

Boosting 21st Century Skills: Project-Based Microteaching's Impact on Communication and Collaboration in Biology Education

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ABSTRACT

This study uniquely addresses the gap in preparing prospective biology teachers for 21st-century education by integrating Project-Based Learning (PjBL) into microteaching. The research investigates the impact of this innovative approach on enhancing essential skills such as communication and collaboration. Utilizing a quantitative one-group pretest-posttest design, data was collected from 34 students out of a population of 109 through random sampling, employing questionnaires and interviews. The analysis, conducted using t-tests, revealed a significant improvement in both communication and collaboration skills, with collaboration showing a higher influence. These findings underscore the efficacy of PjBL in fostering these competencies, which are critical for modern educational environments. The implications of this study suggest that optimizing project design, providing robust support and guidance from educators, ensuring resource availability, focusing on continuous evaluation, and offering targeted training for educators are vital for the successful implementation of PjBL-based microteaching. This approach not only enhances the pedagogical skills of prospective teachers but also aligns with the broader educational goal of developing well-rounded, competent educators equipped to meet the challenges of contemporary classrooms. The study's results contribute valuable insights for educational policy and curriculum development, emphasizing the need for innovative teaching methodologies to prepare future educators effectively.

1. Introduction

The landscape of education in the 21st century demands a revolutionary approach to prepare prospective teachers effectively. In an era marked by rapid technological advancements and global interconnectedness, the traditional methods of teacher education are being challenged to meet the evolving needs of modern classrooms. Prospective teachers must be equipped with not only subject knowledge but also essential skills such as communication and collaboration. These competencies are pivotal in fostering a learning environment that promotes critical thinking, creativity, and problem-solving abilities among students (Knight et al., 2014).

Despite the ongoing efforts to enhance pedagogical knowledge and skills, teacher education programs often fall short in integrating 21st-century skills into their curricula. The conventional focus on basic teaching skills has left significant gaps in preparing teachers for the complexities of contemporary education. Current programs tend to prioritize traditional approaches, neglecting the

development of essential skills such as effective communication and teamwork, which are crucial for sustaining educational progress (Cochran-Smith & Villegas, 2015).

Research indicates that collaboration and communication are integral components of 21st-century education. Collaboration enables students to adapt to diverse perspectives and work effectively in team settings, while communication facilitates the articulation of ideas and solutions, both verbally and non-verbally (Robinson, 2017; Greenstein, 2012). These skills are not only interrelated but also foundational in preparing prospective teachers for real-world teaching scenarios. The urgency to integrate these skills into teacher education has been further accentuated by the integration of technology in learning and the challenges posed by the Covid-19 pandemic (Iskandar, 2023; Byrnes et al., 2021).

Microteaching, a prevalent method used to train prospective teachers in basic instructional skills, traditionally lacks components that foster project-based learning (PjBL) and the development of

communication and collaboration skills. While microteaching is effective in honing basic teaching techniques such as classroom management and material explanation, it does not adequately prepare teachers to navigate the demands of 21st-century education (Donnelly & Fitzmaurice, 2011). This shortcoming highlights the necessity for a more innovative and future-oriented approach.

Integrating PjBL into microteaching presents a promising opportunity to bridge these gaps. PjBL not only enhances academic skills but also cultivates essential life skills by engaging students in real-world challenges. This approach promotes active learning, increases student motivation, and supports the mastery of diverse competencies (Gómez-Pablos et al., 2017). Moreover, it aligns with the MBKM (Merdeka Belajar Kampus Merdeka) curriculum, which advocates for flexible and student-centered learning models.

The significance of mastering communication and collaboration skills cannot be overstated. These skills empower prospective teachers to effectively address contemporary educational challenges, enhance classroom interactions, and prepare students for future success. Critical thinking and creativity, coupled with efficient communication and productive collaboration, form the cornerstone of an engaging and effective teaching-learning process (Trilling & Fadel, 2009).

Survey data underscores the necessity for a more effective microteaching model. Among 65 respondents, including biology teachers, students, and lecturers, 91% reported difficulties in enhancing 21st-century skills, particularly collaboration and communication. Additionally, 87% of 120 surveyed biology students expressed a preference for microteaching courses incorporating the PjBL model. These findings indicate a clear demand for a reformed microteaching approach that addresses these critical skills.

This research aims to fill this gap by exploring the impact of PjBL-based microteaching on the development of communication and collaboration skills in prospective biology teachers. This study's novelty lies in its potential to inform classroom practices and educational policies, providing a model that integrates essential 21st-century skills into teacher education. The findings are expected to contribute constructively to the academic discourse and practical applications in teacher preparation programs.

The structure of this paper is organized as follows: the introduction provides the context and rationale for the study, highlighting the gaps in current teacher education practices. The methodology section outlines the research design, population, sample, data collection, and analysis methods. The results and discussion sections present the findings and their implications, while the conclusion summarizes the study's contributions and suggests directions for future research. The implications of this study emphasize the critical role of innovative teaching methodologies in

preparing future educators, advocating for the integration of PjBL in microteaching to enhance the competencies required for 21st-century education.

2. Method

This research is a quantitative research with a one-group pretest-posttest research design. The results will be used as considerations in developing microphone teaching and other policies.

Table 1. Research Design

SUBJECT	PRETEST	TREATMENT	POSTTEST
Prospective Biology Teacher	O1	X	O2
Ket: O1 , O2 = test X = Implementation of pjbl-based microteacing (Leedy & Ormrod, 2015)			

The research population was biology education students at Jambi University who took microteaching classes as many as 120 students. The research sample was obtained by random sampling, namely 34 students of Regular B Microteaching biology education class.

Data was collected through survey methods and interview. The instrument used was a communication and collaboration skills questionnaire, as well as an interview guide. Questionnaires were given in pretest and posttest stages. The questionnaire was used to determine the condition of collaboration and communication skills of prospective biology teachers before and after implementing the learning. Interviews were conducted to confirm the findings from the survey and support the validity of the findings of this research.

The data was analyzed quantitatively. A t-test was carried out to determine the effect of project based learning on microteaching. Before that, the data obtained from the questionnaire (pretest and posttest) was tested for normality to determine the distribution of the data. Furthermore, the results of this data analysis will answer the following hypothesis:

H1 = There is a significant influence of microteaching based on project based learning on communication and collaboration skills.

H0 = There is no significant effect of microteaching based on project based learning on communication and collaboration skills.

3. Result

The research was conducted using 34 prospective biology teachers who had taken microteaching courses. Demographically, prospective biology teachers consist of men and women, but the majority are women. age range 20-21 years. No previous teaching experience. they have passed the courses on learning planning, learning models, and learning evaluation.

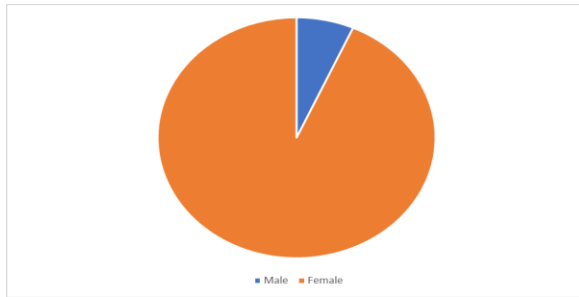


Figure 1. Respondent Demographics

After carrying out a thorough plan, pretest and posttest data were obtained from prospective biology teachers. The research results are presented in [table 1](#) which shows changes in students' communication and collaboration skills. The following are the results of the pretest and posttest of communication and collaboration skills for prospective biology teachers in microteaching based on project based learning.

Table 2. Results of Pretest and Posttest

R	Communication		Colaboration	
	P0	P1	P0	P1
1	2.17	3.83	2.75	4.00
2	2.33	2.83	2.25	3.50
3	2.83	3.33	2.67	3.25
4	3.00	3.17	2.75	3.50
5	1.17	3.33	1.75	3.75
6	2.50	3.33	2.25	3.75
7	3.00	3.50	2.67	3.75
8	2.67	3.33	2.75	3.75
9	3.50	2.83	2.67	3.50
10	2.83	1.83	2.25	2.25
11	2.67	3.17	2.75	3.75
12	2.17	2.67	2.50	3.50
13	2.00	2.33	2.75	3.50
14	3.00	3.50	2.75	3.75
15	2.17	2.67	3.00	2.75
16	2.33	3.00	2.75	3.00
17	3.33	3.17	2.75	3.50
18	2.50	3.50	2.75	3.50
19	3.17	2.83	2.50	3.25
20	2.67	2.33	2.50	3.00
21	3.50	2.33	2.50	2.50
22	3.17	2.83	2.67	3.25
23	2.17	2.67	2.25	4.00
24	2.33	2.33	2.67	3.00
25	2.83	2.67	2.67	3.25
26	3.20	3.00	2.67	3.25
27	1.67	3.67	2.25	4.00

R	Communication		Colaboration	
	P0	P1	P0	P1
28	2.00	2.67	2.00	3.75
29	3.17	3.00	2.50	3.25
30	3.33	3.00	1.75	3.25
31	2.83	3.00	2.50	3.25
32	1.50	3.00	1.75	3.50
33	2.00	2.67	2.75	3.50
34	2.83	2.67	3.00	3.00

As a form of validation to ensure that changes in skills have indeed occurred, further analysis was conducted by examining the average difference between the two skills. It was found that there is a notable difference in the average skills of students as prospective biology teachers before and after participating in microteaching based on project-based learning ([Table 3](#)). This analysis demonstrates a significant increase in the average skills observed between the period before the implementation of the model and after its implementation. This improvement underscores the effectiveness of integrating project-based learning into microteaching for enhancing essential skills among prospective biology teachers.

Table 3. Pretest and Posttest Average

No	Skill	Pretest	Posttest
1	Communication	2,6	2,9
2	Collaboration	2,5	3,3

Based on [table 2](#), it can be seen that students' communication skills before implementing the model were 2.6 and after implementing the model increased to 2.9. Furthermore, in the collaboration aspect, students were found to have an average of 2.5 and after taking part in microteaching based on project-based learning there was a significant increase, 3.3. Next, a prerequisite test is carried out to find out whether the data is normally distributed or not. The test was carried out using Kolmogorov-Smirnov and the results showed that the data was normally distributed.

Table 4. Normality Kolmogorov-Smirnov Test

No	Skill	P-Value	Category
1	Communication	0.204	Normal
2	Collaboration	0.200	Normal

From [table 4](#) it is known that each class data is normally distributed for each indicator observed. The communication skills aspect has a p-value of 0.204 and is categorized as normal. So, the collaboration aspect is in normal condition (0.200).

The t-test requires the prerequisite of normally distributed data. This test has been carried out and the results allow it to be continued with the t test. This test was taken to see the effect of implementing the project-based learning model in microteaching learning. The results showed that there was a significant influence from the application of this model on two students' 21st century skills (communication and collaboration).

Table 5. Result of T-Test Analysis

No	Skill	Uji T	Category
1	Communication	T=-2.597, P=0.014	Significant
2	Collaboration	T=-9.048, P=0.000	Significant

The results also confirm that the research hypothesis H1 is accepted, while the null hypothesis H0 is rejected. This finding indicates that microteaching based on the project-based learning (PjBL) model significantly influences students' communication and collaboration skills. These two competencies are essential components of 21st-century skills, which are critical for teachers to thrive and adapt in future educational environments.

To further validate these findings and enhance the reliability of the data, an interview session was conducted. This session aimed to confirm the quantitative data and gather qualitative feedback on the learning experiences. The interviews focused on the influence of PjBL-based microteaching on communication skills, specifically examining aspects such as reception, oral communication, and presentation skills. By incorporating direct feedback from participants, the study ensured a comprehensive understanding of how PjBL impacts these crucial skills.

Participants provided insights into their experiences with PjBL-based microteaching, highlighting improvements in their ability to receive and process information, communicate effectively in oral presentations, and present ideas clearly and confidently. This qualitative data not only corroborates the statistical findings but also offers a richer perspective on the practical benefits of integrating PjBL into microteaching.

Overall, the combination of quantitative and qualitative data provides robust evidence that the PjBL model significantly enhances communication and collaboration skills among prospective biology teachers. These findings underscore the importance of adopting innovative teaching methods to equip future educators with the skills necessary to succeed in the evolving landscape of education.

"I think this learning model can help me to practice communicating in front of the class" (R1/M).

"Learn to make presentations in front of the class so that you don't feel awkward when explaining the material in front of real students" (R2/F).

"The benefit that I feel is that my communication skills have improved to become a prospective biology teacher" (R3/F).

"What I feel is that we can communicate within the group to complete the task together" (R4/F).

"The project based learning model implemented is good and we can learn how to communicate well" (R5/F).

"What I feel is that my presentation skills have become better" (R6/F).

"Microteaching is an opportunity for me to practice communication skills, especially when explaining lesson material in front of the class" (R7/F).

"With the stages in making teaching videos, I can get used to speaking in front of many people" (R8/M).

"Taking this microteaching lecture can help me to practice my communication skills as a prospective teacher" (R9/F).

"Teaching requires fluency in conveying information and we have practiced through microteaching based on project based learning" (R10/F).

Apart from that, confirmation was also carried out regarding aspects of collaboration capabilities. The aspects of collaboration highlighted are cooperation, responsibility and respect for friends. The following are the results of interviews with student respondents as prospective biology teachers.

"Through microteaching we learn to work together, for example in preparing teaching modules" (R1/F).

"The integration of the project based learning model with clear direction is very helpful for being responsible in learning" (R2/F).

"Collaboration in this era is very important and we can train it through this project-based microteaching" (R3/M).

"Through this learning, we learn among fellow group members to be responsible and respect each other" (R4/F).

"Learning that requires project completion requires us to collaborate among fellow group members" (R5/F).

"From microteaching I learned to be a good teacher not only cognitively, but also requires other skills such as collaboration" (R6/F).

"After taking part in microteaching lessons, we can realize the importance of respect and respect for each other. This is also a value that prospective teachers must have" (R7/F).

"Microteaching with PjBL does not only train us to have good teaching skills, but also to work together in groups" (R8/F).

"This lecture is very helpful in honing the cooperation of group members" (R9/F).

"I feel collaboration is an important aspect to improve as a prospective teacher" (R10/F).

The results of this interview confirm and strengthen previous results. This will also help in decision making in this research.

4. Discussion

This study reveals that the Project-Based Learning (PjBL) based microteaching model has a significant impact on improving collaboration and communication skills. These findings provide empirical evidence regarding the effectiveness of PjBL in the context of microteaching, especially in the education of prospective biology teachers. The PjBL-based microteaching model allows prospective teachers to develop their teaching skills through projects that require collaboration and effective communication. In this context, it is important to understand how PjBL influences these skills and the implications for the education of prospective teachers.

4.1 Communication Skills

Communication skills are a vital component in education, especially in preparing prospective biology teachers. Research data shows that the PjBL-based microteaching model significantly increases students' ability to convey ideas and information effectively, with a T value of -2.597 and P 0.014. Effective communication involves listening attentively, articulating ideas clearly, and utilizing various communication media. These skills are essential in classroom interactions and educational organizations. Effective communication prepares teacher candidates to interact with diverse audiences, including students, colleagues, and other stakeholders. This ability also helps in conveying complex subjects, such as biology, in an understandable way. With good communication skills, prospective teachers can create a conducive and engaging learning environment. According to [Brinia et al. \(2022\)](#), effective communication skills are crucial for preparing prospective teachers for productive classroom interactions.

4.2 Collaboration Skills

Collaboration skills also showed a significant increase after implementing the PjBL-based microteaching model, with a T value of 9.048 and P 0.000. Interestingly, collaboration skills received the highest score compared to communication skills, indicating that PjBL is particularly effective in fostering cooperation among students.

In PjBL, project assignments encourage students to work productively together, respect each other, listen and discuss various ideas, and compromise to complete the project optimally. Each student takes responsibility and contributes to the assigned tasks, allowing their collaboration skills to develop naturally.

Collaboration is a fundamental skill in the teaching profession, enabling educators to work effectively with colleagues, students, and the broader school community. By fostering good collaboration, teachers can leverage shared resources, teaching strategies, and experiences to enhance the quality of education. [Çelik et al. \(2018\)](#) highlight that project-based learning (PjBL) initiatives offer students valuable opportunities to develop critical thinking skills, engage in collaborative teamwork, and conduct independent research, underscoring the importance of collaborative learning environments in educational settings ([Elstad et al., 2019](#)). Effective collaboration among teachers is essential for promoting professional growth and improving instructional practices. Research by [Elstad et al. \(2019\)](#) emphasizes the significance of teachers engaging in collaborative activities across different subjects to enhance feedback provision on student assignments, illustrating how collaboration can positively impact teaching practices and student learning outcomes ([Elstad et al., 2019](#)). Furthermore, studies by [Bajar et al. \(2021\)](#) and [Witti \(2023\)](#) underscore the benefits of regular teacher collaboration in strengthening pedagogical expertise, encouraging innovation, and fostering a culture of continuous improvement within educational institutions ([Bajar et al., 2021](#); [Witti, 2023](#)).

In the teaching profession, collaboration extends beyond internal interactions among educators to encompass partnerships with external stakeholders. explore professional relationships within and outside schools, shedding light on the barriers and opportunities associated with intergenerational collaborations among teachers, highlighting the importance of diverse collaborations in enriching educational practices ([Abellán et al., 2022](#)). Additionally, [Vangrieken et al. \(2015\)](#) provide a systematic review of teacher collaboration, offering insights into the terminological framework used to describe collaborative practices in educational research, further emphasizing the significance of collaborative endeavors in the teaching profession ([Vangrieken et al., 2015](#)).

4.3 PjBL Syntax and Microteaching Implementation

PjBL has learning steps that educators must understand and implement to achieve learning goals. [Widiasworo \(2016\)](#) explains that there are six steps in PjBL: (1) formulating fundamental questions, (2) designing solutions as projects, (3) scheduling project completion, (4) monitoring, (5) project assessment, and (6) evaluation.

These steps are applied in the implementation of microteaching in the classroom. Basically, microteaching aims to prepare prospective teachers by reducing the complexity of teaching so that they can focus on developing specific skills. For example, teaching practice can be done by recording prospective teachers' teaching activities, which are then evaluated together.

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endeavors in the teaching profession ([Vangrieken et al., 2015](#)).

4.4 Effectiveness and Challenges of PjBL

The findings of this study are in line with research by [Sagala et al., \(2020\)](#), which states that implementing PjBL can improve collaboration skills. In the context of the Industrial Revolution 4.0, collaboration skills are very important, and projects in PjBL provide opportunities for students to think critically, collaborate with team members, and conduct independent research. The implementation of PjBL in various countries shows that this approach can increase student motivation, conceptual understanding, collaboration skills, and critical thinking skills ([Raja & Abirami, 2022](#)).

However, the success of PjBL is highly dependent on project design, support from educators, and availability of resources. Teachers must ensure that there are sufficient opportunities for students to discuss, share ideas, and provide feedback to each other. In the last decade, the use of PjBL has undergone significant changes with greater emphasis on collaboration, reflection and critical evaluation skills ([Untari et al., 2020](#); [Kurniahtunnisa, 2023](#); [Bulu, 2021](#)).

4.5 Effective Communication Skills

Effective communication is very important in this global era. According to [Trilling & Fadel, \(2009\)](#), effective communication involves the ability to listen attentively, articulate ideas clearly, and utilize various communication media. These skills prepare students to communicate with diverse audiences. In an educational context, good communication skills enable prospective teachers to convey subject matter in a way that is easily understood by students, as well as to interact with parents, colleagues, and other community members.

Communication and collaboration skills improve with the implementation of the PjBL-based microteaching model due to effective teamwork. Effective teamwork encourages students to communicate well to achieve common goals. These effective interactions improve collaboration and communication skills. PjBL has been proven to improve students' communication and collaboration skills ([Kumalaretna et al., 2017](#)).

In implementing the PjBL-based microteaching model, students are often involved in group discussions and exchanging ideas to solve problems or design projects. This process requires listening, speaking, and expressing opinions clearly thereby improving communication skills. In addition, the PjBL-based microteaching model involves project presentations in front of the class or panel. Students must communicate the results of their projects clearly and receive feedback from classmates and lecturers. This activity is very effective in practicing verbal and non-verbal communication skills.

Project-based learning as an active learning model has learning activities through group discussions and presentations. Of course, this will be a good platform and opportunity for students to practice their communication skills, both verbal and non-verbal. Several findings also provide support that this learning model has a good impact on communication skills. (Haniah & Setyaningsih, 2021; Menggo et al., 2023; Mukaromah & Wusqo, 2020; Suciari & Suwono, 2021).

4.6 Student Perspective

These findings were also confirmed by students as future biology teacher candidates. After participating in project learning-based microteaching, they felt changes in their communication skills. Of course, this is a good thing because communication is a vital aspect of teaching. In fact, it has its own urgency if it is related to the development of the 5.0 era (Ambarawati, 2021).

Students emphasized that project-based learning requires good collaboration to complete it. In these conditions, collaboration is the key to group success. Students also expressed that their sense of responsibility and mutual respect also experienced good changes after attending this microteaching lecture.

4.7 Benefits of PjBL in Learning

The application of PjBL in learning (especially microteaching) is known to have good benefits for collaboration skills. Among these are student motivation, increasing teamwork, and stimulating joint creative efforts to solve problems (Andriyani & Anam, 2022). Collaboration is essentially an essential skill in the teaching profession. Usually, teachers will be required to be able to adapt and collaborate with colleagues and other factors in their world of work. This is also recommended for higher education in preparing prospective teachers (Bush & Grotjohann, 2020).

The success of implementing this model cannot be separated from efforts to maximize various factors supporting the implementation of project-based learning. Hignasari et al., (2023) explains that optimizing project-based learning can be done by providing guidance and guidance to students. Therefore, in its implementation, PjBL-based microteaching is equipped with a logbook as a means of monitoring by educators. Awareness in preparing prospective teachers (especially prospective biology teachers) must be supported by every relevant party. Students must get the best service, both in learning and other facilities. The success of this coaching process will influence the teaching skills possessed by prospective teachers (Agustina & Saputra, 2017).

Recommendations for Improving PjBL Implementation

- 1) Optimizing Project Design: Good project design is the key to PjBL's success. Teachers must ensure

that the projects given are relevant, challenging, and encourage students to think critically and collaborate (Untari et al., 2020).

- 2) Support and Guidance from Educators: Educators must provide clear guidance and adequate support during the PjBL process. The use of notebooks as a monitoring tool by educators can help in providing constructive feedback (Hignasari et al., 2023).
- 3) Increased Availability of Resources: The availability of adequate resources, such as learning materials, technological tools, and discussion spaces, is very important to support the effective implementation of PjBL (Untari et al., 2020).
- 4) Communication Skills Development: Educators must ensure that there are sufficient opportunities for students to discuss, share ideas, and provide feedback to each other. Good communication skills are very important in this global era (Yusof et al., 2016; Reith-Hall, 2023).
- 5) Continuous Evaluation: Teachers and students must carry out continuous evaluation of implemented projects. Video recording of the microteaching process can be an effective evaluation tool for measuring teaching skills and providing constructive feedback (Seco & Cendana, 2022).
- 6) Training for Educators: Educators also need training to implement PjBL effectively. This training can include developing skills in designing projects, facilitating group discussions, and providing constructive feedback (Kumalaretna et al., 2017).

4. Conclusions

21st century learning requires prospective biology teachers to master collaboration and communication skills. Based on this research, the PjBL-based Microteaching Model can improve collaboration skills and communication skills of prospective biology teachers. The PjBL-based microteaching model has proven to be effective in improving the communication and collaboration skills of prospective biology teachers. With good communication skills, prospective teachers can create a conducive and engaging learning environment, while collaboration skills enable them to work together effectively in a variety of contexts. Implementing PjBL requires good project design, support from educators, and the availability of adequate resources. With the right training and guidance, PjBL can be a very effective learning model in preparing prospective teachers who are competent and ready to face challenges in the world of education. These findings emphasize the important role of PjBL in the education of prospective teachers and provide guidance for educational institutions to optimize the implementation of PjBL in their curriculum. Thus, prospective biology teachers will not only have good teaching skills but also the ability to collaborate and communicate effectively, which is very important in the world of modern education.

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