

The Implementation of Project-Based Learning to Enhance Collaborative Skills in Senior High School

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ABSTRACT

Collaboration skills are an important competency in facing the challenges of the 21st-century world. Therefore, collaboration skills need to be developed since students are in school. The Project-Based Learning (PjBL) learning model, whose learning center is focused on students, is said to be able to improve students' collaboration skills. This study aims to describe the implementation of the PjBL model in Senior High School (SMA) and examine its contribution to improving students' collaboration skills. This study uses a literature review method. Analysis was carried out on the implementation of PjBL and the indicators of collaboration skills developed. The data was taken from the Google Scholar and Publish or Perish databases, with the article criteria being an Indonesian article about implementing the Project-Based Learning learning model in high school students with a publication period of 2015 to 2025. 18 articles met these criteria. The results of the study show that to obtain effective implementation of PjBL, teachers must know the proper stages of implementation of PjBL and be able to carry out their role as facilitators well. PjBL has improved students' collaboration skills in five key dimensions: active participation, effective communication, group responsibility, respect for differences, and resource management. These findings reinforce the importance of implementing PjBL as an effective approach in shaping students' collaboration skills in the 21st-century learning era.

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1. Introduction

Collaboration skills are important for humans to be able to compete in the world of work. According to the World Economic Forum in its report entitled "The Future of Jobs Report 2020", collaboration skills are the most needed skills in facing the challenges of the world of work in the future. Collaboration skills include actively contributing to group activities, being responsible,

respecting differences, and using time effectively and efficiently [1]. Collaboration skills are assessed as the ability of students to respect and cooperate with other students [2]. Collaboration means coordinating related parties to work hand in hand, complement each other, and share tasks to achieve a goal [3].

Collaboration skills in learning are important because they will improve student work in groups and will determine the success of students' social relationships in the community [4]. However, research has shown a crisis of collaboration skills among students. In 2015, the Programme for International Student Assessment (PISA) conducted a survey on Collaborative Problem Solving, resulting in data that 28% of students worldwide have difficulty working together in a team [5]. In another study in 2024, research has been conducted on student collaboration skills in post-Covid-19 pandemic learning at SMKN 1 Lamongan. As a result, the collaboration skills of SMKN 1 Lamongan students in learning after the Covid-19 pandemic as a whole were in the medium category, which was 54%. Collaboration skills in students are now introduced to learning in schools through the concept of 21st-century learning [6].

The US-Based Partnership for 21st Century Skills (P21) develops the main skills framework needed to face the challenges of the 21st century, namely "The 4Cs" which are critical thinking, creativity, communication, and collaboration. In 2016, the Ministry of Education and Culture revised the 2013 Curriculum, one of which is by adding 21st-century skills (4C), which are now still valid in the concept of the Kurikulum Merdeka.

Education regulations in Indonesia stipulate in Permendikbudristek No. 16 of 2022 that the implementation of learning is held in a learning atmosphere that motivates students to actively participate, and provides space for students' ideas, creativity, and independence [7]. This learning atmosphere can be achieved by determining a student-centred learning method. Learning that involves the role of students will develop a lot of students' potential in a positive and optimal direction [8]. Student confidence also needs to be increased from the school level so that students can make a real contribution to the surrounding community [9]. Therefore, a learning concept is needed that is able to increase student potential, including in terms of collaboration.

The concept of learning that contains 21st-century skills is called 21st-century learning. 21st-century learning is learning with a student-centred or student-centred learning approach [10]. One of the student-centred learning methods is the Project-Based Learning method. Project-based Based Learning is a project-based learning method with students as the centre of learning. Project-Based Learning allows for the development of students' cognitive and socio-emotional skills [11]. Students need to explore, assess, interpret, synthesize data, and analyze information to obtain learning outcomes in the form of attitudes, skills, and knowledge [12].

Therefore, this study was conducted with the aim of describing the results of the implementation of the use of the Project-Based Learning method at the Senior High School level and describing the Project-Based Learning method to improve students' collaboration skills.

2. Method

The paradigm of this research is qualitative research. Qualitative research is research that aims to describe and analyze individual or group phenomena, social activities, events, attitudes, perceptions, beliefs, and thoughts [13]. The data produced from qualitative research methods are in the form of spoken and written words and human deeds [14]. This type of research is a literature review. According to Nazir, the literature review is a method of collecting data by examining books, literature, notes, and reports that are in accordance with the topic of the problem to be solved. Literature reviews limit their activities to the resources available in the library without the need to conduct field research [15]. The data collection technique applied in this study is the document collection method, in which the researcher collects written materials to obtain the information needed [14]. Data were taken from Google Scholar and Publish or Perish databases with the following document inclusion criteria: a) it is a research article on the implementation of the Project Based Learning learning model; b) research on high school students; c) the research was conducted from

2015 to 2025; d) in Indonesian. The exclusion criteria for this study are research articles that cannot be accessed completely, are not in full text, and are not in languages other than Indonesian.

The articles that have been collected are analyzed and synthesized. Content analysis can be done by systematically recording the content of the document and interpreting it [16]. The researcher describes the implementation, advantages, and disadvantages of the Project-Based Learning implementation applied in each document obtained. Then the researcher analyzed and criticized the implementation of Project-Based Learning on the increase in student collaboration. This study uses a combination of research articles and educational theoretical foundations to compare and synthesize.

3. Results and Discussion

3.1. Implementation of the PjBL Learning Model in Senior High School

In general, the steps implemented are in accordance with the Project-Based Learning syntax. The Project-Based Learning learning model is also known as the PETRA (Projekt-und Transfer Orientierte Ausbildung) method. The Project-Based Learning learning model has 6 stages. First, the determination of fundamental questions. Learning begins with questions that can trigger the presence of assignments or projects that can be done by students. Second, design project planning. The planning contains the selection of projects to be carried out by the students. This stage is carried out collaboratively between students and teachers. The selected activity is the answer to the fundamental question and is integrated with the appropriate subject. This stage also includes the determination of the tools and materials needed for the project. Third, prepare a schedule. Stages Preparing a schedule is related to deadline setting activities, project development timelines, and teacher guidance with students to choose the way students choose to complete the project. Fourth, monitor students and project progress. Student monitoring is a stage of facilitating every student's process. Teachers as mentors monitor and guide students' progress in completing their projects. The use of rubrics will help teachers monitor students and record important activities that occur. Fifth, test the results. The stage of testing the results is the stage of evaluation. Assessments are conducted to determine the achievement of student standards, evaluate, and provide constructive feedback for student progress. Sixth, evaluate experience. The last stage is also called reflection. Reflection is carried out with students expressing their feelings and experiences while completing the project. Then the teacher and students discuss the project evaluation to get answers to the questions asked at the beginning of the learning process [17].

In practice, the form of the project given is very varied and adjusted to the subject and learning objectives. For example, coordination system poster projects, social and religious campaigns, short story and short story text videos, infographics using Canva, and product creations such as hand sanitizers or plant pots from waste. This variation shows that PjBL is flexible and can be applied across maps.

The PjBL learning model can be carried out in a more varied way, the activities are centered on students, and provide opportunities for students to solve problems in daily life. The PjBL learning model is designed so that students practice understanding complex problems and then investigate and study solutions to these problems [12].

Project-Based Learning refers to a learning method in the form of inquiry that asks students to investigate complex tasks in the form of problems, questions, or challenges within a predetermined period of time and by giving freedom to students' voices and choices, especially in the project planning stage. According to Septianingsih, teachers must be able to provide space for students to speak up and make choices when exploring ideas. The space can be provided by providing loose guidance, freedom to determine projects, and freedom to approach according to their learning style [18].

Khalisah's research applies freedom to students to determine the products that students will make. The learning outcomes of students with the complete category in the pre-action obtained a figure of 47%, increasing to 79% in cycle 1 and continuing to increase to 88% in cycle 2. According to students, the PjBL learning model increases students' motivation to follow learning activities well and helps

them understand the material more easily [19]. Similar research was conducted by Adiniyah, which also gave students the freedom to determine the products to be worked on. Uniquely, this research not only applies the product differentiation approach but also applies process differentiation. Students are mapped according to learning readiness and treated according to students' needs and abilities. As a result, there is an increase in student learning outcomes in terms of cognitive, affective, and psychomotor [19].

The PjBL learning model can also be done with the help of learning media such as audio-visual. Purba's research, et al., using the help of learning media, showed a significant increase in individual learning completeness from pretest (28.52%) to cycle 1 (52.61%) and cycle 2 (87.24%) [20]. The PjBL learning model is able to increase students' interest and contribution to learning. Students become more enthusiastic about learning, actively discuss, and dare to express their understanding of the material [21]. Student activity is triggered by students' enjoyment in participating in learning. As mentioned in Rauziani's research [22].

Implementing the PjBL learning model will run well if teachers can be present as facilitators [23]. Teachers as facilitators mean that teachers must be able to play the role of student learning partners. Not only being a facilitator, but the role of motivator and inspirer must also be given to students by teachers. These roles will bring a learning atmosphere to more discussion, students learn to solve problems, and stimulate students' critical thinking through projects [17].

In line with research conducted by Diyanti, which shows that maximizing the role of teachers as facilitators can improve student learning outcomes. It is shown by the percentage of student learning outcomes that increased from cycle 1 to cycle 2 to 45.71%. Teachers maximize their role as facilitators, provide instructions for the implementation of PjBL more clearly, direct students to contribute more actively, and motivate students to reward students with the best results [24].

It is strengthened by research conducted by Habibah et al. with an increase in learning outcomes of 52.5%, which states that to maximize the PjBL learning model, teachers who are able to implement PjBL well are needed [25]. Therefore, teachers really need to understand that their role in the PjBL learning model is as a facilitator who is not patronizing and needs to understand the implementation of good PjBL.

The PjBL learning model has been proven to help students understand the material. The PjBL learning model also shows positive student attitudes during learning, such as being active in discussions, enthusiastic about questions, exchanging ideas, increasing confidence, perseverance, creativity, and cooperation between students [26]. The PjBL learning model stimulates students to be active, understand, and relate concepts so that memories are formed that can be stored for a long time in students' memories [25]. Applying the PjBL learning model with the help of learning media can increase student attention, student activity, and students' ability to respond [20]. This is due to the increase in the role and contribution of all group members and the presence of leaders who encourage fewer active friends to complete project tasks quickly. The results of this finding align with the research of Inayati and Safina, who stated that the choice of learning methods aims to increase understanding, develop creativity, and give students enthusiasm so that they are always motivated to continue learning [27].

3.2. Project-Based Learning Method to Improve Students' Collaboration Skills

The Project-Based Learning (PjBL) learning model is a learning model with investigative activities and responding to problems or challenges that can improve students' knowledge and psychomotor skills by working together. The use of the PjBL model provides students with a learning experience to manage projects and resources [25]. PjBL not only focuses on the project product but also on the team's work process. PjBL allows students to take part in the learning process, produce something, and work together in groups [22].

There are differences in the indicators of collaboration skills, which can be seen in the following table:

Table 1. Collaboration Skills Indicators

No	Research Title	Researchers	Collaboration Skills Indicators
1	<i>Penerapan Model PjBL pada materi Psikotropika terhadap Peningkatan Keterampilan Kolaborasi Siswa XI Mipa 3 SMAN 1 Takalar</i> [28] (The Application of the PjBL Model on Psychotropic Material to Improve Collaboration Skills of Grade XI MIPA 3 Students at SMAN 1 Takalar)	Lusi Indarwati, Andri Faridah Arsal, Rosmawati	Participation in the group Giving ideas Lead discussions
2	<i>Implementasi PjBL Festival Tengah Semester dalam Menumbuhkan Kemampuan Sikap Kolaborasi Siswa pada Mapel Al-Islam di SMA Muh 10 SBY</i> [29] (Implementation of the Mid-Semester PjBL Festival in Fostering Students' Collaborative Attitude Skills in Al-Islam Subject at SMA Muhammadiyah 10 Surabaya)	Fahrunnisa Indillah, Muhammad Bakhruddin, Mulyono	Complete tasks on time
3	<i>Meningkatkan keterampilan Kolaborasi melalui Model Pembelajaran PjBL dengan Alur Merdeka di SMAN 1 Soppeng</i> [30] (Enhancing Collaboration Skills through the PjBL Learning Model with the Merdeka Pathway at SMAN 1 Soppeng)	Usnul Hayati, Kurniadi Saifuddin, Kaharuddin Arafah	Helping each others Participation in the group Responsibility communication skills
4	<i>Penerapan Model PjBL untuk Meningkatkan Keterampilan Kolaborasi dan Kreativitas Pesdik</i> [17] (The Application of the PjBL Model to Improve Collaboration and Creativity Skills of Students)	Nailil Mona, Rivanna Citraning Rachmawati, Moch Anshor	Participation in the group Helping each other Receiving opinions Respect individual differences Responsibility Complete tasks on time.
5	<i>Meningkatkan Keterampilan Kolaborasi Siswa melalui Aktivitas Kebugaran Jasmani Menggunakan Model Project Based Learning (PjBL) SMANegeri 3 Banjarbaru</i> [31] (Improving Students' Collaboration Skills through Physical Fitness Activities Using the Project-Based Learning (PjBL) Model at SMAN 3 Banjarbaru)	M. Tami Rosadi Ahwan, Sunarno Basuki, Mashud	Helping each other Receiving opinions Participation in the group Good results.

To make it easier to understand these findings, the collaboration skills indicator can be simplified in the following graph:

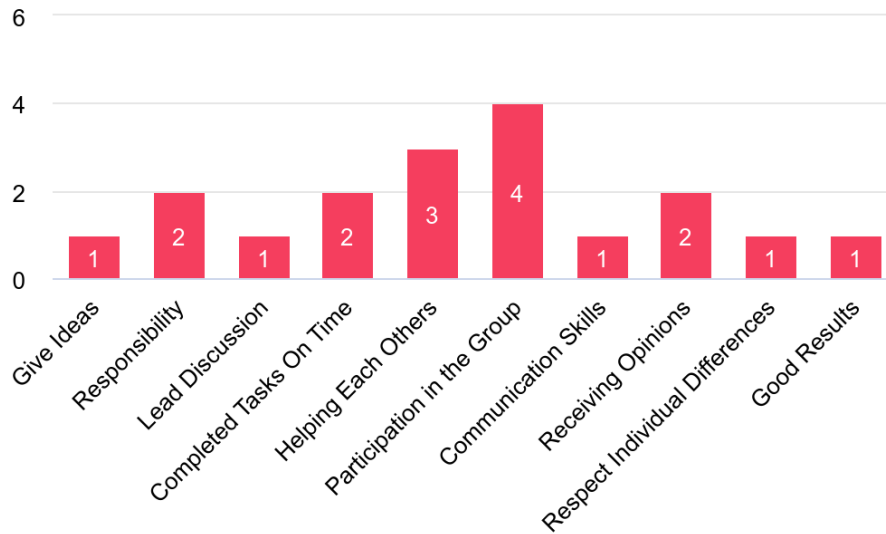


Fig.1. Graph of collaboration skills indicator

Based on the graph, the researchers have a common opinion that indicators of student collaboration skills are seen from student participation in groups and students' attitudes toward helping each other. In addition, some researchers argue that students' collaboration skills can be seen in terms of student responsibility, the ability to receive opinions, collect assignments on time, express opinions, lead discussions, communication skills, respect individual differences, and can be seen from the results of good collaboration.

Research by Lusi Indarwati, et al. emphasizes student contribution as the main indicator of collaboration skills, including the intensity of participation, the provision of ideas, and discussion leadership in psychotropic material projects. The results showed an increase in the percentage of collaboration skills from 61.11% to 80.27% [28].

Meanwhile, the collaboration indicators observed in the study of Usnul Hayati, et al. were more complex, including face-to-face interaction, personal accountability, and communication skills and group work, all of which showed a significant increase from cycle 1 to cycle 2, with an average of 68.63% to 79.46% [29].

The research by Nailil Mona et al. integrates creativity and collaboration in the project of making viral replicas and biopeptideicids. The increase in collaboration skills occurred from 35.34% in the pre-cycle to 85.34% in the second cycle. Uniquely, significant changes in cycle 1 to cycle 2, which were 33.03%, occurred after changes in the group's composition based on student characteristics. This shows that grouping students based on student character has been shown to improve team cohesion and engagement in discussions [17].

Based on these studies, it can be concluded that students' collaboration skills can be seen from several main dimensions. First, active participation in groups can be seen from the intensity of students in discussing, conveying ideas, and completing tasks together. Second, the quality of interaction is reflected in effective communication, direct interaction among group members, mutual help, and emotions that encourage harmonious performance. Third, responsibility to the group includes consistency of attendance, not separating from the group, and time management so that projects that are worked on together can be completed on time. Fourth, the ability to appreciate differences, both differences of opinion and differences in character. Fifth, the use of learning resources and other factors that support collaboration success. This synthesis shows that Project-Based Learning encourages students to produce products or projects and forms a complex and all-round collaborative attitude.

The success of student collaboration is influenced by several factors. First, forming. The success of student collaboration has started since the formation of the group. Groups are formed to achieve learning objectives. Second, functioning. The second factor is to utilize resources so that work and responsibilities in the group are carried out effectively and efficiently. Third, formulating. This is about the student's efforts to understand concepts and strategies to complete the project. Fourth, fermenting or developing. Students' efforts to rethink start with understanding, facing conflicts, seeking information, and conveying conclusions [32].

4. Conclusion

Based on the results of a review of research articles regarding the implementation of the Project-Based Learning (PJBL) learning model at the Senior High School (SMA) level, it can be concluded that the PJBL model has proven to be effective in improving students' collaboration skills. PjBL allows students to actively engage in learning through structured teamwork, project-based assignments, and opportunities to develop social, communication, and responsibility skills.

The implementation of PjBL generally follows six main stages: determining fundamental questions, project planning, scheduling, progress monitoring, testing results, and reflection on experience. The application of this learning model is carried out flexibly according to the context of the subject and the needs of students. The project's form can vary, from posters, social campaigns, creative videos, physical products, to technology-based projects, showing that PjBL can be adapted in various learning situations.

This model significantly contributes to forming students' collaboration skills through five main dimensions: active participation, quality of interaction and communication, individual responsibility towards the group, attitude of respecting differences, and the ability to manage resources and time. The data synthesis showed a significant increase in collaboration indicators after the implementation of PjBL, especially when teachers could act as facilitators, motivators, and supervisors who were responsive to students' learning needs.

However, the success of the implementation of PjBL is largely determined by teachers' strategies in forming groups, facilitating process and product differentiation, and directing healthy collaboration dynamics. If teachers can adapt their approach to students' character, the collaboration process becomes more effective and meaningful.

Thus, the PjBL learning model serves not only as a method to produce project products, but also as a means to cultivate complex and contextual collaborative skills, which are urgently needed in the face of 21st-century learning challenges. Therefore, training or guidance on the implementation of the Project-Based Learning learning model for teachers is needed, so that the implementation of Project-Based Learning can have a maximum impact on students.

Although this study successfully summarizes the implementation of Project-Based Learning in improving students' collaboration skills, there are several limitations that need to be considered. First, the article search process only uses two databases, namely Google Scholar and Publish or Perish, so there is a possibility that relevant articles from other databases have not yet been reached. Second, this study only analyzed articles in Indonesian, so the findings may not represent a global context. Therefore, further research is recommended to use a systematic approach with stricter selection criteria and involving more data sources.

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References

- [1] A. Devia, "Pengaruh Model Project Based Learning (Pjbl) Terhadap Keterampilan Kolaborasi Mata Pelajaran Ips Peserta Didik Kelas V Sd Negeri 4 Kuripan Kota Agung Kabupaten Tanggamus [The Influence of the Project-Based Learning (PjBL) Model on Collaboration Skills in .]" UIN RADEN INTAN LAMPUNG, p. (in Indonesia), 2022. [Online]. Available: <https://repository.radenintan.ac.id/id/eprint/22406>
- [2] Y. Yokhebed, "Profil kompetensi abad 21: komunikasi, kreatif, kolaborasi, berpikir kritis pada calon guru biologi [21st Century Competency Profile: Communication, Creativity, Collaboration, and Critical Thinking in Prospective Biology Teachers]," in *Proceeding Biology Education Conference: Biology, Science, Enviromental, and Learning*, 2019, pp. 1–18, (in Indonesia). [Online]. Available: <https://jurnal.uns.ac.id/prosbi/article/view/38406>
- [3] S. Rahayu, E. E. Pramiasih, and B. A. Sritumini, "Pengaruh model project based learning terhadap peningkatan kemampuan kolaborasi siswa dalam mata pelajaran ekonomi bisnis [The Influence of the Project-Based Learning Model on Improving Student Collaboration Skills in Business Economics Subjects]," *J. Pendidik. Dan Pembelajaran Ekon. Akunt.*, vol. 5, no. 2, pp. 132–143, (in Indonesia), 2019, [Online]. Available: <https://jurnal.fkip.unla.ac.id/index.php/jp2ea/article/view/330>
- [4] N. Afif and A. Fauzi, "Hubungan kecerdasan emosional dan perilaku sosial dengan keterampilan kolaborasi dalam pembelajaran [The Relationship Between Emotional Intelligence and Social Behavior with Collaboration Skills in Learning]," *Paradigma*, vol. 19, no. 1, pp. 40–54, (in Indonesia), 2022, doi: <https://doi.org/10.33558/paradigma.v19i1.3250>.
- [5] P. OECD, *Results (Volume V): Collaborative Problem Solving*, 2017. Paris: OECD Publishing, 2015. doi: <http://dx.doi.org/10.1787/9789264285521-en>.
- [6] E. Shany, M. G. Miranti, and L. T. Pangesthi, "Analisis Kemampuan Komunikasi dan Kolaborasi Siswa Dalam Pembelajaran Post Pandemic COVID-19 [Analysis of Students' Communication and Collaboration Skills in Post-Pandemic COVID-19 Learning]," *Pubmedia J. Penelit. Tindakan Kelas Indones.*, vol. 1, no. 4, pp. 13, (in Indonesia), 2024, doi: <https://doi.org/10.47134/ptk.v1i4.868>.
- [7] P. M. K. R. Pendidikan, "Tahun 2022 tentang Standar Proses pada Pendidikan Anak Usia Dini [The 2022 Standard Process for Early Childhood Education]," *Jenjang Pendidikan Dasar, dan Jenjang Pendidikan Menengah*. p. (in Indonesia), 16AD. [Online]. Available: <https://peraturan.bpk.go.id/Details/224238/permendikbudriset-no-16-tahun-2022>
- [8] A. Puspitasari and Q. Z. A. Murtadho, "Spinning Wheels of Knowledge: Elevating Arabic Language Learning Through Innovative Teaching Methods," *Suhuf Int. J. Islam. Stud.*, vol. 35, no. 2, pp. 50–58, 2023, doi: <https://doi.org/10.23917/suhuf.v35i2.23074>.
- [9] N. F. Rohmah and Z. Abidin, "Model Program Unggulan Di Madrasah Aliyah Darul Huda Mayak Tonatan Ponorogo [Excellence Program at Madrasah Aliyah Darul Huda Mayak Tonatan Ponorogo]," *Suhuf Int. J. Islam. Stud.*, vol. 33, no. 2, pp. 169–180, (in Indonesia), 2021, doi: <https://doi.org/10.23917/suhuf.v33i2.16584>.
- [10] E. Syahputra, "Pembelajaran abad 21 dan penerapannya di Indonesia [21st Century Learning and Its Implementation in Indonesia]," *J. Inf. Syst. Educ. Dev.*, vol. 2, no. 4, pp. 10–13, (in Indonesia), 2024, doi: <https://doi.org/10.62386/jised.v2i4.104>.
- [11] M. F. J. Syah and Suranto, *Strategi Pembelajaran Teori dan Praktik di Abad 21*. Surakarta: Muhammadiyah University Press, 2022.
- [12] M. N. Huda, M. Duwila, and R. Rohmadi, "Menantang Disintegrasi Moral di Era Revolusi Industri 4.0: Peran Revolusioner Pondok Pesantren [Challenging Moral Disintegration in the Era of the Industrial Revolution 4.0: The Revolutionary Role of Islamic Boarding Schools (Pondok Pesantren)]," *J. Islam. Educ.*, vol. 9, no. 1, pp. 1–13, (in Indonesia), 2023, doi: <https://doi.org/10.18860/jie.v9i1.22805>.
- [13] S. A. Mappasere and N. Suyuti, "Pendekatan Kualitatif," in *Metode Penelitian Sosial*, KulonProgo: Penerbit Gawe Buku, 2019, pp. 33–53. [Online]. Available: <https://www.researchgate.net/profile/Ismail->

[Wekke/publication/344211045_Metode_Penelitian_Sosial/links/5f5c132ea6fdcc11640bd740/Metode-Penelitian-Sosial.pdf#page=42](https://www.scribd.com/publication/344211045_Metode_Penelitian_Sosial/links/5f5c132ea6fdcc11640bd740/Metode-Penelitian-Sosial.pdf#page=42)

- [14] Sugiyono, *Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif, dan R&D*. Jakarta: Alfabeta, 2013.
- [15] M. Sari and A. Asmendri, "Penelitian kepustakaan (library research) dalam penelitian pendidikan IPA [Library Research in Science Education Research]," *Nat. Sci.*, vol. 6, no. 1, pp. 41–53, (in Indonesia), 2020, doi: <https://doi.org/10.15548/nsc.v6i1.1555>.
- [16] F. Mulianingsih, K. Anwar, F. A. Shintasiwi, and A. J. Rahma, "Artificial Intellegence dengan Pembentukan Nilai dan Karakter di Bidang Pendidikan [Artificial Intelligence with the Formation of Values and Character in the Field of Education]," *Ijtimaiya J. Soc. Sci. Teach.*, vol. 4, no. 2, pp. 148–154, (in Indonesia), 2020, doi: <http://dx.doi.org/10.21043/ji.v4i2.8625>.
- [17] N. Mona, R. C. Rachmawati, and M. Anshor, "Penerapan Model Project Based Learning untuk Meningkatkan Keterampilan Kolaborasi dan Keterampilan Kreativitas Peserta Didik," *J. Pendidik. Guru Prof.*, vol. 1, no. 2, pp. 150–167, 2023, doi: [10.26877/jpgp.v1i2.230](https://doi.org/10.26877/jpgp.v1i2.230).
- [18] D. Septianingsih, M. Z. Burhanudin, M. Fawzia, H. Irawati, and P. A. Wahyuni, "Implementasi Metode Pembelajaran Project Based Learning Berbasis Teknologi Canva Untuk Meningkatkan Kreativitas Peserta Didik di SMA N 1 Tambun Selatan [Implementation of the Project-Based Learning Method Using Canva Technology to Enhance Student Creativi," *SSRN*, pp. 1–30, 2024, doi: <https://dx.doi.org/10.2139/ssrn.4837650>.
- [19] N. Adiniyah and A. P. Utomo, "Implementasi Model Project Based Learning Berdiferensiasi Berdasarkan Kesiapan Belajar Peserta Didik Pada Materi Sistem Imun Kelas XI SMA [Implementation of the Differentiated Project-Based Learning Model Based on Students' Learning Readiness in the Immun," *J. Teknol. Pendidik.*, vol. 1, no. 1, pp. 1–9, (in Indonesia), 2023.
- [20] A. A. Purba, A. Y. S. Sitanggang, J. Panjaitan, and R. Tampubolon, "Penerapan Project Based Learning (Pjbl) Berbantuan Media Pembelajaran Untuk Meningkatkan Keterampilan Berpikir Kritis Siswa Kelas X Sma Swasta Pamasta Tanjung Morawa 2022 [Implementation of the Differentiated Project-Based Learning Model Based on Students," *J. Penelit. Fis.*, vol. 6, no. 1, pp. 1–14, 2023, doi: <http://dx.doi.org/10.46930/jurnalpenelitianfisikawan.v6i1.2691>.
- [21] I. Ulva *et al.*, "Implementasi Model Pembelajaran Project Based Learning (PjBL) pada Teks Hikayat dan Cerpen dengan Proyek Video di Kelas X SMA Negeri 1 Kota Mojokerto [Implementation of the Project-Based Learning (PjBL) Model on Hikayat and Short Story Texts through a Vid," *Sinar Dunia J. Ris. Sos. Hum. dan Ilmu Pendidik.*, vol. 3, no. 4, pp. 31–39, (in Indonesia), 2024, doi: <https://doi.org/10.58192/sidu.v3i4.2656>.
- [22] R. Shihah, J. Siburian, and A. Sadikin, "Pengaruh Model Project Based Learning (PjBL) Terhadap Kemampuan Berpikir Kreatif dan Keterampilan Kolaborasi Siswa SMA pada Materi Keanekaragaman Hayati [The Effect of the Project-Based Learning (PjBL) Model on Creative Thinking Skills and Collaboration S," *Syntax Lit.*, vol. 8, no. 4, p. (in Indonesia), 2025, [Online]. Available: <https://repository.unja.ac.id/76139/>
- [23] I. Setiawan, "Implementasi Pembelajaran Pendidikan Agama Islam melalui Metode Project-Based Learning di SMA Islam Al-Azhar [Implementation of Islamic Religious Education Learning Through the Project-Based Learning Method at Al-Azhar Islamic Senior High School]," *An Najah (Jurnal Pendidik. Islam dan Sos. Keagamaan)*, vol. 3, no. 2, pp. 58–62, (in Indonesia), 2024, [Online]. Available: <https://journal.nabest.id/index.php/annajah/article/view/390>
- [24] D. Mustafa, A. Adnan, and A. Kuddus, "Implementasi Model Pembelajaran Project Based Learning dalam Peningkatan Hasil Belajar Peserta Didik Kelas XI Materi Sistem Koordinasi di SMA Negeri 6 Makassar [The Implementation of the Project-Based Learning Model in Improving Learning Outcomes of Grade," *J. Pemikir. DAN Pengemb. PEMBELAJARAN*, vol. 5, no. 2, pp. 458–463, (in Indonesia), 2023.
- [25] N. S. Azhari, H. H. Simangunsong, I. A. A. Hrp, N. A. Afdilani, and I. F. Tanjung, "Penerapan Project Based Learning (PjBL) untuk Meningkatkan Hasil Belajar Siswa Kelas XII IPA 1 SMA N 2 Percut Sei Tuan pada Materi Gen [The Application of Project-Based Learning (PjBL) to Improve Learning Outcomes of Grade XII IPA 1 Students at SMA N 2 Pe," *J. PTK Dan Pendidik.*, vol. 8, no. 2,

- pp. 1–7, (in Indonesia), 2022, doi: <https://doi.org/10.18592/ptk.v8i2.6806>.
- [26] Y. Riskayanti, “Peningkatan Keterampilan Berpikir Kritis, Komunikasi, Kolaborasi Dan Kreativitas Melalui Model Pembelajaran Project Based Learning Di Sma Negeri 1 Seteluk,” *Second. J. Inov. Pendidik. Menengah*, vol. 1, no. 2, pp. 19–26, (in Indonesia), 2021, doi: <https://doi.org/10.51878/secondary.v1i2.117>.
- [27] N. L. Inayati and A. Safina, “Manajemen Pembelajaran Tahfidzul Qur’an Santriwati Pondok Pesantren Islam Al-Mukmin Sukoharjo [Management of Tahfidzul Qur’an Learning for Female Students at Al-Mukmin Islamic Boarding School, Sukoharjo],” *Suhuf Int. J. Islam. Stud.*, vol. 31, no. 1, pp. 13–39, (in Indonesia), 2019, doi: <https://doi.org/10.23917/suhuf.v31i1.9003>.
- [28] L. Indarwati, A. F. Arsal, and Rosmawati, “Penerapan Model Project Based Learning(PjBL)pada Materi Psikotropika Terhadap Peningkatan Keterampilan Kolaborasi Siswa XI MIPA 3 SMA Negeri 1 Takalar,” *J. Pemikir. dan Pengemb. Pembelajaran*, vol. 5, no. 2, pp. 357–364, 2023.
- [29] F. Indillah and M. Bakhrudin, “Implementasi Project Based Learning Festival Tengah Semester dalam Menumbuhkan Kemampuan Sikap Kolaborasi Siswa pada Mata Pelajaran Al-Islam di SMA Muhammadiyah 10 Surabaya [Implementation of the Project-Based Learning Middle Semester Festival in Fosterin,” *Risalah, J. Pendidik. dan Stud. Islam*, vol. 9, no. 2, pp. 775–781, (in Indonesia), 2023, doi: https://doi.org/10.31943/jurnal_risalah.v9i2.480.
- [30] U. Hayati, K. Saifuddin, and K. Arafah, “Meningkatkan Keterampilan Kolaborasi melalui Model Pembelajaran Project Based Learning dengan Alur Merdeka di SMA Negeri 1 Soppeng,” *J. Pemikir. Dan ...*, vol. 5, no. 2, pp. 555–559, 2023.
- [31] M. T. R. Ahwan, S. Basuki, and Mashud, “Meningkatkan Keterampilan Kolaborasi Siswa melalui Aktivitas Kebugaran Jasmani Menggunakan Model Project Based Learning (PjBL) SMA Negeri 3 Banjarbaru,” *J. Pendidik. Kesehat. Rekreasi*, vol. 9, no. 1, pp. 106–119, 2023, doi: [10.5281/zenodo.7592832](https://doi.org/10.5281/zenodo.7592832).
- [32] F. U. Nasution, N. Amanda, P. I. Galingging, and W. Arwita, “Studi Literatur: Permasalahan Kolaborasi Siswa dengan Penerapan Model Project Based Learning (PjBL) di SMA Negeri 14 Medan [Literature Study: Issues of Student Collaboration with the Implementation of the Project-Based Learning (PjBL) Model at SMA Negeri ,” *Innov. J. Soc. Sci. Res.*, vol. 4, no. 3, pp. 9800–9807, (in Indonesia), 2024, [Online]. Available: <http://j-innovative.org/index.php/Innovative/article/view/11507>