



The Effect Of The Project-Based Learning Model Assisted By Blended Learning On The Critical Thinking Ability Of Grade VIII Students at SMP Negeri 04 Paleleh Barat

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Abstract. This study was undertaken in response to the deficient cognitive abilities of students. The problem in this study is whether there is an influence of the project-based learning (PjBL) model, which is assisted by blended learning, on improving students' critical thinking skills in class VIII of SMP Negeri 04 Paleleh Barat. This study aims to determine whether the project-based learning (PjBL) model is assisted by blended learning in students' critical thinking skills in class VIII of SMP Negeri 04 Paleleh Barat. This study was performed in SMP Negeri 04 Paleleh Barat between April to May 2024, employing a quasi-experimental methodology. The sample in this study consisted of class VIII-A as the experimental group and class VIII-B as the control group. Both classes will undergo a learning outcome assessment comprising a pretest and a posttest. The data analysis revealed that the project-based learning (PjBL) paradigm, augmented by blended learning, significantly influenced students' critical thinking skills on the human excretory system in class VIII at SMP Negeri 04 Paleleh Barat. This is derived from the t-test results obtained using IBM SPSS for Windows version 2.2, with a significance value. If the p-value (2-tailed) is less than the significance level (alpha) of 0.05, specifically $0.002 < 0.05$, then the null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted.

Keywords: Project-Based Learning, Blended Learning, Beroy Kritis, Biology, Learning outcomes

Abstrak. Penelitian ini dilakukan sebagai tanggapan atas kurangnya kemampuan kognitif siswa. Permasalahan dalam penelitian ini adalah apakah ada pengaruh model project-based learning (PjBL) yang dibantu blended learning terhadap peningkatan kemampuan berpikir kritis siswa di kelas VIII SMP Negeri 04 Paleleh Barat. Penelitian ini bertujuan untuk mengetahui apakah model project-based learning (PjBL) dibantu oleh blended learning dalam keterampilan berpikir kritis siswa di kelas VIII SMP Negeri 04 Paleleh Barat. Penelitian ini dilakukan di SMP Negeri 04 Paleleh Barat antara bulan April hingga Mei 2024, dengan menggunakan metodologi kuasi-eksperimental. Sampel dalam penelitian ini terdiri dari kelas VIII-A sebagai kelompok eksperimen dan kelas VIII-B sebagai kelompok kontrol. Kedua kelas akan menjalani penilaian hasil pembelajaran yang terdiri dari pretest dan posttest. Analisis data mengungkapkan bahwa paradigma pembelajaran berbasis proyek (PjBL), ditambah dengan blended learning, secara signifikan mempengaruhi kemampuan berpikir kritis siswa pada sistem ekskresi manusia di kelas VIII SMP Negeri 04 Paleleh Barat. Hal ini berasal dari hasil uji-t yang diperoleh menggunakan IBM SPSS for Windows versi 2.2, dengan nilai signifikansi. Jika nilai-p (2-ekor) kurang dari tingkat signifikansi (alfa) 0,05, khususnya $0,002 < 0,05$, maka hipotesis nol (H_0) ditolak dan hipotesis alternatif (H_1) diterima.

Kata kunci: Project-Based Learning, Blendeed Learning, Berpikir Kritis, Biologi, Hasil Belajar

1. INTRODUCTION

Education constitutes a deliberate and systematic endeavor to cultivate a learning environment and process, enabling students to actively enhance their ability for self-regulation, character development, intellectual growth, ethical values, and skill acquisition. (Amalia, 2019; Hamidah & Citra, 2021; Rahmawati & Juandi, 2022; Fatimah et al., 2024). Thus, education is everything that affects the growth, change and condition of every human being.

The changes occur by developing a person's potential, knowledge, skills, and attitudes in his life (Ramadhani, 2021; Hanifah, 2023; Lesa et al., 2023; Noorhalida et al., 2023).

Project-based learning (PjBL) is one of the student-centered learning models recommended by the 2013 curriculum, even the independent learning curriculum that uses real projects or activities as the core of learning (Panjaitan, 2019; Anggela & Rina, 2023; Nurohmah et al., 2023; Rengkuan et al., 2023). In project-based learning, students engage in exploration, assessment, interpretation, synthesis, and processing of information to generate diverse learning outcomes that closely resemble real-world applications, thereby extending learning beyond the confines of the classroom (Poppyariyana & Munajat, 2020; Auliah, 2023; Parhusip & Wardhani, 2023; Rezki & Sari, 2023).

The problem of low thinking ability in students found at SMP Negeri 04 Paleleh is evidenced by the student results that are still below the KKM. Problems were also found during the implementation of observation, where, during the discussion, the number of students actively asking questions was very small compared to the number of existing students. It shows that the *project-based learning model* used is still wrong where the teacher is dominant in using the lecture method. *Project-based learning* is a learning approach that is specifically designed to overcome complex problems that students can investigate to understand. This is marked by long activities given to students and is product-oriented (Rahmania, 2022; Setiawan et al., 2022; Azzahra et al., 2023; Purba & Harahap, 2023; Wahid, 2024).

Cognitive talents are essential competencies for confronting life's obstacles. These encompass critical thinking, creative thinking, and problem-solving abilities (Chyntia and Sihotang, 2023). Syafitri et al. (2021) asserted that critical thinking constitutes self-regulation in decision-making, encompassing interpretation, analysis, assessment, and inference, alongside the use of evidence, concepts, procedures, criteria, or contextual factors that inform decisions. Anggela and Rina (2023) characterize critical thinking as a multifaceted process necessitating advanced cognitive abilities for information processing. This aligns with the perspective of Van Harling and Martono (2023), who asserted that critical thinkers possess the ability to analyze and evaluate information, formulate essential questions and issues, articulate these inquiries and challenges distinctly, gather and assess pertinent information utilizing abstract concepts, maintain open-mindedness, and communicate effectively. Manurung et al. (2023) asserted that critical thinkers had the ability to critique, interrogate, assess, and contemplate the knowledge acquired.

Based on the description above, the researcher conducted a study entitled "The Effect of the *Project-Based Learning* Model Assisted by *Blended Learning* on the Critical Thinking Ability of Grade VIII Students of SMP Negeri 04 West Paleleh".

2. METHOD

This research was conducted at SMP Negeri 04 Paleleh Barat on April 2-May 14 in the even semester of the 2024/2025 school year. The type of research used in this study is *quasi-experimental design with a presetest-posttest control group design*.

The population in the study is all grade VIII students of SMP Negeri 04 West Paleleh for the 2024/2025 school year, which totals 4 classes. The sampling technique in this study was taken randomly (*random sampling*). Of the 4 classes taken, only 2 classes were taken as samples, 1 class as a control class and 1 more class as an experimental class. Class VIII B was an experimental class with the treatment of the project-based learning model of blended learning, as many as 20 students, and class VIII A was a control class with the treatment of the conventional learning model, as many as 17 students.

The data collection technique of this research is testing questions in the form of pretest questions and posttest questions, the use of tests is carried out to measure the basic ability of achievement and achievement. Meanwhile, the data analysis technique uses normality, homogeneity, and hypothesis tests.

The instruments used to collect data in this study are learning tools such as syllabus, learning implementation plan (RPP), student worksheets/LKS, and instruments containing written tests in the form of *essays*. This written test consists of one type of question that is given as a pretest and posttest in the control and experimental classes. The number and form of pre-test and post-test questions are 10 items of excretory system questions in humans in the form of *essays*.

3. RESULT AND DISCUSSION

Results

1. Description of Research Data

The description of the data presented in this study is data obtained from the results of student science with excretory system material in humans. The results of this study were obtained from two different classes, namely class VIII-A as an experimental class by applying a *project-based learning* (PjBL) model assisted by *blended learning* and class VIII-B as a control class by applying a conventional learning model at SMP Negeri 04 West Paleleh. The

data that has been processed is data on student learning outcomes through evaluation activities before and after the science learning process, especially on human excretory system material. The results of the descriptive analysis of the research are presented in Table 1 below.

Table 1. Descriptive Analysis of Experimental Class and Control Class

Data	Value			
	Experimental Class (VIII-A)		Control Class (VIII-B)	
	<i>Pretest</i>	<i>Posttest</i>	<i>Pretest</i>	<i>Posttest</i>
Total	732	1.664	560	1317
Maximum score	65	95	55	88
Minimum score	15	68	20	54
Average	36,60	83,2	32,94	77,47
Standard Deviation	14,361	9,925	10,419	8,232
Variance	206,253	98,513	108,559	67,765

The *pretest* and *posttest* data of the experimental class presented in Table 1 shows that the average score of the experimental class *pretest* is 36.60 and has increased in the implementation of the *y posttest* with an average score of 83.2 with a total of 20 students. The *pretest* and *posttest* data of the control class were described as 32.94, and the implementation of the *posttest* increased to 77.47, with a total of 17 students. So, there is an increase in student learning outcomes in both experimental and control classes in science learning, especially in the excretory system material in humans in grade VIII of SMP Negeri 04 West Paleleh.

2. Data Analysis

To find out whether the application of the *project-based learning* (PjBL) model assisted by blended learning affects critical thinking and student learning outcomes on excretory system material in humans, an analysis will be carried out using the statistical technique of differential power test. Before the differentiation test is carried out, the prerequisite tests must first be carried out in the form of normality tests and data homogeneity tests.

3. Uji Normalitas

To find out whether the sample used comes from a normally distributed population or not, a normality test must be conducted on the data that has been collected. This test was carried out using the *pretest* and *posttest* values of the experimental class and the control class, using the *Shaphiro-Wilk* method which was analyzed using the help of the *IBM SPNormality TestSS*

for Windows version 2.2 application with a significant level of $\alpha=0.05$. For the following decision-making

- If the test results get a significance value of >0.05 , the data is declared to be normally distributed.
- If the test results get a significance value of <0.05 , the data is declared to be normally distributed.

The results of the data normality test are presented in the following Table 2.

Table 2. Normality Test Results

Class	L_{count}	L_{table}
Sample	37	37
Significant	0,05	0,05
<i>Pre-test</i> experiments	0,139	0,145
<i>Post-test</i> experiments	0,055	0,145
<i>Pretest</i> Control	0,136	0,145
<i>Posttest</i> Control	0,060	0,145

Based on the normality test results, the two samples, namely the experimental class and the control class, came from a population normally distributed because of the $L_{count} < L_{table}$. In the experimental class, the values of L_{count} *pretest* and *posttest* (0.139 and 0.055) $< L_{table}$ (0.145) were obtained, and in the control class, L_{cal} values of *pretest* and *posttest* (0.136 and 0.060) $< L_{table}$ (0.145) were obtained.

Based on the results of the normality test using *IBM SPSS for Windows* version 2.2, it can be found that the sample data of the *pretest* and *posttest* of the experimental class and the *pretest* and *posttest* of the control class have a significance value greater than $\alpha=0.05$. The results of the normality test of the experimental class were 0.139 and 0.055 > 0.05 , while the normality test of the control class was 0.136 and 0.060 > 0.05 . So, it can be known that the sample data of the experimental and control classes is normally distributed.

4. Homogeneity Test

After the sample is declared to be normally distributed, a homogeneity test will be carried out to determine whether the data from the research results has homogeneous or non-homogeneous variants. The results of the homogeneity test are shown in Table 3 below.

Table 3. Homogeneity Test Results

Data Pretest	Experimental Classes	Control Classes
Number of Resonants	20	17
Varians	206,253	108,559
F_{count}	1,899	
F_{table}	4,12	
Conclusion	Homogeneous	

The results of the analysis of the similarity test of the two varieties with statistics using the *Fisher Test* (Test F) at a significant level of $\alpha=0.05$ in the data of the pretest results with the variant of the experimental class = 206.253 and the variant of the control class = 108.559 gave the value of $F_{count} = 1.899$ and $F_{table} = 4.12$. This can indicate that $F_{count} < F_{table}$ so that the samples used are proven to come from populations with the same variance or are homogeneous.

Based on the output of the homogeneity test results from *IBM SPSS for Windows* version 2.2 using the *Levene test*, the posttest significance value of the two classes is $0.307 > \alpha = 0.05$. Because the significance value is more than 0.05, the students of the control and experimental classes come from populations that have the same variance, or the two classes are homogeneous, so they are suitable as research samples.

5. Hypothesis test

The hypothesis test aims to compare the learning outcomes of students from the experimental class and the control class using the t-test with a level of $\alpha=0.05$. The results of the hypothesis test are shown in Table 4 below.

Table 4. Hypothesis Test Results

Information	Experimental Classes	Control Classes
Average	83,2	77,47
Standard Deviation	9,925	8,232
Number of Respondents	20	17
T_{count}	1,898168	
T_{table}	1,68957	
Conclusion	Reject H_0 and Accept H_1	

Based on the table, the data obtained by $t_{count} (1.898168) > t_{table} (1.6897)$. In accordance with the test criteria, if the $t_{count} > t_{table}$, H_0 is rejected, and H_1 is accepted.

To remind, the hypothesis in this study is as follows:

- H_0 : There is no effect of *the project-based learning* (PjBL) model assisted by *blended learning* on improving critical thinking and student learning outcomes on excretory system material in humans in grade VIII of SMP Negeri 04 West Paleleh.
- H_1 : There is an effect of *the project-based learning* (PjBL) model assisted by *blended learning* on improving critical thinking and student learning outcomes in human excretory system material in grade VIII of SMP Negeri 04 West Paleleh.

Based on the test results, Sig's posttest score was obtained. (*2-tailed*) = 0.002 with the level of research $\alpha = 5\%$ or 0.05. That is the value of *Sig. (2-tailed)* is smaller than the alpha value ($0.002 < 0.05$), so according to the test criteria, the research hypothesis H_0 is rejected, and H_1 is accepted. So, it can be seen that there is an effect of the application of *the project-based learning* (PjBL) model assisted by *blended learning* on the learning of science excretory system material in humans on the improvement of critical thinking and learning outcomes of grade VIII students of SMP Negeri 04 West Paleleh.

4. DISCUSSION

Based on the results of the research carried out at SMP Negeri 04 Paleleh Barat in April - May of the odd semester of the 2023/2024 school year with the sample used in this study, namely class VIII-A as an experimental class with a total of 20 students and class VIII-B as a control class with a total of 17 students through the application of *a project-based learning* (PjBL) learning model assisted by *blended learning*. In the excretory system material in humans, there are differences in learning outcomes between the experimental class and the control class. In the experimental class with excretory system material in humans through the project of making excretory system props in humans, in general, it shows that there is a real positive influence on the use of these treatments on the ability to think critically and improve the learning outcomes of grade VIII students, especially in science subjects.

This is evidenced by the results of the data analysis that has been carried out, showing that there is a significant difference *in pretest* and *posttest* learning between the experimental class and the control class conducted in class VIII of SMP Negeri 04 West Paleleh. In class VIII-A as a treatment class or experimental class that applied the *project-based learning* (PjBL) model assisted by *blended learning* through the manufacture of excretory system props in humans, it showed that the average result of *the pretest* with a score of 36.60 then increased in the average result of *the posttest* with a score of 83.2. Meanwhile, in class VIII-B as a control class through the application of conventional learning models, the average pretest result with a score of 32.94 then increases in the average *posttest* with a score of 77.47. The difference in the average scores of students in the experimental class and the control class is due to the fact that the experimental class, namely class VIII-A, uses *a project-based learning* (PjBL) model assisted by *blended learning* through a project to make excretory system props in humans in the learning process. In contrast, the control class, namely class VIII-B, only uses the conventional learning model. This proves that the application of the PjBL model in learning activities can improve learning and improve students' critical thinking skills in problem-solving

activities through the investigation of a project so as to produce work (Setiawan et al., 2022; Rengkuan et al., 2022).

Grade VIII students of SMP Negeri 04 West Paleleh whose learning process is applied to *the project-based learning (PjBL) model based on blended learning* get better results because of the application of *the project-based learning (PjBL) model* combined with the creation of excretory system props in humans, where the PjBL model is a learning model that focuses on the main concepts and principles of a discipline because students are directly involved in problem-solving activities, providing opportunities for students to collaborate, arrange learning activities independently to be able to produce products in the form of valuable and realistic works (Auliah, 2023; Rengkuan et al., 2023). In addition, the project of making excretory system teaching aids in humans can clarify information or learning messages so that it is more in-depth, through this project the level of critical thinking skills and learning motivation of students will also increase in addition to providing variety in learning activities so that students will understand the material being studied faster and easier (Amalia, 2019; Rengkuan et al., 2024). Through the results of the study, it is proven that there is a difference in the learning outcomes of students in the experimental class (VIII-A) who use *the project-based learning (PjBL) model assisted by blended learning* and the control class (VIII-B), which only uses the conventional learning model.

Through the results of hypothesis testing (t-test) where the tcount was obtained more significant than the ttable, namely $1.898168 > 1.68957$ so that the results of the analysis showed that there was a very significant difference in student learning outcomes between the experimental class and the control class. The results of the study of the T-test through SPSS for Windows version 2.2 with a level of $\alpha=0.05$ found that the significance value was 0.002, which was less than 0.005. Therefore, it can be concluded that the application of *the project-based learning (PjBL) model assisted by blended learning* through the manufacture of excretory system props in humans has a very significant influence on the improvement of critical thinking skills of grade VIII students at SMP Negeri 04 Paleleh Barat.

5. CONCLUSIONS AND SUGGESTIONS

The project-based learning (PjBL) learning model assisted by blended learning improves the critical thinking skills of grade VIII students of SMP Negeri 04 West Paleleh. Based on the results of this conclusion, there are several suggestions put forward by the researchers, namely (1) For Class VIII Science Teachers in the process of teaching excretory

system material in humans can apply *the project-based learning* (PjBL) learning model, (2) Become input material for the science learning process in various units and levels of education, (3) For researchers who will conduct research related to the influence of *the project-based learning* model (PjBL) is expected to analyze all forms of shortcomings in this research so that it can be used as a consideration in the future.

REFERENCES

- Amalia, L. (2019). Kreativitas dan hasil belajar siswa pada materi sistem ekskresi manusia di SMA Negeri 1 Aceh Barat Daya menggunakan model Project Based Learning dengan media tiga dimensi (Doctoral dissertation, UIN Ar-Raniry Banda Aceh).
- Anggela, R., & Rina, R. (2023). Pengaruh model Experiential Learning terhadap kemampuan berpikir kritis siswa sekolah dasar. *Sosial Horizon: Jurnal Pendidikan Sosial*, 10(2), 161–171.
- Auliah, A. (2023). Penerapan model pembelajaran Project Based Learning untuk meningkatkan hasil belajar siswa. *Global Journal Teaching Professional*, 2(4), 1446–1458.
- Azzahra, U., Arsih, F., & Alberida, H. (2023). Pengaruh model pembelajaran Project-Based Learning (PjBL) terhadap keterampilan berpikir kreatif peserta didik pada pembelajaran biologi: Literature review. *BIOCHEPHY: Journal of Science Education*, 3(1), 49–60.
- Cynthia, R. E., & Sihotang, H. (2023). Melangkah bersama di era digital: Pentingnya literasi digital untuk meningkatkan kemampuan berpikir kritis dan kemampuan pemecahan masalah peserta didik. *Jurnal Pendidikan Tambusai*, 7(3), 31712–31723.
- Fatimah, S., Anggraini, R., & Riswari, L. A. (2024). Peningkatan hasil belajar siswa melalui model pembelajaran Project Based Learning (PjBL) pada siswa kelas IV sekolah dasar. *Jurnal Basicedu*, 8(1), 319–326.
- Hamidah, I., & Citra, S. Y. (2021). Efektivitas model pembelajaran Project Based Learning (PjBL) terhadap minat dan hasil belajar siswa. *BIOEDUSAINS: Jurnal Pendidikan Biologi dan Sains*, 4(2), 307–314.
- Hanifah, I. Z. D. (2023). Penggunaan multimedia interaktif yang dikembangkan dengan Articulate Storyline sebagai komponen TPACK dalam meningkatkan kemampuan analisis peserta didik pada sistem ekskresi (Doctoral dissertation, FKIP UNPAS).
- Les, M., Rengkuan, M., & Batlolona, J. R. (2023). PBLRQA model to the development of metacognitive awareness in pre-service teachers. *Journal of Education and Learning (EduLearn)*. <https://doi.org/10.11591/edulearn.v18i1.20977>
- Manurung, A. S., Fahrurrozi, E. U., & Gumelar, G. (2023). Implementasi berpikir kritis dalam upaya mengembangkan kemampuan berpikir kreatif mahasiswa. *Jurnal Papeda*, 5(2).

- Noorhalida, N., Yuliani, H., & Santiani, S. (2023). Studi literatur: Pengaruh Project Based Learning pada pembelajaran fisika. *ORBITA: Jurnal Pendidikan dan Ilmu Fisika*, 9(2), 200–212.
- Nurohmah, A. N., Kartini, D., & Rustini, T. (2023). Relevansi kebijakan Kurikulum Merdeka dengan pendidikan abad 21 pada pembelajaran IPS di SD. *Jurnal Ilmiah Wahana Pendidikan*, 9(3), 24–35.
- Panjaitan, E. U. (2019). Pengaruh model pembelajaran Project Based Learning terhadap hasil belajar biologi siswa SMAN 1 Aeksongsongan. *Jurnal Edu-Bio*, 1(1), 30.
- Parhusip, A. A., & Wardhani, I. I. (2023). Strategi pengelolaan teknologi sistem informasi pembelajaran metode blended learning sekolah swasta Pelangi. *Jurnal Peradaban Masyarakat*, 3(4), 142–149.
- Poppyariyana, A. A., & Munajat, A. (2020). Pengaruh permainan sains terhadap kemampuan berpikir logis anak. *AWLADY: Jurnal Pendidikan Anak*, 6(1), 1–16.
- Purba, A., & Harahap, E. P. (2023). Penerapan model pembelajaran berbasis proyek (PjBL) pada mata kuliah strategi pembelajaran bahasa Indonesia sebagai upaya meningkatkan hasil belajar mahasiswa pendidikan bahasa dan sastra Indonesia FKIP Universitas Jambi 2021/2022. *Jurnal Ilmiah Dikdaya*, 13(1), 109–120.
- Rahmania, I. (2021). Project Based Learning (PjBL) learning model with STEM approach in natural science learning for the 21st century. *Budapest International Research and Critics Institute-Journal (BIRCI-Journal)*, 4(1), 1161–1167.
- Rahmawati, L., & Juandi, D. (2022). Pembelajaran matematika dengan pendekatan STEM: Systematic literature review. *Teorema: Teori dan Riset Matematika*, 7(1), 149–160.
- Ramadhani, D. P. (2021). Analisis penerapan asesmen formatif dalam pembelajaran IPA dan fisika: Literature review. *LENSA (Lentera Sains): Jurnal Pendidikan IPA*, 11(2), 110–120.
- Rengkuan, M., Leasa, M., & Sumampouw, M. H. (2023). Metacognitive and critical thinking skills of genetics of biology students with project-based learning. *Cypriot Journal of Educational Sciences*, 18(2), 533–543.
- Rengkuan, M., Simal, F., Leasa, M., & Maelan, M. (2022). Mitigation of learning loss and teacher awareness: Qualitative study in science practicum. *Jurnal Penelitian Pendidikan IPA*, 8(2).
- Rengkuan, M., Sompotan, A. F., & Batmetan, J. R. (2024). Development of problem-based tools to improve thinking abilities in in-service PPG program students. *International Journal of Information Technology and Education*, 3(2), 113–121.
- Rezki, I., & Sari, R. H. Y. (2023). Analisis potensi YouTube sebagai upaya meningkatkan minat mahasiswa dalam belajar matematika dan berwirausaha: Analysis of YouTube's potential as an effort to increase student interest in learning mathematics and entrepreneurship. *Tunas: Jurnal Pendidikan Guru Sekolah Dasar*, 8(2), 63–71.

- Setiawan, T., Sumilat, J. M., Paruntu, N. M., & Monigir, N. N. (2022). Analisis penerapan model pembelajaran Project Based Learning dan Problem Based Learning pada peserta didik sekolah dasar. *Jurnal Basicedu*, 6(6), 9736–9744.
- Sugiyono. (2019). *Metodologi penelitian kuantitatif, kuantitatif, kualitatif, dan R&D*. Alfabet.
- Syafitri, E., Armanto, D., & Rahmadani, E. (2021). Aksiologi kemampuan berpikir kritis (kajian tentang manfaat dari kemampuan berpikir kritis). *Journal of Science and Social Research*, 4(3), 320–325.
- Van Harling, V. N., & Martono, S. M. (2023). Penerapan model Project Based Learning (PjBL) untuk meningkatkan kemampuan berpikir kritis peserta didik pada materi korosi. *Soscied*, 6(1), 38–45.
- Wahid, S. (2024). Pengaruh pembelajaran berbasis proyek terhadap keterampilan berpikir kritis peserta didik SMA Negeri 22 Makassar. *Jurnal Ilmiah Ecosystem*, 24(2), 358–368.