Implementing Project Based Learning (PjBL) in Learning Process: A Systematic Literature Review

Dian Kurniasari[1], Sri Yamtinah[2], Chumdari[3]

[13]Faculty of Elementary School Teacher Education Department, Sebelas Maret University
[2]Faculty of Chemistry Education Department, Sebelas Maret University

diankurniasari99@student.uns.ac.id, jengtina@staff.uns.ac.id, chumdari@staff.uns.ac.id

Abstract. Teachers have implemented project-based learning to support current learning, but several obstacles indicate that teachers have not been able to optimize learning in 21st-century learning. This research is an analytical study to know how project-based learning is applied in the learning process to improve 21st-century skills and the design (teaching materials or learning steps) taken with project-based learning to enhance students' 21st-century abilities. This research was conducted using the SLR (Systematic Literature Review) method. Script search is in an online eBook Collection (EBSCOhost), Science Direct, Scopus, Education Resources Information Center (ERIC), and Directory of Open Access Journals (DOAJ) databases by retrieving a wider variety of texts with accessibility. The analysis results show that project-based learning is a learning model that can improve the abilities of 21st-century students. Project-based learning is structured by designing interesting projects and arranged according to the environment around students, both from the material, planning, organizing material, and matters dealing with material so that students can convey their work based on their learning independence. Project-based learning using suitable media and approaches can improve the student's skills, so it can be recommended that teaching materials be developed based on project-based learning.

Keywords: systematic literature review, project-based learning, teaching-material

1 Introduction

Education today must refer to 21st-century learning because we live in an era of globalization. Improving the quality of science and technology learning is an effort that cannot be delayed any longer in line with the challenges faced by students today, namely the challenges of the 21st century. To prepare students to have 21st-century skills, the learning that teachers must do must also be oriented to 21st-century learning, that has the characteristics or principles: (1) learner-centered learning approach, (2) students are taught to be able to have collaborating skills, (3) learning materials are learning must relate to problems faced in everyday life because learning must enable

M. Salimi et al. (eds.), *Proceedings of the 6th International Conference on Learning Innovation and Quality Education (ICLIQE 2022)*, Advances in Social Science, Education and Humanities Research 767,
https://doi.org/10.2991/978-2-38476-114-2_36

students to connect with their daily lives, and 4) learning is designed to prepare students to become responsible citizens, schools should be able to facilitate students to involved in the social environment [1]. The education system must conform to the educational process with the characteristics of the industrial revolution of 4.0. Therefore, the education system must be changed from traditional to modern. Making these changes requires preparation to create more innovative learning and can improve the competence of graduates in the 21st century [2]. One way to enhance abilities is through education, which is applying appropriate and practical learning.

A project-based learning model is an approach to instructional programs that provide opportunities for students to develop their knowledge and skills. This lesson is structured by creating attractive and organized projects according to the environment around students, both from the material, planning, organizing material, and things that are following the material so that students can result based on independent learning [3]. The project-based learning model can encourage students to know a problem so they can propose and explain ideas through their involvement in education. This involvement comes from problem-solving and decision-making skills that are taken from the activities of students conducting investigative activities [4]. Project-Based Learning (PjBL) is one of the innovative learning approaches that teach multi-strategies that are critical for student success in the 21st century [5].

21st-century abilities are divided into two; there are soft skills and hard skills [6]. Soft skills are separated into (1) abilities communication which is the skills of students to express their thoughts, ideas, knowledge, and new information both in writing and orally. These skills include listening skills, writing skills, and public speaking skills (2) Numeracy skills which is the ability of an individual to use data in the form of numbers, graphs, or other mathematical symbols to make a decision using their knowledge and skills [7] (3) IT skills, which is a person's ability to use technology in learning. Students are expected to be able to develop various forms of information through the exploitation and exploration of available resources [8] (4) Problem-solving skills, which are a person's activity to determine problem-solving with his ability to predict what will happen. This problem-solving ability starts from the stage where a person understands the situation. It then creates the right strategy to overcome the problem based on the knowledge he has [9], and (5) Teamwork skill, which is a skill that a person needs to increase work productivity in a group. These skills consist of the ability to work together in a team and the ability to be able to participate in a team to solve problems [10]. Hard skills are divided into (1) specific knowledge, which is an understanding of concepts, theories, and facts obtained through his studies, and (2) Specific skills, which is a person's ability to use his knowledge to be applied in his daily life.

Furthermore, [11] divides the 21st century into four, namely (1) learning and innovation skills, which contain critical thinking and problem solving, creativity and innovation, and communication and collaboration, (2) information, media, and technology skills, which are divided into the information literacy, technology literacy, and media literacy (3) life and career skills which are divided into flexibility and compliance (4) initiative and self-management, productivity and accountability, and leadership and liabilities (5) essential subject includes English, reading and language, foreign languages, art, mathematics, economics, science, geography, history, knowledge of citizenship,

and (6) interdisciplinary themes including global awareness, financial literacy, citizenship literacy, also health and environmental literacy. Because this research has students as the subject, this research is only limited to improving 21st-century sub-learning and innovation skills.

Project-based learning has the main advantages of making the learning process effective and increasing students' motivation. Project-based learning can also improve students' creative thinking skills [12]. Several previous studies have applied project-based learning. One of the studies to enhance the 21st-century ability of students is research, according to [Sholahuddin et al., 2021], which states that project-based learning can improve collaboration and teamwork skills, independent knowledge and analysis, and students' problem-solving skills. Students in the experimental class can enhance their learning activities and use various learning resources effectively compared to the control class [13]. Therefore, based on this research, it can be concluded that they can improve their scientific literacy skills by applying project-based learning. Furthermore, research was conducted by [Ningrum et al. 2021], who used project-based learning to improve mastery of concepts and critical thinking skills. This study uses STEM from home combined with project-based learning. The results showed that the ability to master concepts increased by 43%, and students' critical thinking skills increased by 63%. [14].

This research attempts to examine how project-based learning relates to 21st-century skills. It is because, in the practice of learning in the 21st century, educators have an important role. Educators must be able to design a learning system that follows this 21st century in terms of curriculum and teaching and learning processes. Educators must master various skills that can make their students become individuals with skills in critical thinking to solve a problem, collaboration, communication, creativity, and innovation, as well as technology and concepts. Therefore, this study wants to explain how the application of project-based learning in schools can improve the 21st-century skills of students. The main questions of this research are as follows.

1. How is project-based learning applied in the learning process to improve 21st-century skills?
2. How is the design (teaching materials or learning steps) taken with project-based learning to improve students' 21st-century abilities?

2 Method

This research used SLR (Systematic Literature Review) conducted according to PRISMA. Based on the PRISMA guidelines, this systematic review presents the essential stages, including (a) eligibility and exclusion criteria, (b) identity check, (c) screening, (d) eligibility, and (e) abstraction and data analysis. [15]. Script search is in an online eBook Collection (EBSCOhost), Science Direct, Scopus, Education Resources Information Center (ERIC), and Directory of Open Access Journals (DOAJ) databases by retrieving a wider variety of texts with accessibility. In the process, some of the keywords used are "application of project-based learning," "effectiveness of project-based learning", and "project-based learning to improve 21st-century skills".

This literature study has been carried out since May 2022. The steps taken in conducting the research include (1) identifying articles regarding the application of project-based learning in elementary schools, (2) selecting based on an abstract by adjusting inclusion and exclusion criteria, and (3) trying to check a larger database within the specified time. The sources analyzed followed the inclusion criteria, namely (1) having gone through a peer-reviewed process, (2) published between 2017-2022, (3) written in English (4) containing information about the sample (n) and participants. Sources that do not meet the criteria will be excluded. In addition, if the articles found do not contain information that can answer the research after a complete review, the article will be banned.

Figure 1 presents the process of selecting articles which are then analyzed to answer two research questions:

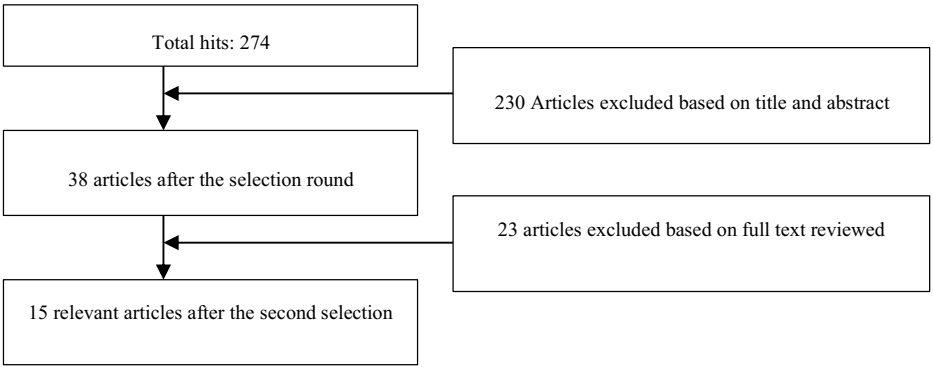

Fig. 1. The process of Article Selection

3 Result And Discussion

3.1 Result

The application of project-based learning models can improve students' 21st-century abilities. These relevant studies indicate that applied project-based learning can enhance critical thinking and problem-solving skills, (2) creativity and innovation, and (3) communication and collaboration. Applied learning can make students more able to ask and answer questions with answers and have and be able to express many ideas smoothly about a problem, come up with various solutions to problems, describe something in detail, and produce something worthwhile, new and did not exist before or which already exists but is combined with two or more existing ideas.

In addition to presenting activity designs in project-based learning that invites students to take an active role in education, appropriate approaches and media are also needed to implement project-based learning in the classroom. One of the approaches used in STEM-based learning (Science, Technology, Engineering, and Math). Furthermore, the media used in the project-based learning process is an exciting medium and

can increase students' interest in the learning process. One example is media with technology integration in it. The results of the study can be described as follows.

Table 1. Result of Analysis

Dimensions of 21st-century competence	Author	Research Design	Participants
Critical thinking and problem-solving.	Trisdiono et all., (2019)	This is product development research in the form of a project-based learning model integrated with multidisciplinary [16].	Students in elementary schools
	Permana & Chamisijatin (2019)	His is classroom action research using observation, interview, and test data collection techniques to determine the effect of project-based learning using Edmodo to improve critical thinking and histology concepts [17].	35 students from Malang Muhammadiyah University
	Andanawarih et all., (2019)	It is experimental research with a one-group pretest-posttest design used to determine problem-solving ability and concept mastery. Problem-solving ability is measured using a test based on Bloom's Taxonomy [18].	40 students in SMK Negeri 1 Cileunyi
	Mutakinati et all., (2018)	This research is a descriptive study to determine students' critical thinking skills using project-based STEM-based learning. Data were obtained through the analysis of student worksheets and observations during the learning process [19].	160 first-grade Japanese middle school students
	Priantari et all., (2020)	This is a true experimental-research design with a posttest-only control group research design. This study uses a STEM approach with project-based learning that is applied at the junior high school level, which is divided into a control class and an experimental class [1].	Students in SMP Muhammadiyah 6 Wuluhan, Jember.

Dimensions of 21st-century competence	Author	Research Design	Participants
Creativity and innovation	Yamin et all., (2020)	This is a quantitative study to measure the effectiveness of the implementation of project-based learning in junior high schools. The instruments used in this study were the CTS test, peer assessment, and product creativity assessment Rubric [20].	One hundred thirty-three seventh-grade students in junior high school.
	Ummah et all., (2019)	This is a qualitative descriptive study to describe students' creative abilities in making learning media through the application of project-based learning [21].	Students of the University of Muhammadiyah Malang mathematics department in the third semester.
	Arlinda et all., (2022)	This research aims to analyze project-based learning with Instagram as the media for learners' creativity. The method used is Quasy Experimental research with Nonequivalent Control Group Design [22].	Student at tenth graders of the school from two classes of Science and Mathematics program, in the academic year 2019/2020.
	Zhalalovna et all., (2020).	This research analyzes students' ability in the military education process, which is improved through learning with project-based activity [23].	Students in higher education
	Wijayati et all., (2019)	This study uses three cycles of classroom action research design (classroom action research). In the first phase, the teacher prepares plans and strategies for students where learning is designed based on projects. In the second phase, the teacher implements the procedure into education. The third phase is when the teacher evaluates the learning process results by recording each student's progress. In the fourth phase, reflection is carried out [24].	34 students in 11th IPA 3 in SMA N 14 Semarang

Dimensions of 21st-century competence	Author	Research Design	Participants
Communication and Collaboration	Saldo & Walag (2020)	This research utilizes problem-based and project-based learning methods to develop students' communication and collaboration skills in physics with a quasi-experimental pretest-posttest non-equivalent research design [25].	Seventy-eight students were in the first class of junior high school.
	Naila, (2020)	This research uses a quasi-experimental scientific learning model, which predicts the conditions received after implementing project-based learning. Data collection uses pre-test and post-test to describe students' collaborative skills [26].	Thirty students from three different classes in elementary schools in Surabaya, Indonesia.
	Hartati, L. (2022)	This research uses a quantitative approach using ex-post facto analysis to describe project-based learning applied to students' collaborative skills [27].	170 students in SMK
	Mafruudloh & Fitriati (2020)	This study aimed to describe the implementation of project-based learning in non-English department classes (Management department classes) and to know the effect on students' speaking ability was conducted from observation and analyzed statistically using a T-test [28].	25 students
	Sirisrimangkorn, (2018)	This study uses project-based learning focusing on drama to promote the speaking skills of EFL learners with quantitative and qualitative data collected [29].	23 students.

3.2 Discussion

Project-Based Learning to Improve Critical thinking and problem-solving skills. Based on the research results, project-based learning that is most often used to improve critical thinking and problem-solving skills is integrating the STEM approach into project-based learning [1], [19]. The two studies show that learning using the STEM approach in project-based learning can make students more enthusiastic about working together and taking inspiration from collaboration with their friends. Learners become more capable of utilizing various resources and problem-solving skills well. This is in line with the opinion of [Fajrina et al. 2020], which states that STEM as a learning approach is a solution to global change in learning in the 21st century to improve the abilities of 21st-century students [30]. Project-based learning with a STEM approach is a harmonious collaboration of four disciplines in learning closely related to solving real-life problems. PjBL and STEM complement each other with their advantages and disadvantages so that students can understand the concept of product manufacturing which is assisted by the PJBL learning model and the design and redesign process (engineering design process) to produce suitable products [31]. There are similarities between PjBL and STEM-integrated PjBL, but STEM-integrated PjBL emphasizes the design process or the process of making a prototype. STEM has six unique characteristics that make it different from other approaches, which are (1) focusing on problems that exist in the real world and finding solutions to solve those problems, (2) being guided by the engineering design process, to know the design comes from the thoughts of the students in building solutions. To overcome the problem (3) engaging students in effective teamwork (4) can lead students to direct inquiry and open discovery, which means that in STEM courses, learning activities, The set is available and has limitations (5) has an integration of math and science. Content so that students can realize that science and math are not separate subjects but work together to solve problems and (6) can give correct answers and correct mistakes. Fail as an essential part of learning that STEM classrooms offer many possibilities for creative solutions. [32]

Project-Based Learning to Enhance Creativity and innovation skills. Based on the research results, students' creativity and innovation abilities can be improved through project-based learning that is integrated with media use [22]. With the help of the use of the media, project-based learning can increase students' learning activity and motivation for learning. Through students who are active and have a high interest in education, the cognitive, affective, and psychomotor aspects of students will increase, and they can develop creativity and motivation abilities. This is in line with the opinion conveyed by [Oh et al. 2020], which states that project-based learning can provide motivation and lasting effects for students because students can experience learning directly and participate actively in it [33]. In other lines, the implementation of project learning will be more meaningful if it is carried out in a natural environment. This is because learning in a real environment can encourage students to be more active and creative in solving problems. So it can be concluded that using real issues in the project-based learning model can encourage students to carry out activities in a real natural environment such as field observation. The learning experienced directly by

these students supports efforts to improve students' creativity and problem-solving skills. Project-based learning can improve students' ability to find new things regarding problem identification and solving, practice problem management, process problems into potential, and form good cooperation in groups [34].

Project-Based Learning to Enhance Communication and collaboration skills. Based on the research results, communication and collaboration skills can be developed through project-based learning [25]–[29]. Project-based learning is necessary to improve communication and collaborative skills because teachers can flexibly guide students. Teachers provide support and encouragement to students to develop their solutions and maintain their efforts to achieve learning goals [26]. This is in line with the opinion expressed by [Hamilton et al. 2021], which states that a teacher must be able to change the approach they take from the original "students as recipients of knowledge" becomes "students as active contributors in obtaining their knowledge" [35]. Learning using project-based learning (PjBL) models can also improve problem-solving skills. Students become active in the learning process, increase student collaboration, make decisions and frameworks, become responsible, have tolerance among others, and become diligent in school, disciplined and confident. By applying the PjBL model, students not only memorize facts but also connect and think about how to use their knowledge in everyday life, provide collaborative opportunities to build knowledge, improve communication and social skills, improve problem-solving skills, and provide opportunities to contribute to society. School or community, improve students' skills to use information with various disciplines, increase student confidence, and improve students' ability to use technology in learning [36].

4 Conclusion

21st century learning must create learner-centered learning, teamwork, and learning that is embedded in students' daily lives. Project-based learning is a learning model that can forge 21st century skills in critical thinking and problem solving, creativity and innovation, communication and collaboration. This result shows that the PjBL model affects the skills of the 21st century. It can be seen that many studies use the random sampling technique to improve the efficiency and accuracy of the PjBL model in skills. 21st century is maintained and protected to avoid research bias. Therefore, the PjBL model is suitable for achieving learning goals, especially for fostering 21st century skills. Through this research, it is hoped that there will be various developments in learning using project-based learning to enhance the competence of 21st century students.

References

1. I. Priantari, D. R. Prafitasari, A. N Kusumawardhani, and S. Susanti, "Improving Students Critical Thinking through STEAM-PjBL Learning," *Bioeducation J.*, vol. 4, no. 2, pp. 94–102, 2020.
2. Siti Zubaidah, "Mengenal 4C: Learning and Innovation Skills Untuk Menghadapi Era Revolusi Industri 4.0," *2nd Sci. Educ. Natl. Conf.*, vol. 13, pp. 1–18, 2018.
3. K. KOVÁCSNÉ PUSZTAI, "Evaluation of Project-Based Learning," *Acta Didact. Napocensia*, vol. 14, no. 1, pp. 64–75, 2021.
4. Y. H. Wang, "Integrating games, e-books and AR techniques to support project-based science learning," *Educ. Technol. Soc.*, vol. 23, no. 3, pp. 53–67, 2020.
5. N. Hikmah, E. Budiasih, and A. Santoso, "Pengaruh Strategi Project Based Learning (PjBL) Terhadap Kemampuan Berpikir Kritis," *J. Pendidik.*, vol. 1, no. 11, pp. 2248–2253, 2016.
6. H. Hadiyanto, F. Failasofah, A. Armiwati, M. Abrar, and Y. Thabran, "Students' practices of 21st century skills between conventional learning and blended learning," *J. Univ. Teach. Learn. Pract.*, vol. 18, no. 3, 2021.
7. R. R. Anderha and S. Maskar, "Pengaruh Kemampuan Numerasi Dalam Menyelesaikan Masalah Matematika Terhadap Prestasi Belajar Mahasiswa Pendidikan Matematika," *J. Ilm. Mat. Realis.*, vol. 2, no. 1, pp. 1–10, 2021.
8. H. Hadiyanto, "Enhancing Students' Core Competencies by Applying Blended Cooperative E-learning (BCeL) in Teaching and Learning Process," vol. 253, no. Aes 2018, pp. 169–173, 2019.
9. A. J. Khoiriyah and H. Husamah, "Problem-based learning: Creative thinking skills, problem-solving skills, and learning outcome of seventh grade students," *J. Pendidik. Biol. Indones.*, vol. 4, no. 2, pp. 151–160, 2018.
10. H. Sunardi, S., & Hasanuddin, "Pengembangan Employability Skill Mahasiswa Vokasi Melalui Pembelajaran Stem-Project Based Learning," *SemanTECH (Seminar Nas. Teknol. Sains Dan Humaniora)*, vol. 1, no. 1, pp. 210–217, 2019.
11. H. Erol, "Reflections on the 21st Century Skills into the Curriculum of Social Studies Course," *Int. J. Educ. Lit. Stud.*, vol. 9, no. 2, p. 90, 2021.
12. S. Naviri, S. Sumaryanti, and P. Paryadi, "Explanatory Learning Research: Problem-Based Learning or Project-Based Learning?," *Acta Fac. Educ. Phys. Univ. Comenianae*, vol. 61, no. 1, pp. 107–121, 2021.
13. A. Sholahuddin, N. Hayati, R. Iriani, P. Saadi, and E. Susilowati, "Project-based learning on ethnoscience setting to improve students' scientific literacy," *AIP Conf. Proc.*, vol. 2330, no. March, 2021.
14. R. Ningrum, T. Rahman, and R. Riandi, "Penerapan STEM FROM HOME dengan Model PjBL untuk Meningkatkan Penguasaan Konsep dan Keterampilan Berpikir Kreatif Siswa SMP," *PENDIPA J. Sci. Educ.*, vol. 6, no. 1, pp. 299–307, 2021.
15. N. A. Rahman, R. Rosli, A. S. Rambely, and L. Halim, "Mathematics teachers' practices of stem education: A systematic literature review," *Eur. J. Educ. Res.*, vol. 10, no. 3, pp. 1541–1559, 2021.
16. H. Trisdiono, S. Siswandari, N. Suryani, and S. Joyoatmojo, "Development of Multidisiplin Integrated Project-Based Learning Model To Improve Critical Thinking and Cooperation Skills," *JPI (Jurnal Pendidik. Indones.*, vol. 8, no. 1, p. 9, 2019.
17. F. H. Permana and L. Chamisijatin, "Project-based learning through edmodo: improving critical thinking and histology concepts," *Biosfer*, vol. 12, no. 1, pp. 58–69, 2019.

18. M. Andanawarih, S. Diana, and A. Amprasto, "The implementation of authentic assessment through project-based learning to improve student's problem solving ability and concept mastery of environmental pollution topic," *J. Phys. Conf. Ser.*, vol. 1157, no. 2, 2019.
19. L. Mutakinati, I. Anwari, and K. Yoshisuke, "Analysis of students' critical thinking skill of middle school through stem education project-based learning," *J. Pendidik. IPA Indones.*, vol. 7, no. 1, pp. 54–65, 2018.
20. Y. Yamin, A. Permanasari, S. Redjeki, and W. Sopandi, "Implementing project-based learning to enhance creative thinking skills on water pollution topic," *JPBI (Jurnal Pendidik. Biol. Indones.*, vol. 6, no. 2, pp. 225–232, 2020.
21. S. K. Ummah, A. Inam, and R. D. Azmi, "Creating manipulatives: Improving students' creativity through project-based learning," *J. Math. Educ.*, vol. 10, no. 1, pp. 93–102, 2019.
22. C. P. Arlinda, A. Marianti, and M. Rahayuningsih, "Unnes Science Education Journal Accredited Sinta 3 The Implementation of Project-Based Learning Model with Insta- gram Media towards Students ' Critical Thiking and Creativity," vol. 11, no. 1, pp. 9–16, 2022.
23. L. P. Zhalalovna, K. L., Shishov, S. E., Rozhnova, T. M., Rozhnova, K. S., Polozhentseva, I. V., & Lobacheva, "Development of students' individual creativity in higher education institutions: project based learning," *Univ. y Soc.*, vol. 12, no. 2, pp. 380–384, 2020.
24. N. Wijayati, W. Sumarni, and S. Supanti, "Improving Student Creative Thinking Skills Through Project Based Learning," *KnE Soc. Sci.*, vol. 2019, pp. 408–421, 2019.
25. I. J. P. Saldo and A. M. P. Walag, "Utilizing Problem-Based and Project-Based Learning in Developing Students ' Communication and Collaboration Skills in Physics," *Am. J. Educ. Res.*, vol. 8, no. 5, pp. 232–237, 2020.
26. I. Naila, "The Effectiveness of Science Project Learning based on Entrepreneurship Model to Improve Elementary Students' Collaborative Skills," *Mimb. Sekol. Dasar*, vol. 7, no. 3, pp. 348–361, 2020.
27. L. Hartati, Marsono, and Yoto, "The Effect of The Project-Based Learning Model on The Soft Skills of Vocational School Students," *Tech. Soc. Sci. J.*, vol. 27, pp. 180–193, 2020.
28. R. Mafruudloh, N., & Fitriati, "The Effect Of Project Based Learning To The Students'speaking Ability," *Celt. A J. Cult. English Lang. Teaching, Lit. Linguist.*, vol. 7, no. 1, pp. 57–64, 2020.
29. L. Sirisrimangkorn, "The Use of Project-based Learning Focusing on Drama to Promote Speaking Skills of EFL Learners," *Adv. Lang. Lit. Stud.*, vol. 9, no. 6, p. 14, 2018.
30. Y. (2020) Fajrina, S., Lufri, L., & Ahda, "Science, Technology, Engineering, and Mathematics (STEM) as a Learning Approach to Improve 21st Century Skills: A Review," *Int. J. Online Biomed. Eng.*, vol. 16, no. 7, 2020.
31. A. A. Dywan and G. S. Airlanda, "Efektivitas Model Pembelajaran Project Based Learning Berbasis STEM dan Tidak Berbasis STEM terhadap Kemampuan Berpikir Kritis Siswa," *J. Basicedu*, vol. 4, no. 2, pp. 344–354, 2020.
32. C. E. Erlinawati, S. Bektiarso, and Maryani, "Model Pembelajaran Project Based Learning Berbasis Stem Pada Pembelajaran Fisika," *Semin. Nas. Pendidik. Fis.*, vol. 4, no. 1, pp. 1–4, 2019.
33. J. E. Oh, Y. K. Chan, and K. V. Kim, "Social media and e-portfolios: Impacting design students' motivation through project-based learning," *IAFOR J. Educ.*, vol. 8, no. 3, pp. 41–58, 2020.
34. A. M. Puspita, E. Utomo, and A. Purwanto, "Model Pembelajaran Berbasis Proyek Mata Pelajaran IPA Kelas III dalam Meningkatkan Kemampuan Berfikir Kreatif Siswa," *TUNAS J. Pendidik. Guru Sekol. Dasar*, vol. 7, no. 2, pp. 55–56, 2022.

35. F. Hamilton, K. Hile, D. Skelley, S. Roller, S. Lampley, and E. Young, “Exploring students’ perceptions of collaboration and critical thinking skills following an escape room experience.,” *J. Campus Act. Pract. Scholarsh.*, vol. 3, no. 1, pp. 5–16, 2021.
36. E. Ariyani, T. Jalmo, and B. Yolida, “Pengaruh Model PjBL terhadap Kemampuan Komunikasi Sains dan Berpikir Kreatif Peserta Didik,” *J. Bioterdidik Wahana …*, vol. 7, no. 3, pp. 1–12, 2019.