecting the crucial role of discussion in scientific research to elucidate the observed phenomena. However, most students have not effectively conveyed a clear explanation of the underlying mechanisms behind the phenomena and comparisons with previous studies. On the other hand, nearly all groups successfully presented their research findings using tables, diagrams, and pie charts, and presented the results in an engaging manner. This serves as an early indicator of the students' ability to effectively communicate their findings to the audience. In line with the research about a growing body of research supports the notion that Project-Based Learning (PjBL) approaches to writing instruction can effectively enhance students' writing skills (Santoso et al., 2021; Swasono, 2020). Studies have consistently demonstrated that PjBL methods, characterized by hands-on, inquiry-driven activities, foster deeper engagement, critical thinking, and problem-solving abilities, all of which contribute to improved writing performance. For instance, one study found that students engaged in PjBL writing projects exhibited significant gains in their ability to organize their thoughts, develop coherent arguments, and employ effective language mechanics. Another study revealed that PjBL writing instruction promoted creativity and self-confidence among students, leading to more engaging and impactful writing pieces (Kurniawati, 2023; Wati, 2018). These findings underscore the effectiveness of PjBL in nurturing students' writing skills and preparing them to communicate effectively in various contexts.

Each group generally chose a mini-project title related to the utilization of microorganisms in the production of probiotic foods. Examples include the use of moringa seeds for tempe, strawberry-infused kombucha, nata from apple and purple yam peels, and tape from kapok bananas. All groups have developed good ideas that contribute to waste management or the diversification of local food to increase the value of these foods. The ability to think critically is an invaluable asset for students, enabling them to effectively navigate and address the challenges they encounter in their daily lives (Luna Scott, 2015). Critical thinking empowers students to analyze situations objectively, identify root causes, generate creative solutions, and implement those solutions effectively. This process equips them to tackle a wide range of problems, from personal challenges and academic dilemmas to social issues and environmental concerns (Bramwell-Lalor et al., 2020; Retnowati et al., 2020).

These mini-research projects have demonstrated positive outcomes for students in terms of their ability to write mini-research reports, which will have a lasting impact on their awareness. Additionally, these projects have also helped students understand the framework of scientific report writing, preparing them better for their final assignments. As stated by researchers have found that engaging students in hands-on research experiences, such as mini-projects, can significantly enhance their scientific writing skills and overall research competencies (Haryono & Adam, 2021; Kaneza et al., 2024). These projects provide students with a practical platform to apply their knowledge, develop critical thinking skills, and effectively communicate their findings in a structured and organized manner.

4. CONCLUSION

The study concludes that the implementation of mini-research projects within a project-based learning (PjBL) framework significantly enhances students' scientific writing skills and overall engagement in biotechnology education. The findings indicate that while students showed improvement in various aspects of their writing, particularly in presenting research findings, there were still areas needing development, such as the discussion section of their reports. The research emphasizes the importance of active participation in mentoring sessions, which correlates with higher motivation and better writing outcomes. Overall, the study suggests that hands-on research experiences are effective in fostering critical thinking, motivation, and good skills on writing scientific report among students.

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