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Enhancing Students' Creative Thinking Skills in Equilibrium and Rotational Dynamics Through The Implementation of Project Based Learning Modules

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Abstract
The world of education requires students who are able to create and develop new ideas. Creative thinking needs to be done, because it can improve the quality of student learning. Project-based learning is an effective learning model for encouraging creative thinking. By implementing PjBL in the classroom, teachers can help students achieve success in the future. This research aims to determine the increase in creative thinking of high school students with project learning modules on balance and rotation dynamics. This research is quantitative descriptive. The method used is one-group pre-test – post-test design. Data collection techniques use questionnaires, observations and tests. This research was carried out at SMAN 5 Palangka Raya class XI MIPA 3 with three meetings. The research results show that: 1) The learning tools in the research are very suitable for use with a value of 0.85 for the module, 0.80 for the RPP and 0.92 for the questions. 2) The learning model implemented can be implemented very well, as seen from the percentage of implementation sheets for 3 meetings of 100% in the first meeting, and 91.6% in the second and third meetings which is categorized as very good, 3) There is an increase in creative thinking in students SMA from the use of project learning modules, balance material and rotation dynamics seen from the pre-test and post-test data which shows the calculated t value < t table.

Keywords: *Creative thinking, PjBL modules, Physics*

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1. Introduction

Education at the Senior High School (SMA) level poses challenges to the rapid flow of competitive development in the current era. The greater the standard of human resources that is currently required, the development of students' confidence in keeping up with the times decreases. Therefore, nowadays it is necessary for students to master 21st century skills, one of which is to be creative in improving skills as a preparation for facing challenges in the 21st century education era [1].

Based on pre-research conducted at SMAN 5 Palangka Raya, it shows that students still have not mastered creative thinking skills, especially balance and rotation dynamics. This was seen when researchers distributed creative thinking test questionnaires during pre-research, especially in class XI MIPA 3. Researchers made observations in the field and obtained results that when students were given physics questions, students tended to answer very basic questions without any theoretical development. This is because when students answer physics questions they do not understand the concepts and steps in working on the questions, besides that, students tend to answer physics questions by rote and do not use logical reasoning [2].

Indicators of creative thinking in students very rarely appear when answering questions, such as the absence of new ideas, lack of accuracy in answering questions, and lack of mastery of the material. Factors that influence students' low levels of creative thinking are less varied learning methods, less motivation to learn, less trying new ideas, and less supportive teaching materials [3].

Support from various parties is really needed in the learning process in class to help students understand the material well [4]. Therefore, teachers need to prepare teaching materials for a better learning process. The use of modules can help teachers carry out more effective and efficient learning with the aim of making students independent in learning. Teaching materials such as modules function as references and evaluation materials for students [5]. Teaching materials in the form of modules are a set of materials originating from learning experiences that are coherently arranged and specifically designed to help and meet students' needs in the learning process [6]. The minimum components in the module consist of learning objectives, learning materials, and learning evaluation [7]. Modules as teaching materials require steps in their implementation, these steps can be taken based on the learning model used by the teacher as a complement to the content of the module they want to implement.

Preparing interesting teaching materials is an effective way to overcome the problem of students' lack of focus and motivation to learn. Interesting teaching materials make students' creativity develop so that learning in class becomes effective and efficient [8]. The facilities at the school can support project learning offered by researchers to students to develop creativity, apart from providing facilities for students with a background who are capable of preparing tools and materials for project learning, it is also a solution so that students' creativity can further develop.

The learning model offered is Project Based Learning (PjBL) which is an innovation in teaching whose process is centered on students and the teacher acts as a motivator in the classroom. In this model, students are expected to be able to self-regulate the learning process creatively and innovatively [9]. The Project Based Learning (PjBL) learning model makes the teacher a director, mentor, provider of facilities, and motivates the continuity of learning so that this model is expected to help students improve their creative thinking abilities in learning [10].

Students experience obstacles in creative thinking which hinder their creativity from increasing, this is caused by a learning system that focuses on memorization so they have less opportunity to practice creative thinking, lack of work on varied questions which hinders the development of creativity, as well as students' fear of taking risks. so they don't want to try new ideas [11]. This can be overcome by applying models in learning. Students' creative thinking can improve through the project based learning model used by teachers in class, with the project based learning model students are able to solve problems by analyzing the material studied [12].

The appropriate learning model in improving each indicator of creative thinking is contextual project-based learning which is able to realize new knowledge [13]. The use of project based learning in learning helps teachers increase students' creativity, because this model focuses on students so that students can develop their ideas with the project skills they create, therefore project based learning is very suitable in influencing students' creative thinking [14].

Previous research shows that the Project Based Learning (PjBL) model is able to very effectively improve students' creative thinking abilities, especially in physics subjects. This learning model is also able to attract students' interest in understanding learning material [15]-[19] and [12]. This research is different from previous research. The project-based module that the author applies is different from previous research, this application aims to improve students' creative thinking abilities, which according to the author is very important for the future. This research can provide scientific evidence about the effectiveness of Project Based Learning, enrich learning practices, increase student motivation and engagement, build 21st century skills, and strengthen collaboration between teachers and researchers.

Based on the description above, it is proven that the use of modules containing the Project Based Learning learning model is able to improve physics learning which is of interest in class. The material that is suitable to be applied is balance and rotation dynamics because this material can improve high school students' creative thinking skills by means of this material requiring complex problem solving so that creative thinking with different approaches is needed. Apart from that, the material on balance and rotational dynamics is suitable for improving creative thinking because studying balance and rotational dynamics often involves experiments and physical demonstrations. This allows students to think creatively in planning, implementing and interpreting experimental results [20]. Referring to the description above, research will be carried out to determine the increase in high school students' creative thinking abilities in the material of equilibrium and rotational dynamics through the application of the Project Based Learning module.

2. Methods

The research was conducted at SMA Negeri 5 Palangka Raya in the 2023–2024 academic year. The research was conducted descriptively quantitatively using the one group pretest-posttest design method. Class XI MIPA 3 SMA Negeri 5 Palangka Raya students in the 2023 – 2024 academic year were taken as research samples The two variables used in this research are the independent variable and the dependent variable.

In this research, the independent variable is a project-based module, while the dependent variable in this research is high school students' creative thinking. The initial test and final test used the same test equipment. In simple terms, the research design can be seen in Figure 1.

O_1 X O_2

Figure 1. Research Design

In Figure 1, O_1 is defined as the pre-test (before implementing the PjBL learning module), X is defined as the treatment given (PjBL learning module), and O_2 is defined as the post-test (after implementing the PjBL learning module), the source is adaption from [21] instrument.

Data collection techniques include validation, observation and tests. Validation technique, the calculation is carried out through the validity of the media/ instrument used. The validity of the instrument used is tested first by the expert. The use of tests in this research was carried out before and after providing research material in class. This test is measured based on reliability, discriminating power, and level of difficulty of the questions. As well as the t-test to draw conclusions about the proposed formulation. The validation criteria for the appropriateness of the instruments used can be seen in Table 1.

Table 1. Validation Score Criteria

Score	Value
0.8 – 1.0	Very Feasible
0.5 – 0.7	Feasible
0 – 0.4	Not Feasible

Based on the criteria in Table 1, the expert validation results obtained regarding the suitability of the learning instruments, namely the Project Based Learning Module, RPP (lesson plan), and creative thinking questions can be seen in Table 2.

Table 2. Instrument Validation Results

Research Instrument	Value	Information
Project Based Learning Module	0.85	Very Feasible
Lesson Plan	0.80	Very Feasible
Creative Thinking Questions	0.92	Very Feasible

The research was carried out over three meetings after the instrument was declared suitable for use. The first meeting carries out learning steps according to Project Based Learning syntax 1 to 3, namely determining basic questions, creating a project design, and arranging scheduling. The second meeting carried out Project Based Learning syntax 4, namely monitoring project progress. The third meeting carried out the 5th and 6th Project Based Learning syntax, namely assessment of results and evaluation. This research focuses on the results of the creative thinking test. The stages in collecting data for the creative thinking test are 1) Carrying out trials of creative thinking test questions, 2) Processing trial data to determine the validity of the questions, the reliability of each question, the differentiating power of the question items, and level of difficulty of the questions, 3) determining the questions that can be used in the test. The results of the test questions calculated using Excel can be seen in the following Table 3.

Table 3. Test Results on Creative Thinking Questions

Validity test::										
rxy Count	0,885	0,885	0,885	0,496	0,066	0,672	0,145	0,575	0,472	0,443
r Table	0,349									
Conclusion	Valid	Valid	Valid	Valid	Invalid	Valid	Invalid	Valid	Valid	Valid
Category	Very High	Very High	Very High	Medium	Very Low	High	Very Low	Medium	Medium	Medium
Valid Amount	8									
Invalid Amount	2									

Alpha Method Reliability Test										
Item Variant		1,072	1,072	1,072	1,007	0,136	1,338	0,113	1,419	1,576	1,547
Total Number of Item Variant		10,353									
Total Variants		35,161									
Reliability Coefficient(r11)		0									
r table		0,349									
Conclusion		unreliable									

Difficulty Level (P)	0,74	0,089	0,089	0,085	0,069	0,092	0,068	0,097	0,098	0,1
Criteria P	Too Easy	Too Difficult	Too Difficult	Too Difficult	Too Difficult	Too Difficult	Too Difficult	Too Difficult	Too Difficult	Too Difficult
SA	6,6	6,6	6,6	6,4	5,167	6,867	5,133	7,167	7,233	7,433
SB	7	7	7	5	5	6	5	9	9	8
Power Difference (D)	-0,044	-0,005	-0,005	0,0186	0,002	0,012	0,002	-0,024	-0,024	-0,008
Criteria D	DROP	DROP	DROP	DROP	DROP	DROP	DROP	DROP	DROP	DROP

Table 3 shows data from the 10 questions given to students, only 8 questions were valid for use in the test, the invalid questions were question numbers 5 and 7. Data on students' creative thinking abilities will be divided into each creative thinking indicator. The results of the description test of 8 questions which were assessed using the creative thinking skills assessment rubric produced data on creative thinking skills. Increased creative thinking abilities will be seen from statistical tests, as well as the N-gain value on the pretest-posttest scores for each indicator.

3. Results and Discussions

The research data was obtained based on students' pretest-posttest scores to find out whether the use of project-based learning modules has proven effective in improving students' creative thinking abilities in physics subjects. Data on students' creative thinking was obtained by giving test questions to students with a total of 8 questions whose suitability had been tested. The creative thinking test questions were answered by students during the pre-test, namely before being given treatment using the project based learning module and during the post-test where after being given treatment using the project based learning module. Based on the administration of this test, differences in students' creative thinking abilities can be seen before and after being given treatment using the project based learning module. The following is a recapitulation of the data from students' creative thinking test results.

The average score obtained by students during the pre-test was 38.54 and the average score obtained during the post-test was 77.37. Apart from the pre-test and post-test scores, it is necessary to look for the gain and N-gain values obtained to determine the increase in students' creative thinking. The gain value obtained was 38.84 and the N-gain value obtained was 0.62. It can be seen that students have experienced an increase in the scores obtained which shows an increase in creative thinking, after being given learning with the project based learning module. In Sari's research [21], active student participation in learning activities resulted in increased creative thinking abilities.

In this research, the creative thinking test questions consisted of 4 indicators, namely: 1) Fluency, 2) Flexibility, 3) Originality, and 4) Elaboration. The results of the analysis of students' creative thinking abilities for each indicator are in the following Table 4.

Table 4. Average of Pre-test and Post-test for Each Indicator

No	Creative Thinking Indicators	Pretest	Posttest	Gain	N-gain
1	Fluency	30	81.9	51.9	0.74
2	Flexibility	41.6	71	29.4	0.50
3	Originality	42.7	84.6	41.9	0.73
4	Elaboration	47.3	78.7	31.4	0.59
Average		40.4	79.1	38.7	0.65

In Table 4, the average pretest result for each creative thinking indicator is 40.4 and the posttest average for each creative thinking indicator is 79.1. There is an increase in each indicator of creative thinking.

The author uses the t-test to ensure that there is an increase after using the Project Based Learning Module on students' creative thinking. The condition for using the t-test is that the data must be normally distributed. To find out whether the data is normally distributed or not, a normality test is carried out using the SPSS version 26 application. The following Table 5 is the pre-test and post-test data through the normality test.

Table 5. Results of Students' Creative Thinking Normality Test

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		37
Normal Parameters[a,b]	Mean	.0000000
	Std. Deviation	10.01840860
Most Extreme Differences	Absolute	.116
	Positive	.081
	Negative	-.116
Test Statistic		.116
Asymp. Sig. (2-tailed)		.200[c,d]

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.
d. This is a lower bound of the true significance.

Based on Table 5, the significance value is 0.200 > 0.05 so it can be concluded that the value is normally distributed. After obtaining normal data, proceed with the t test to determine the significant effect after students were given treatment using the Project Based Learning Module on creative thinking. The t test results are contained in the following Table 6.

Table 6. Student Creative Thinking t-test Results

Paired Samples Test

		Paired Differences							Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	
					Lower	Upper			
Pair 1	pre test - post test	-38.83784	13.11173	2.15555	-43.20951	-34.46617	-18.018	36	.000

Based on the significance value (2-tailed) 0.000 < 0.05 shows that there is a significant difference between the initial variable and the final variable. In this case, H_0 is rejected. H_a is accepted, meaning that it shows that there is a significant influence on the differences in treatment given to the variables.

Looking at Table 6, the increase in each indicator occurred after the module learning was provided. This shows the important role of project based learning modules in students' creative thinking abilities [22]. The project based learning module given to students certainly contains project based learning syntax, the first syntax is determining basic questions, this syntax refers to students formulating questions that open their minds to deep curiosity about completing the project they want to create. At this stage, it triggers students' curiosity to look for creative solutions so that they hone their thinking which creates ideas that are diverse, varied and unique, and different from others. Based on this, the first syntax is related to indicators of creative thinking, namely flexibility and originality. This is confirmed based on previous research, namely that the flexibility indicator is able to trigger students' curiosity to develop new ideas in questions created in the project [23].

The second syntax is designing a project plan, this stage contains students formulating specific and measurable project results in accordance with the basic questions that have been created. This stage refers to students' ability to produce many original ideas in a short time and be able to develop ideas in detail. This second syntax is related to indicators of fluency and elaboration. Fluency indicators can increase through learning project planning, namely students are able to formulate stages in detail [24]. The third syntax is to prepare a schedule, students plan a timeline for project work by referring to the development of ideas in detail according to the time plan so that the project to be created is completed at the specified time. This stage is related to elaboration indicators. This explanation was confirmed by Amalia, that in the step of preparing a schedule, students need detailed ideas because this step is to determine the implementation in making the project so that it is completed according to the set time limit [25].

The fourth syntax is monitoring project progress. In this stage of activity, the teacher observes the progress of the project and ensures that the project goes according to the students' plan. The teacher directs students to improve the quality of ideas and develop flexibility and originality of ideas, as well as elaborating ideas optimally. This is in accordance with the opinion of Maesaroh et al., authenticity and detail are needed at this stage when students develop projects that are created with new ideas that are different from other people's concepts [26]. The fifth and sixth syntax are assessment of project results and evaluation. At this stage the teacher gives appreciation to the project completed by students and appreciates students for being able to apply and develop ideas for each existing indicator. This has been confirmed by several researchers, namely that modules with project based learning syntax are able to improve creative thinking according to each indicator related to the syntax [27].

Based on the explanation of the relationship between project based learning syntax and creative thinking indicators, it can be seen in the conclusions of the data obtained in Table 6. Based on the results of hypothesis testing through pretest and posttest data with the t-test, the value $t_{count} > t_{table}$ was obtained,

which can be concluded that there is a significant influence after implementing learning with the Project Based Learning module, balance material and rotation dynamics on students' creative thinking abilities. This is obtained from the results of tests on students' creative thinking abilities by comparing pretest and posttest scores. This is in line with research by Prasetyo [28] showing that there is an influence of the Project Based Learning learning model on students' creative thinking abilities. Project Based Learning model learning material on balance and rotation dynamics on students' creative thinking abilities is seen from the results of hypothesis testing and is supported by previous research.

The results of the creative thinking ability test are in accordance with the previous explanation that the results of the creative thinking ability test in relation to learning can be seen from the improvements that occur. The overall percentage increase was found to be 40%, which is in the good category. So it can be concluded that learning with the Project Based Learning model influences students' creative thinking abilities. The Project Based Learning learning model has an effect on creative thinking abilities because teachers create several aspects of creative thinking in the learning syntax [29]. Combining project based learning steps with creative thinking indicators has the effect of increasing good and more effective creative thinking skills [30].

4. Conclusion

Based on the results of data analysis and research discussions regarding improving high school students' creative thinking abilities in the material of equilibrium and rotational dynamics through the application of the Project Based Learning module, the conclusions obtained are: The instruments used in the research are very suitable for use, the implementation of learning is very successful in the classroom, and there is an increase High school students' creative thinking abilities in equilibrium and rotation dynamics through the application of the Project Based Learning module.

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References

[1] L. F. A. N. F. Albana, "Efektivitas Modul Pembelajaran Berbasis Proyek sebagai Sumber Belajar Siswa SMK," *SAP Susunan Artik. Pendidik.*, vol. 5, no. 1, Aug. 2020, doi: 10.30998/sap.v5i1.6623.

[2] S. Surosos, "Analisis Kesalahan Siswa Dalam Mengerjakan Soal-Soal Fisika Termodinamika Pada Siswa SMA Negeri 1 MaGETAN," *JEMS J. Edukasi Mat. Dan Sains*, vol. 4, no. 1, Art. no. 1, Nov. 2016, doi: 10.25273/jems.v4i1.200.

[3] D. U. Mulyadi, S. Wahyuni, and R. D. Handayani, "Pengembangan Media Flash Flipbook Untuk Meningkatkan Keterampilan Berfikir Kreatif Siswa Dalam Pembelajaran IPA dI SMP," *J. PEMBELAJARAN Fis.*, vol. 4, no. 4, Art. no. 4, Mar. 2016.

[4] Abbas and M. Y. Hidayat, "Faktor-faktor Kesulitan Belajar Fisika pada Peserta Didik Kelas IPA Sekolah Menengah Atas," *JPF J. Pendidik. Fis. Univ. Islam Negeri Alauddin Makassar*, vol. 6, no. 1, pp. 45–50, 2018, doi: 10.24252/jpf.v6i1.3273.

[5] F. I. Astutik, M. Nur, and T. Prastowo, "Perangkat Pembelajaran Fisika Model Project Based Learning (PJBL) untuk Meningkatkan Keterampilan Proses Sains SMA," *Fikrotuna*, vol. 10, no. 02, pp. 1338–1347, 2020, doi: 10.32806/jf.v10i02.3791.

[6] I. Saftina, M. Muttaqien, and H. Hadiansah, "Pengembangan Bahan Ajar Berbasis Metode Studi Kasus Terintegrasi Nilai Islam," *Bioeduca J. Biol. Educ.*, vol. 3, no. 2, pp. 135–145, Sep. 2021, doi: 10.21580/bioeduca.v3i2.6632.
[7] U. Maulida, "Pengembangan Modul Ajar Berbasis Kurikulum Merdeka," vol. 5, no. 2, 2022.
[8] N. Zuriah, H. Sunaryo, and N. Yusuf, "IbM GURU DALAM PENGEMBANGAN BAHAN AJAR KREATIF INOVATIF BERBASIS POTENSI LOKAL," *J. Dedik.*, vol. 13, Apr. 2016, doi: 10.22219/dedikasi.v13i0.3136.
[9] N. M. Y. Suranti, G. Gunawan, and H. Sahidu, "Pengaruh Model Project Based Learning Berbantuan Media Virtual Terhadap Penguasaan Konsep Peserta didik pada Materi Alat-alat Optik," *J. Pendidik. Fis. Dan Teknol.*, vol. 2, no. 2, pp. 73–79, 2017, doi: 10.29303/jpft.v2i2.292.
[10] S. Sonia, Y. Kurniawan, and R. Muliyani, "Penerapan Model Pembelajaran Project Based Learning (Pjbl) Terhadap Pemahaman Konsep Siswa Pada Materi Suhu Dan Kalor," *J. Educ. Rev. Res.*, vol. 4, no. 1, p. 14, 2021, doi: 10.26737/jerr.v4i1.2437.
[11] M. Masruri, "Identifikasi Hambatan Pelaksanaan Praktikum Biologi Dan Alternatif Solusinya DI SMA Negeri 1 Moga :," *Perspekt. Pendidik. Dan Kegur.*, vol. 11, no. 2, Art. no. 2, Oct. 2020, doi: 10.25299/perspektif.2020.vol11(2).5259.
[12] M. Y. Ningsih, N. Efendi, and S. B. Sartika, "Pengaruh Model Project Based Learning Terhadap Berpikir Kreatif Peserta Didik dalam Pembelajaran IPA," *J. Inov. Pendidik. Sains JIPS*, vol. 2, no. 2, pp. 42–51, Nov. 2021, doi: 10.37729/jips.v2i2.1403.
[13] H. Noviyana, "Pengaruh Model Project Based Learning Terhadap Kemampuan Berpikir Kreatif Matematika SiswA," *J. E-DuMath*, vol. 3, no. 2, Art. no. 2, Sep. 2017, doi: 10.52657/je.v3i2.455.
[14] N. M. R. Kusadi, I. P. Sriartha, and I. W. Kertih, "Model Pembelajaran Project Based Learning Terhadap Keterampilan Sosial Dan Berpikir Kreatif," *Think. Ski. Creat. J.*, vol. 3, no. 1, pp. 18–27, Apr. 2020, doi: 10.23887/tscj.v3i1.24661.
[15] D. M. S. Pratiwi, E. Supriana, and A. Hidayat, "Pengembangan Modul Berbasis Project Based Learning (PjBL) dengan Sistem QR Code untuk Membantu Siswa Menerapkan Konsep Kesetimbangan dan Dinamika Rotasi," *Semin. Nas. Fis. Dan Pembelajarannya*, no. 0, Art. no. 0, 2019.
[16] S. Maysyaroh and D. Dwikoranto, "Kajian Pengaruh Model Project Based Learning terhadap Keterampilan Berpikir Kreatif Peserta Didik pada Pembelajaran Fisika," in *Pengaruh Model Project Based Learning Terhadap Keterampilan Berpikir Kreatif Peserta Didik Pada Pembelajaran Fisika"*, 2021, p. 7.
[17] C. Umamah and H. J. Andi, "Pengaruh Model Project Based Learning Terhadap Keterampilan Berpikir Kreatif Dalam Pembelajaran Fisika Terapan," *J. Penelit. Pembelajaran Fis.*, vol. 10, no. 1, p. 70, 2019, doi: 10.26877/jp2f.v10i1.3507.
[18] M. Meldawati, A. Hamid, and M. Mahdian, "Implementasi Model Project Based Learning (Pjbl) Berbantuan Aplikasi Modul Chemondroid Terhadap Kemampuan Berpikir Kreatif pada Materi Tata Nama Senyawa," *JCAE J. Chem. Educ.*, vol. 6, no. 2, Art. no. 2, 2022, doi: 10.20527/jcae.v6i2.1710.
[19] I. Rachmawati, S. Feranie, P. Sinaga, and D. Saepuzaman, "Penerapan Pembelajaran Berbasis Proyek untuk Meningkatkan Keterampilan Berpikir Kreatif Ilmiah dan Berpikir Kritis Ilmiah Siswa SMA pada Materi Kesetimbangan Benda Tegar," *WaPFi Wahana Pendidik. Fis.*, vol. 3, no. 2, Art. no. 2, Sep. 2018, doi: 10.17509/wapfi.v3i2.13725.
[20] E. Uzaedah, S. E. Nugroho, and H. Susanto, "Analisis Kemampuan Calon Guru dalam Menyusun Prosedur Pemecahan Masalah Fisika Materi Dinamika Rotasi dan Kesetimbangan Benda Tegar," 2019.
[21] W. William and H. Hita, "Mengukur Tingkat Pemahaman Pelatihan PowerPoint Menggunakan Quasi-Experiment One-Group Pretest-Posttest," *J. SIFO Mikroskil*, vol. 20, no. 1, Art. no. 1, Apr. 2019, doi: 10.55601/jsm.v20i1.650.

[22] I. R. R. Nugraha, U. Supriadi, and M. I. Firmansyah, "EFEKTIVITAS STRATEGI PEMBELAJARAN PROJECT BASED LEARNING DALAM MENINGKATKAN KREATIVITAS SISWA," *J. Penelit. Dan Pendidik. IPS*, vol. 17, no. 1, Art. no. 1, Apr. 2023, doi: 10.21067/jppi.v17i1.8608.

[23] X. Palapessy, M. A. Ningrum, K. R. Adhe, and M. D. Widayanti, "Analisis Project Based Learning (PjBL) Untuk Kemampuan Berpikir Kreatif Anak Usia 5-6 Tahun," *PENDIPA J. Sci. Educ.*, vol. 7, no. 3, Art. no. 3, Dec. 2023, doi: 10.33369/pendipa.7.3.431-438.

[24] R. S. Nita and I. Irwandi, "Peningkatan Keterampilan Berpikir Kreatif Siswa Melalui Model Project Based Learning (PjBL)," *BIOEDUSAINSJurnal Pendidik. Biol. Dan Sains*, vol. 4, no. 2, pp. 231–238, Sep. 2021, doi: 10.31539/bioedusains.v4i2.2503.

[25] F. D. Amalia, F. Setiawan, and K. D. A. Afiani, "Project Based Learning Sebagai Solusi Melatih Ketrampilan Berpikir Kreatif Siswa SD Dalam PembelajaraN IPS," *Pendas J. Ilm. Pendidik. Dasar*, vol. 8, no. 1, Art. no. 1, Jun. 2023, doi: 10.23969/jp.v8i1.7126.

[26] S. Maesaroh, Q. Mushafanah, and D. E. Handayani, "Penerapan Model Project Based Learning Materi Siklus Air Terhadap Kreativitas Siswa KelaS V SD Negeri 1 Harjowinangun," *J. Wawasan Pendidik.*, vol. 4, no. 1, Art. no. 1, Feb. 2024, doi: 10.26877/wp.v4i1.17078.

[27] M. Triantoro, "Pengembangan Modul Pembelajaran Berbasis Project Based Learning Untuk Membantu Meningkatkan Berfikir Kreatif MahasiswA," *Konstr. J. Pendidik. Dan Pembelajaran*, vol. 14, no. 1, Art. no. 1, Jan. 2022, doi: 10.35457/konstruk.v14i1.1962.

[28] Y. D. Kristanti, Subiki, and R. D. Handayani, "Model Pembelajaran Berbasis Proyek Pada Pembelajaran Fisika Disma," *J. Pembelajaran Fis.*, vol. 5, no. ue 2, pp. 122–128, 2016, doi: https://jurnal.unej.ac.id/index.php/JPF/article/view/3958/3086.

[29] K. S. Sitaresmi, S. Saputro, and S. B. Utomo, "Penerapan Pembelajaran Project Based Learning (Pjbl) untuk Meningkatkan Aktivitas dan Prestasi Belajar Siswa pada Materi Sistem Periodik Unsur (SPU) Kelas X MIA 1 SMA Negeri 1 Teras Boyolali Tahun Pelajaran 2015/2016," *J. Pendidik. Kim.*, vol. 6, no. 1, Art. no. 1, May 2017.

[30] P. N. Ananda and U. Salamah, "Meta Analisis Pengaruh Integrasi Pendekatan STEM Dalam Pembelajaran IPA Terhadap Kemampuan Berpikir Kritis Peserta Didik," *J. Penelit. Pembelajaran Fis. JPPF*, vol. 7, no. 1, 2021, doi: 10.24036/jppf.v7i1.111634.