Jurnal
Guru Komputer
Journal homepage: https://ejournal.upi.edu/index.php/JGrKom

Implementation of Project-Based Learning Model Based on Differentiated Learning to Improve Collaboration Skills in Informatics Subjects of Grade 11 of SMA Negeri 15 Bandung

*Farhan Maulana Harahap**

Universitas Pendidikan Indonesia, Indonesia
*Correspondence: E-mail: han.harahap99@gmail.com

ABSTRACT

This study aims to determine the results of the implementation of the Project Based Learning (PjBL) model based on differentiated learning on improving collaboration skills in informatics subjects for Class 11 of SMA Negeri 15 Bandung. The type of research used is Classroom Action Research (CAR). The subjects in this study were all 33 students in class 11 at SMA Negeri 15 Bandung. Data collection techniques were conducted through observation and documentation. Data from observations regarding students' learning concentration were analysed using descriptive statistics from the observations of students' learning concentration during the learning process. The results of the study indicate that the implementation of the Project-Based Learning (PjBL) model based on differentiated learning shows a significant improvement in students' collaborative skills. In cycle 1, the average collaboration skill score of the students was 10.67, with a percentage of 53% (low category). Then, in cycle 2, the average learning concentration score of the students increased to 17.16 with a percentage of 86% (good category), achieving the success indicator. It can be concluded that the implementation of the Project-Based Learning (PjBL) model based on differentiated learning can enhance collaboration skills in the subject of computer science.

ARTICLE INFO

Article History:
Submitted/Received 16 May 2025
First Revised 26 Jun 2025
Accepted 27 Jun 2025
First Available Online 30 Jun 2025
Publication Date 01 Jul 2025

Keyword:
Collaboration,
Differentiated,
Project Based Learning.

1. INTRODUCTION

Much has changed significantly because of developments in information and communication technology, which have brought about enormous changes in various aspects of life, especially in the field of education. These changes have occurred to support high-quality learning, to shape students into individuals with Pancasila character, and to equip them with the skills needed in the future world of work.

Every citizen, regardless of age, has the same rights and obligations to continuously develop their competencies in order to achieve the goals of the Indonesian nation. This is in accordance with the Law of the Republic of Indonesia Number 2 of 1989 concerning the National Education System. Individuals from various generations have the right to obtain or receive lifelong learning opportunities as an effort to produce superior human beings based on the values of Pancasila.

Senior High Schools (SMA) play a crucial role as formal educational institutions that prepare students to pursue higher education while equipping them with the knowledge and basic skills relevant to the challenges of the 21st century. One critical area is mastery of information and communication technology (ICT), where senior high schools are expected to provide adaptive and responsive learning that keeps pace with the times. To compete in the global era, high school students need to master 21st-century skills known as the 4Cs: critical thinking and problem-solving, creativity, effective communication, and the ability to work collaboratively in teams (Nurhayati, 2024). These four competencies are crucial to develop from high school onwards to prepare students for future challenges, whether in higher education or the workforce.

Collaboration skills are the ability of each individual to work with others to achieve previously agreed-upon goals (Nur & Taim, 2023). Collaboration describes cooperation between more than one party or relationships between organisations that participate and agree to achieve common goals. This skill enables learners to collaborate effectively with others, necessitating specific approaches to maximise the effectiveness of their learning outcomes. Collaboration among learners, whether within the same group or across different groups, is believed to enhance their academic performance. Such capabilities are a vital asset in navigating the globalised era, which demands individuals to collaborate with diverse groups possessing varying characteristics and backgrounds.

Efforts to further improve student learning success include efforts to improve the learning process. In improving this learning process, the role of teachers is very important, namely determining the right learning method (Nasron et al, 2024). The learning model used must be in accordance with the learning objectives and the material taught in order to be able to actively involve students during the learning process. One approach that can help overcome this problem is the project-based learning model (Project Based Learning/PjBL) (Hairunisa, 2019; Amelia, 2021).

This model allows teachers to adjust lesson plans or instructions according to the needs of students. The PjBL model is known to improve collaboration or cooperation among group members because PjBL can support children in building their own knowledge through the experience of completing projects together (Faslia, Aswat, & Aminu, 2023).

PjBL also encourages students to actively seek solutions to real-world problems, rather than just passively receiving information from teachers (Amaliya & Kubro, 2025). With PjBL, students can hone their critical thinking, problem-solving, and collaboration skills. Learning with students to be able to process knowledge in every learning activity so that it can stimulate students' skills in every project to improve their conceptual abilities and answer

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

every problem that exists in society. In addition, PjBL can also improve cooperation skills among students and encourage children to be more proactive in the learning process through various activities that are centred on themselves (Wijayanti, 2025). Students will be encouraged to be independent in solving problems and completing tasks, thereby improving their cognitive abilities, group cooperation, learning motivation, teamwork, and creativity.

The Project-Based Learning (PBL) model consists of six main stages, namely: 1) Providing initial stimulation through trigger questions or essential questions to start the learning process; 2) Designing the project to be undertaken by the students; 3) Systematically scheduling the project implementation; 4) Monitoring the project implementation process and the students' progress; 5) Assessing the completed project outcomes; 6) Reflecting on or evaluating the entire learning experience. Each stage in this model will run optimally if supported by appropriate adjustments and cooperation from all parties involved, thereby creating an effective and high-quality learning process. Differentiated learning takes into account a number of factors, including learning preferences, prior knowledge, interest in the subject matter, and students' understanding of the subject matter.

Differentiated learning is an approach that focuses on the individual needs of learners by adjusting the material, process, outcomes, and learning environment based on the learners' preferences, interests, and learning styles (Sarnoto, 2024). This approach enables teachers to teach effectively by making various adjustments to accommodate the unique characteristics of each learner. This allows learners to explore themselves without needing to meet rigid, uniform standards applicable to all learners.

Based on initial observations conducted during PPL 2 activities in class 11 at SMA Negeri 15 Bandung, students still rarely engage in collaborative activities in Informatics lessons. This was confirmed by one of the subject teachers in class 11 at SMA Negeri 15 Bandung, who stated that computer science lessons are typically conducted individually, in line with the number of computers available in the computer lab. The class representative of class 11 at SMA Negeri 15 Bandung also mentioned that computer science lessons often utilise individual projects, resulting in very limited collaborative activities in this class.

Based on the background of the problem stated previously regarding collaboration skills in Class 11 of SMA Negeri 15 Bandung, the researcher is interested in conducting classroom action research with the title "Implementation of the Project-Based Learning Model Based on Differentiated Learning to Improve Collaboration Skills in Informatics Subjects in Class 11 of SMA Negeri 15 Bandung".

2. METHODS

This research was conducted in the even semester of the 2024/2025 academic year at SMA Negeri 15 Bandung. This research was conducted using the Classroom Action Research (CAR) approach. According to Mufidah (2020), CAR is a scientific effort carried out through special activities by educators to improve their professionalism in the learning process in the classroom. This action research aims to overcome various problems that may be faced by educators during the learning process, as well as being a means to improve the quality of learning interactions. In addition, CAR also allows educators to assess student learning outcomes more accurately and objectively.

In the computer science class for grade 11 at State High School 15 Bandung, the Differentiated Project-Based Learning (PjBL) paradigm was used in this classroom action research project with the aim of enhancing students' collaborative skills. The four steps in each cycle of this Classroom Action Research (CAR) study are planning, action, observation,

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

and reflection (Sunny, Sundari, & Kurniasih, 2023). Thirty-three students from class 11 at SMA Negeri 15 Bandung participated in this study, comprising three males and thirty females.

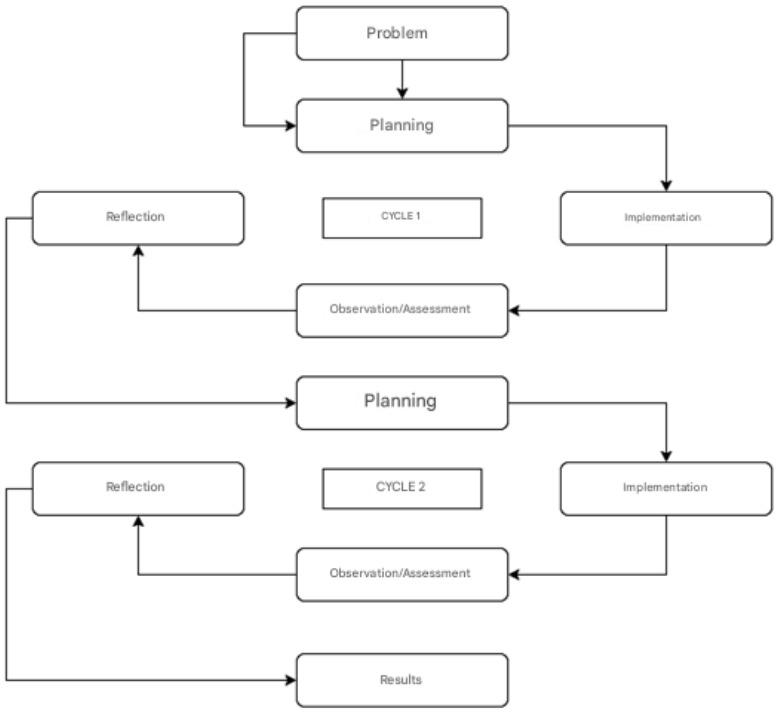

Figure 1. Research Flow.

This study was conducted in four main stages, namely planning, implementation, observation, and reflection. The first stage was planning, in which the researcher observed class 11 at SMA Negeri 15 Bandung to identify problems, develop a lesson plan, prepare open teaching materials, and design research instruments.

The second stage is the implementation of actions, which is carried out by applying the Project Based Learning (PjBL) model tailored to the learning needs of each student.

The third stage is observation, which aims to record various important aspects that occur during the learning process. The final stage is reflection, which involves analysing the results of the observation to identify weaknesses and formulate improvements for the next cycle in order to achieve the research objectives optimally. Two data collection techniques were used in this study, namely observation and documentation.

The observation sheet is used as a research tool in this study. The tool for collecting research data is called a research instrument. At each level of learning, this study integrates two types of data analysis: qualitative and quantitative. Meanwhile, collaboration skills data will be assessed using the indicators ‘Yes’ and ‘No’, while observations of students' progress in collaboration skills will be presented descriptively. A ‘Yes’ response to a positive statement is assigned a value of 1, while a ‘No’ response is assigned a value of 0. Conversely, 'Yes' is assigned a value of 0 and ‘No’ is assigned a value of 1 for responses to negative statements. One way to measure improvements in collaboration is by comparing the values from Cycle 1 with those from Cycle 2.

To determine the effect of the treatment, a comparison between Cycle 1 and Cycle 2 student’s average score is conducted. The formula used to find the average score can be seen in **Equation 1**.

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

$$Average = \frac{total\ scores\ of\ all\ students}{number\ of\ students}$$

Equation 1. Formula used to find student's average score

By dividing the actual score by the desired score and multiplying the result by 100%, we obtain the percentage of the student's score, which indicates the effectiveness of the activity. The formula for determining the percentage of a student's score is as shown in **Equation 2**:

$$Percentage = \frac{Score\ obtained}{Ideal\ score}\ x\ 100\%$$

Equation 2. Formula used to determine the effectiveness of the activity

The results of this observation data were analysed using the following criteria listed in **Table 1**:

Table 1. Classification of Observation Results

Percentage	Criteria
86% - 100%	Very Good
76% - 85%	Good
67% - 75%	Average
0% < 66%	Deficient

3. RESULTS AND DISCUSSION

This study is the result of implementing a project-based learning model based on differentiated learning to improve collaboration skills in the Informatics subject for Grade 11 students. The study focused on investigating Grade 11 students at SMA Negeri 15 Bandung during the second semester of the 2024/2025 academic year. Research data was collected using observation sheets and documentation as instruments. The study consists of two cycles, each cycle comprising two sessions that include planning, implementation, observation, and reflection stages. In each cycle, the researcher will observe how students' collaboration skills develop during learning using the project-based learning model.

3.1. First Cycle

The first cycle of this study consisted of two learning sessions. The Classroom Action Research (CAR) in the first cycle was conducted on 9 and 14 April 2025, with the aim of evaluating the effectiveness of the Project-Based Learning (PjBL) model in improving the understanding of students in class 11 at SMA Negeri 15 Bandung. At this stage, the researcher collaborated with the computer science teacher to plan the learning process by adapting several relevant PjBL models.

The first cycle consists of two sessions. The first meeting focuses on deepening understanding of the concepts, while the second meeting is directed towards group work activities, where students begin working on their first project based on the material that has been presented.

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

Before the learning process began, the researcher conducted preliminary observations to understand the characteristics, interests, and learning styles of the students. The results of these observations were used as the basis for developing learning tools, including teaching modules, learning media, and observation sheets. The researcher and teachers then agreed on a schedule for the learning process, which began on 9 April 2025.

The learning activity began with the delivery of material and interactive discussions. In the first meeting, students received in-depth explanations from teachers about the basic concepts of the material to be used, particularly related to the introduction of HTML and CSS as part of the learning topic. After the basic understanding was conveyed, students were divided into several groups to begin designing and working on collaborative projects based on the instructions and material that had been provided.

During the learning process, teachers acted as facilitators and observers. In practice, students showed varying levels of enthusiasm in participating in learning activities. This research was continued in the next meeting with the aim of evaluating the results of the projects that had been completed and assessing the effectiveness of the Project Based Learning (PjBL) model. The following presents the average scores and percentage of collaboration skills based on each established indicator in **Table 2**:

Table 2. Cycle 1 Collaboration Skills Results

Indicators	Average	Percentage (%)
Students demonstrate the ability to collaborate effectively in groups	10.61	53%
Students are able to adapt to their assigned roles to support productive cooperation	11.12	56%
Students have empathy and are able to understand different points of view	10.24	51%
Students can reach mutual agreement in the decision-making process to achieve group goals	10.73	54%

In the first cycle, the students' ability to work together was not fully evident through concrete actions during the learning process, which was based on a differentiated approach and implemented in a Project-Based Learning (PjBL) model. Based on the data presented in the table above, the students' ability to collaborate effectively in groups was recorded at a percentage of 53%. The ability to adapt to role distribution to support productive collaboration shows a percentage of 56%. Meanwhile, students' empathy and ability to understand different perspectives are recorded at 51%. Additionally, students' ability to reach a consensus in the decision-making process to achieve group goals shows an average percentage of 54%. The average collaboration skills for Cycle 1 can be seen in **Table 3** below:

Table 3. Cycle 1 Collaboration Skills Results

Indicators	Average	Percentage (%)
Collaboration Skills	10.67	53%

Based on the results of Cycle 1 collaboration skills in the table above, it is known that the results of student collaboration during informatics learning using the PjBL model have not yet

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

shown maximum results. Based on the observations in Cycle 1, the average collaboration skill score of the students was 10.67, representing 53% (low category). This indicates that the actions taken in Cycle 1 have not yet yielded optimal results in enhancing the students' potential for collaboration.

Students have not yet fully demonstrated their optimal ability to work together in groups. Some of them still need time to adapt to collaborating with their group mates. Students' ability to adjust to various roles and work productively with other group members still shows obstacles, especially in terms of role distribution that suits each individual's learning style.

In addition, other indicators that require attention are the ability to empathise and appreciate different points of view. Students are also still in the process of improving their skills in reaching mutual agreements for decision-making in order to achieve group goals.

Overall, the implementation of the first cycle still requires many improvements, as most students are not yet accustomed to conducting learning activities in groups. This unfamiliarity causes some students to lose focus during activities and even disrupt other groups during collaboration. As a result, the duration of learning becomes longer than the specified time, and the results obtained are not optimal. This condition also affects the next stage of learning, which becomes less effective.

Therefore, corrective measures are needed in the second cycle to optimise student engagement in collaborative activities and improve the overall effectiveness of learning.

3.2 Second cycle

The second cycle is a continuation of the first cycle and serves as a form of improvement on various shortcomings found in the previous stage. This cycle will be held on 21 and 23 April 2025. In its implementation, adjustments were made to the learning tools to better align with the characteristics, needs, interests, and learning styles of each student. The learning tools were also modified to create a more enjoyable learning environment and support collaborative activities.

In the first meeting of the second cycle, students in class 11 continued working on the project they had started previously. The learning activity began with checking personal appearance and classroom cleanliness, followed by the establishment of class agreements between teachers and students.

Entering the core activity, learning continues to the next stage in the project-based learning model, namely the preparation of a product creation schedule and project development. At this stage, students begin working on a simple website creation project in accordance with the theme that was previously selected. Researchers monitor the progress of the project carried out by each group to ensure active involvement and effective collaboration. As a form of appreciation, the best group is given an award or prize.

Towards the end of the session, the students and researchers reflected on the learning process and summarised the material that had been studied. Before closing the activity, the teacher provided motivation and moral messages, then invited the students to conclude the lesson with a prayer.

The following **table 4** are details of the average indicators and percentage of collaboration skills in cycle 2:

Table 4. Cycle 2 Collaboration Skills Results

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

Indicators	Average	Percentage (%)
Students demonstrate the ability to collaborate effectively in groups	17.73	89%
Students are able to adapt to role sharing to support productive collaboration	17.30	87%
Students have empathy and are able to understand different points of view	17.06	85%
Students can reach mutual agreements in the decision-making process to achieve group goals	16.55	83%

There were changes in student activity during learning activities in cycle 2 compared to cycle 1. It was found that out of 33 students, the student ability indicator showed an ability to collaborate effectively in groups, reaching a percentage of 89%, while the ability to adapt to role distribution to support productive collaboration showed a percentage of 87%. Meanwhile, students demonstrated empathy and the ability to understand different perspectives, with a recorded percentage of 85%. Additionally, students were able to reach a consensus in the decision-making process to achieve group goals, with an average percentage of 83%. The average collaboration skills for Cycle 1 can be seen in **Table 5** below:

Table 5. Cycle 2 Collaboration Skills Results

Indicators	Average	Percentage (%)
Collaboration Skills	17.16	86%

There were significant changes between the implementation of learning in the first cycle and the second cycle, particularly in terms of modifications to activities designed to improve students' collaborative skills through the application of a Project-Based Learning (PjBL) model based on differentiated learning.

In the second cycle, students' collaboration skills showed a significant improvement, with an average score of 17.16 and a percentage of 86%, which is classified as good. This data indicates positive progress compared to the results in the first cycle. When presented in graph form, the results are as follows in **figure 2** and **figure 3**:

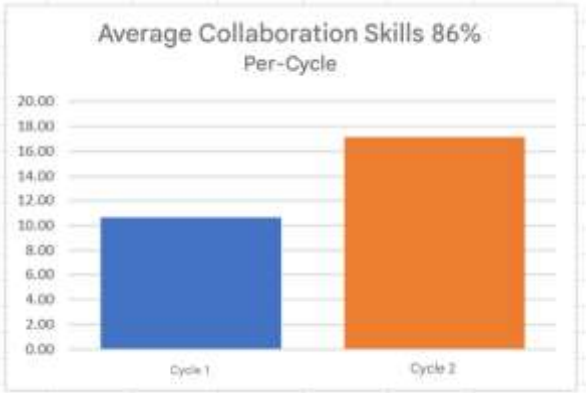

Figure 2. Average Diagram of Collaboration Skill Improvement

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

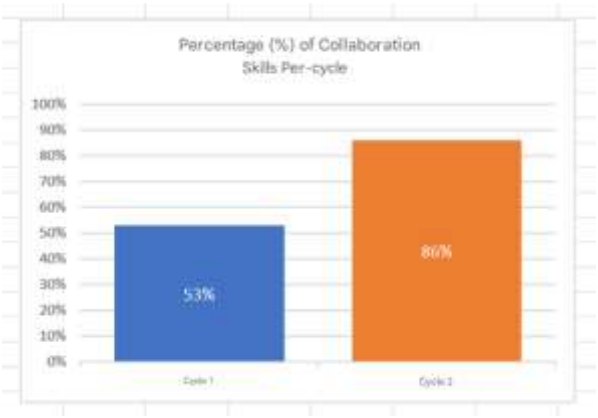

Figure 3. Percentage Increase in Collaboration Skills Diagram

In the second cycle, learning activities were carried out in accordance with the previously designed strategy. The results of the observation data analysis showed that students began to demonstrate teamwork skills, as seen from various indicators during the learning process.

Students are able to share responsibilities, collaborate effectively with other group members, show empathy, understand different perspectives, and are willing to compromise in order to achieve common goals.

In this second cycle, the percentage of students who showed improvement in teamwork skills increased from 53% (Poor category) to 86% (Good category). This achievement indicates that learning activities can be stopped because the indicators of success in collaborative skills among students have been achieved in the second cycle.

4. CONCLUSION

Based on the learning description and discussion results, it can be concluded that the Differentiated Learning-based Project-Based Learning (PjBL) model is capable of improving students' collaboration skills in informatics. This improvement is achieved through the implementation of learning that is tailored to the learning needs of each student.

The learning steps in this model include:

1. Formulating fundamental questions,
2. Designing a product plan,
3. Scheduling the implementation,
4. Monitoring project activities and progress,
5. Evaluating the project outcomes, and
6. Reflecting on the learning experience.

In the first cycle, the collaborative skills of the students showed a percentage of 53%, which is classified as low. Because the actions taken in this cycle did not produce optimal results, the research continued to the second cycle.

In the second cycle, there was a significant improvement. The implementation of learning was carried out more effectively, resulting in an increase in students' collaboration skills to 86%, which falls into the good category. This percentage has reached the predetermined success indicator, so the researcher decided to stop the action in that cycle.

5. ACKNOWLEDGMENT

The author respectfully acknowledge the invaluable support of PPG Program Study of Universitas Pendidikan Indonesia and the contributing teachers of SMAN 15 Bandung in the completion of this research.

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891

6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

7. REFERENCES

Amaliya, R., & Kubro, K. (2025). Strategi pembelajaran (PJBL) aktif untuk meningkatkan keterlibatan siswa di sekolah dasar. *Jurnal Ilmiah Research Student*, *2*(1), 223–235.

Faslia, F., Aswat, H., & Aminu, N. (2023). Pelibatan model Projek Based Learning pada pembelajaran Ilmu Pengetahuan Sosial (IPS) menuju Pelajar Pancasila pada jenjang sekolah dasar. *Jurnal Basicedu*, *7*(6), 3895–3904.

Hairunisa, H., Hakim, A. R., & Nurjumiati, N. (2019). Studi pengaruh model pembelajaran berbasis proyek (Project Based Learning) terhadap kreativitas mahasiswa Program Studi PGSD pada mata kuliah Konsep Dasar IPA. *Jurnal Pendidikan MIPA*, *9*(2), 93–96.

Mufidah, L. (2020). Urgensi penelitian tindakan kelas dalam memperbaiki praksis pembelajaran. *AT-TAJDID: Jurnal Pendidikan dan Pemikiran Islam*, *4*(2), 168–177.

Nasron, H. K., Novriyana, Y., Rosyid, M. A. A., & Susanti, E. (2024). Metode-metode pembelajaran yang diterapkan dalam proses pembelajaran di Indonesia. *Didaktik: Jurnal Ilmiah PGSD FKIP Universitas Mandiri*, *10*(2), 1058-1077.

Nur, S., & Taim, M. A. S. L. (2023). Analisis keterampilan kolaborasi siswa SMA pada pembelajaran biologi. *Diklabio: Jurnal Pendidikan dan Pembelajaran Biologi*, *7*(1), 82–89.

Nurhayati, I., Pramono, K. S. E., & Farida, A. (2024). Keterampilan 4C (Critical Thinking, Creativity, Communication and Collaboration) dalam Pembelajaran IPS untuk Menjawab Tantangan Abad 21. *Jurnal Basicedu*, *8*(1), 36–43.

Sarnoto, A. Z. (2024). Model pembelajaran berdiferensiasi dalam Kurikulum Merdeka. *Journal on Education*, *6*(3), 15928–15939.

Sunny, V., Sundari, F. S., & Kurniasih, M. (2023). Penerapan model Project Based Learning dengan media konkret untuk meningkatkan hasil belajar matematika kelas VE di SDN Polisi 1 Kota Bogor. Didaktik: Jurnal Ilmiah PGSD FKIP Universitas Mandiri, 9(2), 1070-1079.

Wijayanti, R. (2025). Penerapan model Project Based Learning (PjBL) dalam meningkatkan keterampilan menulis pada pembelajaran Bahasa Indonesia. *Jurnal Bima: Pusat Publikasi Ilmu Pendidikan Bahasa dan Sastra*, *3*(1), 63–80.

DOI: http://dx.doi.org/10.17509/xxxx.xxx
p- ISSN xxxx-xxxx e- ISSN 2774-7891