LITERATURE REVIEW: THE IMPACT OF PROBLEM-BASED LEARNING (PBL) MODEL ON STUDENTS' COLLABORATION SKILLS IN 21ST CENTURY SCIENCE EDUCATION

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Abstract :

The research aims to review the impact of the Problem-Based Learning (PBL) model on students' collaboration skills in science learning through a literature review of various related studies. The method used is a literature review by analyzing several articles that discuss the use of PBL in science learning and its impact on improving students' collaboration skills. The results showed that PBL significantly contributed to the improvement of students' collaborative skills. With the implementation of PBL, students actively participate in solving problems, discussing and working together effectively, which contributes positively to improving their learning outcomes and scientific communication skills. The research also revealed that the success of PBL implementation is strongly influenced by the teacher's role in managing group dynamics and facilitating the learning process. The implication of the study is that PBL can be adopted as an effective learning model in improving students' collaboration skills. Proper implementation and strong teacher support can ensure the success of PBL implementation in improving students' collaborative skills in various learning contexts, especially in science.

Keywords: Collaboration skills, Literature review, Problem-based learning (PBL), Science learning.

INTRODUCTION

Learning in the 21st century emphasizes that collaboration skills are one of the basic competencies that are important for students to have (Redhana, 2019). Collaboration is not only a demand in the modern world of work, but also an important part of the teaching and learning process in schools (Octaviana et al., 2022). In the context of science education, collaboration skills are very important because science and problem solving often require teamwork (Muhammad Musyaddad et al., 2024). Therefore, the development of collaboration skills through appropriate learning methods is needed to support the success of students in understanding science material.

The Problem-Based Learning (PBL) model is one of the effective methods in improving students' collaboration skills in science learning (Tri Pudji Astuti, 2019). This model facilitates students to work in groups, solve authentic problems, and develop solutions through collaborative discussions (Almulla, 2020). PBL provides space for students to exchange ideas, share tasks, and develop shared

responsibility in the learning process (Lou et al., 2017). Therefore, this model has a significant opportunity to improve students' collaboration skills, especially in science learning.

Challenges in science learning are often faced by many students, as this lesson requires a deep understanding of abstract concepts as well as critical thinking skills (Ani & Faninda, 2024). Many students find it difficult when having to solve complex problems individually (Amran et al., 2021). In this case, collaboration skills are key to accelerating the learning process and understanding of the material (Nahar, 2023). By working together, students can support each other, exchange views, and explore various solutions that might not arise if they work individually.

The role of PBL in Collaboration The Problem-Based Learning (PBL) model encourages students to collaborate more efficiently, as they are required to actively interact with each other in solving problems. In addition to improving academic ability, PBL also helps develop crucial social skills, such as communication, cooperation, and leadership. (Nisa et al., 2024). In an environment that uses the PBL model, students are exposed to situations where they have to listen to the opinions of their peers, build arguments, and work towards a common goal (Wulan, 2020). This strengthens the relationship between students and develops their collaborative skills significantly.

Findings from Previous Research Various studies have shown the positive impact of PBL models on students' collaboration skills (Apriyani & Alberida, 2023). Studies show that students who learn using PBL are more likely to show improvement in terms of social skills and teamwork compared to those who follow traditional learning models. Problem-based learning also increases the sense of individual responsibility for the success of the group, which in turn contributes to the achievement of better learning outcomes, particularly in science subjects.

The novelty of this research is that the Problem-Based Learning (PBL) model not only improves academic outcomes, but also facilitates the development of students' collaboration skills in the context of science learning. This study will also pay attention to the role of PBL in shaping more effective group dynamics and concrete strategies that can be used by educators to maximize students' collaboration potential. Thus, this review seeks to provide new insights into how the implementation of PBL can be better adapted to the needs of developing students' social and collaborative skills in the 21st century learning era.

Purpose of Literature Review Based on the importance of collaboration skills in science learning and the potential of the PBL model to improve these skills, this literature review aims to further examine the impact of PBL implementation on students' collaboration skills. This review will analyze the various studies that have been conducted on the implementation of PBL in the context of science learning, and summarize the key findings that can guide teachers and educators in implementing PBL models effectively.

RESEARCH METHOD

This research applies the literature review method to analyze various studies related to the topic of the effect of the Problem-Based Learning (PBL) model on students' collaboration skills in science learning. The literature review aims to identify, evaluate, and synthesize previous studies, so as to provide a comprehensive picture of the contribution of PBL to the development of students' collaboration skills (Abraham & Supriyati, 2022).

Data sources for literature study research include journal articles, books, and other scientific publications that have been indexed in various academic databases, including Google Scholar (Ridwan et al., 2021). Researchers focus on empirical studies that have been conducted in the last five to ten years to obtain the most relevant and up-to-date data (Nasri, 2023). The inclusion criteria in the selection of data sources are:

- Research that studies the impact of PBL in science learning.

- Research that discusses student collaboration skills as one of the variables.

- Articles published in accredited and reputable journals.

Data collection is done through a systematic search using keywords such as Problem-Based Learning, student collaboration, collaboration ability, science learning, and PBL in education.

Researchers will conduct an initial selection based on the title and abstract to determine the suitability of the study to the topic raised. Relevant articles will then be downloaded in full for further analysis.

Data analysis in the study uses the content analysis method (Chen et al., 2020). The main purpose of content analysis is to identify patterns, themes, or meanings contained in the content (Prior, 2020). Researchers will evaluate the research results of each article collected based on:

1. Description of PBL Implementation: How is PBL implemented in the context of science learning?

2. Effect on Collaboration Skills: Is there a significant improvement in students' collaboration skills after the implementation of PBL?

3. Learning Conditions and Related Variables: What factors influence the effectiveness of PBL in improving collaboration, such as the number of students, the type of problem given, or the assessment method?

After the data is collected and analyzed, the results of the study will be grouped based on emerging themes, such as the direct impact of PBL on collaboration, difficulties in implementing PBL, and the relationship between collaboration and science learning outcomes. The results of the analysis will be integrated into conclusions that show the general trends of the studies.

RESULTS AND DISCUSSION

Based on a literature review of several national articles that discuss the impact of PBL models in science learning to improve student collaboration skills, which can be seen in Table 1. Below.

Table 1. Article on the Impact of PBL Model in science learning to improve students' communication skills.

No.	Author	Tahun Terbit	Research Results
1.	Godevila Sriyati Wela, Chandra Sundaygara, Hestiningtyas Yuli Pratiwi	2024	There was an interaction between the problem-based learning model and collaboration skills.
2.	Haslinda, Andi Asmawati Azis, Nur Rajemi Hasan	2024	By using a problem-based learning model, collaboration skills and student learning outcomes improved during the learning process.
3.	Sinta Satria Dewi Pendit, Zulnuraini, Azizah, Ni Putu Devi Handayani	2024	There is a significant effect of using Project Based Learning model with students' collaboration skills in science learning.
4.	Nur Kholifatun Nisa, Endang Susilowati, Akhadani Afta Zahara, Ellianawati	2024	The problem-based learning model can be used to improve students' collaboration skills.
5.	Ivo Rahmawati, Arief Bintoro Johan, Nurul Hidayati	2024	The problem-based learning model can improve students' collaboration skills in science subjects.
6.	Indiarti Dwi Fina, Mustaji, Utari Dewi	2023	Problem-based learning trains students to be able to collaborate, communicate and discuss in achieving one common goal.
7.	Nella Dwi Apriyani, Heffi Alberida	2023	The application of the PBL model can have a significant effect on students' collaboration skills.

8.	Meylani Catur Ambarwati, Rohmad Widodo	2023	Problem-based learning model with STAD method can improve students' collaboration skills.
9.	Fatynia Ilmiyatni, Tri Jalmo, Berti Yolida	2019	Students taught with problem-based learning (PBL) implementation model showed improvement in collaboration skills.
10.	Hilda Novia Sabila , Nadira Rasya Pertiwi, Anita Sintawat	2021	The problem-based learning model can improve the ability of collaborative skills and science communication.

According to Table 1, research on the impact of the Problem-Based Learning (PBL) model on student collaboration skills in science learning provides positive results. There is a significant interaction between the use of the PBL model and the improvement of students' collaboration skills (Wela et al., 2020). This is in line with the findings which show that through the problem-based learning (PBL) model, students' collaboration skills and their learning outcomes can improve during the learning process (Haslinda et al., 2024).

The use of the Project-Based Learning (PBL) model in science subjects significantly improves students' ability to collaborate (Pendit et al., 2024). This model was also declared effective by Nisa et al. (2024) where the PBL model can be effectively used to improve students' collaboration skills in various science learning contexts. It further confirms the effectiveness of PBL in improving students' collaboration skills, especially in science learning, with a focus on improving communication skills to achieve common goals (Tamansiswa et al., 2024).

Further research revealed that the problem-based learning (PBL) model can train students to improve their ability to collaborate and discuss, which ultimately contributes positively to the achievement of better learning outcomes (Fina et al., 2023). These results are reinforced by research showing that the application of problem-based learning models (PBL) has a significant effect on students' collaboration skills, especially in science learning (Apriyani & Alberida, 2023). Focusing on the problem-based STAD learning method as an effective means to improve cooperation between students (Meylani Catur Ambarwati & Widodo, 2023).

Research from Ilmiyatni et al. (2019) concluded that PBL not only improves students' collaboration skills, but also helps in the development of scientific communication abilities. In addition, further research shows that the use of PBL contributes to improving students' collaboration and science communication skills, which are very important in science learning (Wulandari et al., 2021). Overall, these studies emphasize that the PBL model, whether in the form of Project-Based Learning, has a significant impact on the development of students' collaboration skills. Effective collaboration results from students' active involvement in problem solving, group discussions, and intense communication during the science learning process.

The Problem-Based Learning (PBL) model serves as an approach that places students at the center of the learning process, facilitating real problem solving through active collaboration (Akben, 2019). Based on the results of previously discussed research, it is clear that PBL has a significant impact on the development of students' collaboration skills in various aspects of science learning (Limiansih et al., 2020). This ability improvement is not only limited to cognitive aspects, but also includes affective and social aspects, which play an important role in building students' communication and cooperation competencies.

Collaboration in the context of science learning is very important because students are often faced with complex problems that require critical thinking, in-depth discussions, and sharing ideas and solutions (Rosa et al., 2023). The PBL model allows students to exchange views, provide arguments, and jointly find solutions to the problems given, so that the learning process becomes more dynamic and participatory. This is reflected in the research results of Godevila Sriyati Wela (2024) and Ivo Rahmawati (2024) who found that the use of PBL significantly affected students' ability to collaborate and communicate effectively during the science learning process.

In addition, the PBL model also serves as a bridge to develop 21st century skills, especially collaboration skills, which are very important in the current era of globalization and technology (Pertiwi et al., 2023). The ability to work together in teams, think creatively, and communicate effectively are some of the skills that are strengthened through the application of the PBL model. However, although the positive impact of PBL on student collaboration has been proven, the application of this model is not free from challenges. One of the main challenges is the need for a strong teacher role as a facilitator, who must be able to direct and manage group dynamics during the problem-solving process. Teachers must ensure that each student actively participates and is able to contribute to problem solving, so that learning objectives can be achieved optimally.

Research suggests that the application of the Problem-Based Learning (PBL) model has a significant positive impact on improving students' collaboration skills in science learning. PBL invites students to be actively involved in the learning process through group discussions, problem solving, and exchange of ideas (Lou et al., 2017). This not only improves cognitive skills but also affective and social aspects, which have an impact on students' cooperation and communication skills (Lay et al., 2024). In addition, PBL contributes to the achievement of better learning outcomes and promotes 21st century skills, such as collaboration and effective communication, which are crucial in the current era of globalization and technology.

The uniqueness of this study is the emphasis on the influence of PBL in building students' collaborative skills in science learning, which involves the use of various methods of interaction between students. In addition, this study shows PBL as an approach that focuses not only on improving cognitive aspects, but also affective and social aspects of students within the framework of science learning (Argaw et al., 2017). This research deepens the understanding of how interactions in PBL help students develop collaboration skills that are critical for future challenges.

The findings of this study provide important implications for educational practice, especially for teachers as facilitators in the problem-based learning process. Teachers need to understand the central role in guiding, directing and managing group dynamics so that every student can actively participate and develop collaborative skills. In the long run, effective implementation of PBL can strengthen students' collaboration skills, make them better prepared to face complex learning challenges, and improve 21st century competencies such as problem solving, effective communication, and teamwork that will be beneficial in the world of work and global society.

CONCLUSION

Based on the literature review on the impact of PBL model on students' collaboration skills in science learning, it can be concluded that PBL significantly improves learners' collaborative skills. PBL encourages students to actively engage in problem solving, collaboration and effective communication, improving not only learning outcomes but also social skills such as communication and teamwork. Various studies have shown that the use of PBL in science learning has a positive impact on collaboration skills in both academic and social contexts. However, the successful implementation of PBL is highly dependent on the role of the teacher. Thus, PBL is an effective method to prepare students for the challenges of 21st century education through strengthening collaboration and problem-solving skills.

REFERENCES

Abraham, I., & Supriyati, Y. (2022). Desain Kuasi Eksperimen Dalam Pendidikan: Literatur Review. Jurnal Ilmiah Mandala Education, 8(3), 2476–2482. https://doi.org/10.58258/jime.v8i3.3800

Akben, N. (2019). Suitability of problem scenarios developed by pre-service teacher candidates to problem-based learning approach. Eurasian Journal of Educational Research, 2019(83), 231–252. https://doi.org/10.14689/ejer.2019.83.11

Almulla, M. A. (2020). The effectiveness of the project-based learning (PBL) approach as a way to engage students in learning. Sage Open, 10(3), 2158244020938702.

Amran, A., Suhendra, S., Wulandari, R., & Farrahatni, F. (2021). Hambatan Siswa dalam Pembelajaran Daring pada Mata Pelajaran Matematika pada Masa Pandemik Covid-19 di Sekolah Dasar. Jurnal Basicedu, 5(6), 5179–5187. https://doi.org/10.31004/basicedu.v5i6.1538

Ani, S. M., & Faninda, N. P. (2024). Literasi Sains Siswa dalam Berinovasi pada Pembelajaran IPA Berbasis Produk. Jurnal Tadris IPA Indonesia, 1(1), 68–72.

Apriyani, N. D., & Alberida, H. (2023). Pengaruh Model Problem Base Learning (PBL) terhadap Keterampilan Argumentasi Peserta Didik pada Pembelajaran Biologi: Literature Review. BIOCHEPHY: Journal Of Science Education, 03(1), 40–48.

Argaw, A. S., Haile, B. B., Ayalew, B. T., & Kuma, S. G. (2017). The effect of problem based learning (PBL) instruction on students' motivation and problem solving skills of physics. Eurasia Journal of Mathematics, Science and Technology Education, 13(3), 857–871. https://doi.org/10.12973/eurasia.2017.00647

Chen, L., Chen, P., & Lin, Z. (2020). Artificial Intelligence in Education: A Review. IEEE Access, 8, 75264–75278. https://doi.org/10.1109/ACCESS.2020.2988510

Fina, I. D., Mustaji, M., & Dewi, U. (2023). Analisis Kebutuhan e-LKPD Berbasis Problem Based Learning Terhadap Pembelajaran IPA SMP Kelas VIII. Oryza (Jurnal Pendidikan Biologi), 12(2), 173–181. https://doi.org/10.33627/oz.v2i2.1379

Ilmiyatni, F., Jalmo, T., & Yolida, B. (2019). Pengaruh Problem Based Learning Terhadap Keterampilan Kolaborasi dan Berpikir Tingkat Tinggi. Jurnal Bioterdidik, 7(2), 35–45.

Lay, S., Ndoa, P. K., & Hutapea, A. K. (2024). PENERAPAN TEORI BELAJAR KOGNITIF DALAM PEMBELAJARAN PENDIDIKAN AGAMA KATOLIK MENURUT DAVID AUSUBEL. Jurnal Serunai Administrasi Pendidikan, 13(1). https://doi.org/https://doi.org/10.37755/jsap.v13i1.1279

Limiansih, K., Sulistyani, N., & Melissa, M. M. (2020). Persepsi Guru SMP terhadap Literasi Sains dan Implikasinya pada Pembelajaran Sains di Sekolah Kintan. Jurnal Pendidikan MIPA, 14(September), 723–731.

Lou, S. J., Chou, Y. C., Shih, R. C., & Chung, C. C. (2017). A study of creativity in CaC 2 steamship-derived STEM project-based learning. Eurasia Journal of Mathematics, Science and Technology Education, 13(6), 2387–2404. https://doi.org/10.12973/EURASIA.2017.01231A

Meylani Catur Ambarwati, & Widodo, R. (2023). Peningkatan kolaborasi peserta didik melalui model pembelajaran problem-based learning. Jurnal Pendidikan Profesi Guru, 4(1), 9–16. https://doi.org/10.22219/jppg.v4i1.25484

Muhammad Musyaddad, Feliza Paramitha Sinaga, & Sri Wina Oktavia. (2024). Analisis Keterampilan Kolaborasi Peserta Didik Pada Mata Pelajaran Fisika Di Sman Titian Teras Kabupaten Muaro Jambi. Scientica Education Journal, 1(2), 48–65. https://doi.org/10.62872/gx3nqe02

Nahar, L. (2023). The Effects of Standardized Tests on Incorporating 21st Century Skills in Science Classrooms. Integrated Science Education Journal, 4(2), 36–42. https://doi.org/10.37251/isej.v4i2.324

Nisa, N. K., Susilowati, E., & Zahara, A. A. (2024). Peningkatan Keterampilan Kolaborasi Menggunakan Model Problem Based Learning (PBL) Siswa Kelas VIID SMP Negeri 32 Semarang. Seminar Nasional Pendidikan dan Penelitian Tindakan Kelas, 1221–1228.

Octaviana, F., Wahyuni, D., & Supeno, S. (2022). Pengembangan E-LKPD untuk Meningkatkan Keterampilan Kolaborasi Siswa SMP pada Pembelajaran IPA. Edukatif Jurnal Ilmu Pendidikan, 4(2), 2345–2353. https://doi.org/10.31004/edukatif.v4i2.2332

Pendit, S. S. D., Zulnuraini, Azizah, & Handayani, N. P. D. (2024). Pengaruh penggunaan model pembelajaran PjBL terhadap keterampilan kolaborasi siswa pada pembelajaran IPA di kelas VI

SD Inpres 1 Tanamodindi. COLLASE (Creative of Learning Students Elementary Education), 7(1), 120–131. https://doi.org/10.22460/collase.v7i1.21915

Pertiwi, N. R., Sabila, H. N., & Sintawati, A. (2023). Implementasi Model Pembelajaran Problem Based Learning terhadap Keterampilan Kolaboratif dan Komunikasi Sains pada Materi Sistem Ekskresi di Kelas VIII B SMP Negeri 1 Ciamis. Bioed Jurnal Pendidikan Biologi, 11(1), 47. https://doi.org/10.25157/jpb.v11i1.10168

Prior, L. (2020). Content analysis. The Oxford Handbook of Qualitative Research, January 2016, 541–568. https://doi.org/10.1093/oxfordhb/9780190847388.013.25

Redhana, I. W. (2019). Mengembangkan Keterampilan Abad Ke-21 Dalam Pembelajaran Kimia. Jurnal Inovasi Pendidikan Kimia, 13(1).

Ridwan, M., AM, S., Ulum, B., & Muhammad, F. (2021). Pentingnya Penerapan Literature Review pada Penelitian Ilmiah. Jurnal Masohi, 2(1), 42. https://doi.org/10.36339/jmas.v2i1.427

Rosa, E. M., Sundari, S., Ambarwati, E. R., Suryandari, G., Rochmawati, E., & Suryanto, F. (2023). "E-Matching Card" to Improve Cooperation and Cognitive Abilities Among Nursing Students. Jurnal Keperawatan Indonesia, 26(2), 89–96. https://doi.org/10.7454/jki.v26i2.1136

Tamansiswa, U. S., Rahmawati, I., Johan, A. B., & Hidayati, N. (2024). Peningkatan Kemampuan Kolaborasi Siswa Kelas VII melalui Model Problem Based Learning berbasis TRI-N. 3(1).

Tri Pudji Astuti. (2019). Model Problem Based Learning dengan Mind Mapping dalam Pembelajaran IPA Abad 21. Proceeding of Biology Education, 3(1), 64–73. https://doi.org/10.21009/pbe.3-1.9

Wela, G. S., Sundaygara, C., & Yuli Pratiwi, H. (2020). PBL dengan Pendekatan Multiple Representation Terhadap Kemampuan Berpikir Kritis ditinjau Dari Kemampuan Kolaborasi. RAINSTEK Jurnal Terapan Sains & Teknologi, 2(3), 209–220. https://doi.org/10.21067/jtst.v2i3.4711

Wulan, T. A. K. (2020). Pengaruh Model PBL dan Berpikir Kritis Siswa dalam Pembelajaran Sejarah Kelas X di SMAN 6 Muaro Jambi. Journal of Social Knowledge Education (JSKE), 1(2), 52–56. https://doi.org/10.37251/jske.v1i2.350

Wulandari, M., Astalini, A., & Darmaji, D. (2021). Analisis Kebutuhan Mahasiswa terhadap Pengembangan E-Modul Fisika Matematika I di Program Studi Pendidikan Fisika FKIP Universitas Jambi Mashelin. Jurnal Pendidikan MIPA, 20(1), 23–29.