



Problem-Based Learning and Its Effects on Critical Thinking Skills and Learning Motivation in Human Excretory System Education

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Abstract:

Background. Developing critical thinking skills and learning motivation is essential in biology education, particularly for complex topics such as the human excretory system.

Aims. This study investigated the effectiveness of Problem-Based Learning (PBL) in improving students' critical thinking skills and learning motivation simultaneously.

Methods. The study used a quantitative quasi-experimental design with a non-equivalent control group. The participants were 52 Grade 11 students at SMA Smart Insani, equally assigned to an experimental group receiving PBL instruction and a control group receiving conventional instruction. Critical thinking skills were assessed using a test, while learning motivation was measured using a questionnaire. Data were analyzed using multivariate analysis of variance (MANOVA) and effect-size analysis. The results demonstrated substantial differences between the two groups. In the experimental group, 50.00% of students achieved a high level, and 11.54% achieved a very high level of critical thinking, while learning motivation was predominantly distributed in the high and very high categories. MANOVA revealed a statistically significant simultaneous effect of PBL on critical thinking skills and learning motivation ($p < 0.001$). Effect-size analysis further demonstrated a strong effect on critical thinking skills (partial $\eta^2 = 0.577$) and a very strong effect on learning motivation (partial $\eta^2 = 0.962$).

Result. These findings indicate that PBL effectively supports both cognitive and affective learning outcomes, with a more pronounced effect on learning motivation. The study contributes context-specific evidence by simultaneously examining critical thinking and learning motivation in learning the human excretory system.

Conclusion. Therefore, PBL represents an effective instructional approach for promoting higher-order thinking and student motivation in senior high school biology.

Keywords: Problem-Based Learning; critical thinking skills; learning motivation; biology education; human excretory system



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INTRODUCTION

Students in modern classrooms require higher-order thinking skills, including creativity, collaboration, communication, and critical thinking (Muhfahroyin, 2009, 2010). Students need to develop critical thinking competencies throughout their educational journey so that they can “analyze information effectively, solve problems, and make logical and systematic judgments” (Rapsan, 2026). To acquire new knowledge, students must develop critical thinking skills throughout their schooling. According to Muhfahroyin et al. (2023), it is important to foster critical thinking skills among children with both high and low ability levels.

However, in reality, students’ critical thinking skills remain inadequate. This happens because, in teacher-centered classrooms, students do not have enough opportunities to explore and solve problems independently. Students’ motivation levels affect their learning outcomes and engagement. According to Sibagariang et al. (2024), when teachers do not implement diverse learning methods, students may become unmotivated, passive, and easily bored.

An individual’s internal motivation to learn is one of the most important factors influencing how well they retain new information. Highly motivated students are often more engaged, attentive, and enthusiastic about achieving academic success. In contrast, students who lack intrinsic motivation to learn tend to be less actively engaged with the learning content and retain less of the information presented. According to Annisa and Annisa (2024), educators should adopt an approach that better inspires students while also helping them develop stronger thinking skills.

Marlinda et al. (2025a) advocate for problem-based learning (PBL). Problem-centered education is a pedagogical approach that involves students in addressing authentic challenges. PBL strengthens pupils' critical thinking by giving them responsibility for their own education as they identify and address real-world issues. Unlike traditional methods, PBL builds critical thinking and boosts students' enthusiasm for learning.

Furthermore, studies indicate that Project-Based Learning (PBL) enhances student

engagement and fosters deeper comprehension of the content. When learners engage with practical examples, they develop a deeper understanding of theoretical ideas. This approach helps students understand the content and apply it in diverse contexts rather than simply memorizing it (Pamungkas & Wantoro, 2024). Learners frequently find it challenging to grasp intricate and esoteric ideas in Biology, especially regarding the human excretory system. Thorough comprehension of this subject requires strong conceptual insight and the ability to connect physiological mechanisms to the roles of the associated organs. Consequently, problem-based learning is an educational paradigm that enhances students' critical thinking abilities and supports understanding within the subject's context. Despite extensive research showing that PBL enhances students' critical thinking and learning motivation, little is known about applying PBL to teach the human excretory system in senior high school, especially when these two elements are integrated. Consequently, this research is significant because it provides empirical data that may support the development of effective and innovative educational frameworks.

The aims of this research were to (1) assess the impact of the problem-based learning model on students' critical thinking abilities and (2) evaluate the model's efficacy in enhancing students' critical thinking skills and learning motivation concerning the human excretory system taught at SMA Smart Insani.

State of the Art

Problem-Based Learning (PBL) is broadly acknowledged as a learner-focused pedagogical method that encourages engagement through genuine, situational problem resolution. Prior research shows that PBL can improve students' critical thinking by prompting them to identify issues, assess material, consider solutions, and build knowledge autonomously. Additional research has indicated that PBL positively affects learning motivation, since problem-centered and cooperative tasks increase students' involvement, participation, and accountability for their education.

The literature cited in this study further indicates that PBL has been applied across different subjects and educational levels, including mathematics, chemistry, elementary science, and biology. The existing literature therefore provides substantial evidence supporting PBL as an effective approach for improving both cognitive and affective learning outcomes. However, the simultaneous examination of critical thinking skills and learning motivation within a specific senior high school Biology topic, particularly the human excretory system, remains comparatively limited.

METHOD

This research utilized a quantitative framework through a quasi-experimental design. The subjects were divided into two groups: one group received therapy using the PBL paradigm, while the other received instruction through a traditional pedagogical method. This approach was chosen as it allows researchers to evaluate the treatment's impact on the variables of interest despite the absence of full randomization of participants (Siregar et al., 2025). The cohort for this research comprised all Grade 11 pupils registered in the present academic year at SMA Smart Insani. The sample comprised two cohorts: an experimental cohort and a control cohort. The research included 52 subjects, evenly allocated among the two cohorts. The researchers gathered information through surveys and assessments. The questionnaire assessed students' learning desire, and a post-treatment test evaluated their critical thinking abilities. Combining these data-gathering techniques aimed to collect thorough and extensive information (Raharja et al., 2023).

Table 1. Categories of Learning Motivation

Score	Categori
0-54	Low
55-74	Moderate
74-100	High

Table 2. Criteria for Students' Critical Thinking Skills

Score	Description
81–100%	Excellent
61–80%	Good
41–60%	Fair
21–40%	Poor
<20%	Very Poor

We used quantitative statistical tests to examine the data. We began by assessing normality and homogeneity. Next, multivariate analysis of variance (MANOVA) was used to compare the two groups and test the research hypotheses regarding differences between the treatment and control groups (Sibagariang et al., 2024b). Furthermore, an effect size analysis was performed to assess the extent of the therapy effect.

Tabel 1. Criteria of *Effec Size*

Effect size (d)	Categori
$d \geq 0,80$	Very large
$d > 0,5, d < 0,8$	Large
$d < 0,5$	Medium
$0 < d \leq 0,2$	Small

(Nusantari et al., 2019)

RESULT

Despite extensive evidence of PBL's effectiveness, several gaps remain relevant to the present study. First, previous research cited in this article has frequently investigated PBL in educational contexts and subject areas other than the human excretory system, including mathematics, chemistry, elementary education, and other learning contexts. Second, although critical thinking and learning motivation have both been examined in previous PBL research, empirical evidence concerning their simultaneous development in senior high school Biology, specifically in learning the human excretory system, remains limited. The article itself explicitly identifies this limitation. Third, further evidence is needed not only to establish whether PBL produces statistically significant differences but also to determine the magnitude of its effects on each outcome. Addressing these gaps is important because the human excretory system involves complex physiological processes that require students to connect conceptual knowledge with real-life biological and health-related problems. The findings indicated that the experimental cohort exhibited superior critical thinking abilities compared to the control cohort. In the control group, 34.62% of students fell into the low category, with none in the very low category, whereas 3.85% were classified as high, and none in the very high category. Conversely, the experimental cohort exhibited a significant enhancement, with 50.00% of participants categorized as high and 11.54% as extremely high.

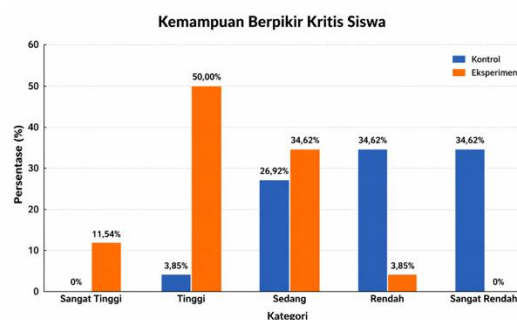


Figure 1. Assessment Results of Students' Critical Thinking Skills

Students' learning motivation varied significantly between the two groups in this research. In the control group, almost all students fell into the low category (96.15%), with a little percentage (3.8%) categorized as moderate, and none placed in the high or very high categories. Conversely, in the experimental cohort, most students were categorized into the high and very high tiers, representing 23.10% and 76.92%, respectively. None of the pupils in the experimental cohort were categorized as moderate, low, or extremely low.

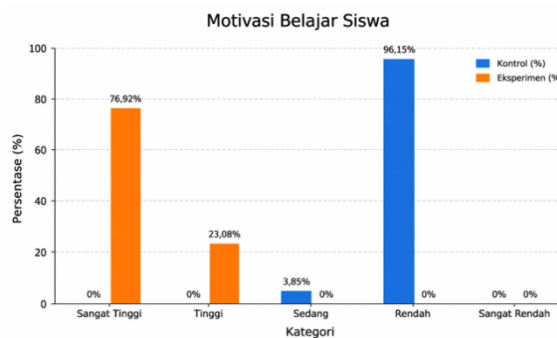


Figure 2. Assessment Results of Students' Learning Motivation

DISCUSSION

The results indicated a disparity in critical thinking abilities between students in the experimental and control groups. Students in the control group had diminished critical thinking abilities (34.62%), while those in the experimental group predominantly fell into the high (50%) and very high (11.54%) classifications. This variance signifies an enhancement in the caliber of students' cognitive processes and also demonstrates a measurable rise in their critical thinking abilities.

Implementing Problem-Based Learning (PBL) in the experimental class fostered a dynamic and engaging learning atmosphere. The instructor began the lecture by introducing practical concerns related to the human excretory system, including renal ailments and the impact of environmental pollutants on this system. Through dynamic small-group discussions, students shared their views, tried to understand the issues, and exchanged ideas about potential solutions. Through this process, students were able to actively construct their knowledge by analyzing and evaluating the information they received.

In contrast, learning in the control group was more teacher-centered. Rather than being actively engaged with the learning material, students primarily listened to the teacher's explanations, took notes, and answered questions individually. Consequently, students were

not adequately supported in developing their critical thinking skills, which may have contributed to lower academic achievement.

Because it relies on problems as the central catalyst for learning, problem-based learning (PBL) can theoretically cultivate advanced cognitive skills. Lestari et al. (2021) found that applying PBL can markedly enhance students' critical thinking abilities. Abdullah and Munawwaroh (2024) corroborated this conclusion by showing that PBL effectively taught students to critically assess and evaluate learning resources. The experimental cohort performed better than the control cohort in learning motivation. Most students in the experimental group showed high motivation to study (74.92%) or moderate motivation (23.18%), while 96.15% of students in the control group showed low motivation for learning.

Regardless of the learning setting, students in the experimental class were actively engaged in every stage of the learning process. Students appeared highly engaged in the lessons, demonstrating considerable interest in the material through questions and discussions. Students were intrinsically motivated to discover answers when presented with real-life situations to solve. In contrast, the control group's learning environment was often less engaging. Students appeared uninterested and unmotivated, and participated only when the teacher specifically prompted them. This suggests that traditional teaching methods may be less effective in inspiring students to learn.

Students' engagement in the learning process significantly affects their motivation to learn. By allowing students to work collaboratively and independently, the PBL approach encourages them to take ownership of their learning. Because it provides relevant, contextualized learning experiences, PBL significantly increases students' motivation to learn, as reported by Herlina (2024). Cahyani and Ahmad (2024) found that when students actively solve problems, they perceive the learning process as more engaging, which in turn increases their enthusiasm for learning.

Pillai's Trace value of 0.966 indicated that the MANOVA findings were significant at the 0.000 level (<0.05). This suggests that the PBL methodology significantly influenced both students' critical thinking abilities and their enthusiasm to study. Learning motivation and critical thinking abilities improved simultaneously during the experimental group's learning experience. Students showed greater involvement in problem analysis, discussion, and solution exploration when they were highly motivated. In contrast, students were motivated to engage in deeper learning and confront new obstacles through critical thinking exercises.

Marlinda et al. (2025b) found that PBL simultaneously affected students' critical thinking skills and their enthusiasm for learning; therefore, our findings are consistent with their results. In addition, Kurniawati et al. (2024) found that contextual and collaborative problem-based learning could improve both aspects. Thus, the PBL approach not only improves one area but also promotes the development of students' cognitive and affective capacities, particularly their critical thinking and willingness to learn.

The effect size analysis showed that learning motivation had a Partial Eta Squared value of 0.962 (very strong effect), whereas critical thinking skills had a value of 0.577 (strong effect). Given this difference, the PBL approach appears to affect students' motivation to learn more than their critical thinking skills. This may be attributable to the classroom environment, in which PBL immediately creates an engaging, dynamic, and challenging learning environment, thereby substantially influencing students' motivation to learn.

On the other hand, learning motivation had a considerably greater effect than critical thinking skills, which require more time and effort to develop but nevertheless showed substantial improvement. Although PBL positively influenced both motivation and critical thinking, the effect on motivation was more pronounced because of the direct relationship between students' motivation and their level of active participation in the learning process (Prasetya et al., 2022).

This study's novelty lies in its integrated empirical assessment of the cognitive and affective effects of PBL in teaching the human excretory system to senior high school students. Rather than examining critical thinking or learning motivation in isolation, the study simultaneously evaluates both variables through a quasi-experimental comparison between PBL and conventional instruction. Furthermore, using MANOVA with effect-size analysis enables the study to determine both the simultaneous statistical effect of PBL and the relative magnitude of its influence on critical thinking and learning motivation. This approach provides additional empirical insight by showing that PBL significantly influences both outcomes simultaneously and that its effect is more pronounced for learning motivation than for critical thinking skills.

Prior research has shown that Problem-Based Learning (PBL) is an effective student-centered methodology for enhancing critical thinking and learning motivation through genuine problem-solving, collaboration, and active student participation. Nonetheless, current studies encompass a variety of topics and educational environments, yet

actual data about the concurrent impact of PBL on critical thinking abilities and learning motivation in senior high school Biology, specifically concerning the human excretory system, are still few. This subject's intricacy requires students to grasp physiological principles while also examining the interconnections among organs, processes, and relevant biological issues. Consequently, this research tackles this deficiency by investigating the impact of PBL on students' critical thinking abilities and motivation to learn about the human excretory system. The originality of the research lies in its incorporation of cognitive and emotional outcomes within a quasi-experimental design, using MANOVA with effect-size analysis to assess both the statistical significance and impact of PBL. This research builds on other PBL studies by providing contextually relevant empirical evidence that problem-based education enhances higher-order thinking and learning motivation in senior high school Biology.

Maulana and colleagues (2025). Effectively deploying this technology necessitates comprehensive backing to cultivate transformative education and nurture a generation of introspective, adaptable, and principled learners. The ISLAMIC-TECH model comprises five primary elements: Infrastructure, Spiritual Content, Learning Activity, Assessment, and Moral Character, providing a cohesive basis for the interplay of technological, pedagogical, and spiritual aspects. Four distinct IT media classifications in PAI education have been recognized, specifically: immersive media (VR/AR), interactive (gamification), collaborative (social learning), and adaptive (personalized learning). The execution plan highlights the concept of "Technology as Servant, Spirituality as Master" alongside a dual-mode learning approach to harmonize digital engagement with direct religious observance. This study presents a conceptual model for a technology-driven digital PAI curriculum that is contextually relevant, genuinely Islamic, and responsive to 21st-century demands (Syarifudin et al., 2025). Recognized obstacles include inadequate infrastructure, educators' digital skills, and challenges in integrating education with spirituality. Nonetheless, IT media can enhance student engagement with PAI content, foster digital acumen, and reinforce character attributes through critical analysis, teamwork, and spiritual understanding.

Tampi et al. (2025) suggested ways to accelerate Indonesia's K-12 education by using alternative designations for RSBI (Rintisan Sekolah Berbasis Internasional, or Prepared International Standard School), which has been legislated, such as accelerated classes or national schools plus. Despite the higher fees compared to conventional schools, many parents believe that incorporating English will accelerate their children's progress.

Conversely, it ought to cultivate students' analytical abilities to distinguish an accelerated course from others. Indonesia, as a determined developing nation, has many aspirations for educational advancement. One of these aspirations is to cultivate a superior generation in the future through accelerated education. In 2011, several concepts were transformed into an actual initiative called RSBI (Rintisan Sekolah Berbasis Internasional, or Prepared International Standard School). Despite the legal abolition of RSBI, it still exists in Indonesia's K-12 education system under several designations, such as accelerated classes or national school plus. It means that critical thinking should be the primary reason why parents enroll their children in accelerated classes and pay more, rather than simply hoping that their children will learn English as the primary language in class. However, many researchers still believe (and even from a local government point of view) that accelerated classes in Indonesia (and some Asian countries, as well) are crucial for differentiating "those students" from others.

This study's novelty lies in its integrated investigation of the cognitive and affective effects of Problem-Based Learning (PBL) in senior high school Biology, specifically in teaching the human excretory system. Unlike previous studies that have predominantly examined critical thinking skills or learning motivation separately or applied PBL in different subject contexts, this study simultaneously evaluates both outcomes within a quasi-experimental framework. Furthermore, combining MANOVA with effect-size analysis provides evidence not only of PBL's simultaneous statistical effects but also of the relative magnitude of its influence on each outcome. The findings reveal that PBL significantly enhances both critical thinking skills and learning motivation, with a stronger effect on learning motivation. Thus, the study contributes context-specific empirical evidence regarding how PBL concurrently supports cognitive and affective development in learning a complex biological system.

CONCLUSION

This study demonstrates that Problem-Based Learning (PBL) significantly enhances students' critical thinking skills and learning motivation in learning the human excretory system. Students taught through PBL showed better critical thinking performance and substantially higher learning motivation than those receiving conventional instruction. The MANOVA results confirmed a significant simultaneous effect of PBL on both outcomes, while the effect-size analysis revealed a strong effect on critical thinking skills (partial $\eta^2 =$

0.577) and a very strong effect on learning motivation (partial $\eta^2 = 0.962$). These findings indicate that PBL supports both cognitive and affective dimensions of biology learning, with a more pronounced influence on students' motivation.

The findings provide context-specific empirical evidence that integrating authentic problems, collaborative discussion, and active problem solving into biology instruction can promote higher-order thinking while strengthening students' engagement and motivation. Therefore, PBL represents an effective instructional approach for teaching complex biological concepts such as the human excretory system. Future research should examine its effectiveness with larger and more diverse samples, across different biological topics and educational settings, and over longer intervention periods to determine the consistency and sustainability of its effects.

Suggestions

Based on the research findings and conclusions, the researchers propose the following suggestions:

1. Teachers are encouraged to implement the *Problem-Based Learning* (PBL) model in the learning process because it has been shown to improve students' critical thinking skills and learning motivation.
2. Schools are expected to support the implementation of innovative learning models such as PBL by providing teacher training and adequate learning facilities.

BIBLIOGRAPHY

- Abdullah, A., & Munawwaroh, F. (2024). Problem-Based Learning Untuk Meningkatkan Keterampilan Berpikir Kritis Siswa. *Jurnal Educatio FKIP UNMA*, 10(1), 155–162. <https://doi.org/10.31949/educatio.v10i1.6313>
- Annisa, D., & Annisa, M. (2024). Peningkatan Motivasi dan Karakter WASAKA Menggunakan Model Problem Based Learning dan Think Pair and Share Terintegrasi STEM Muatan IPA. *Journal of Education Research*, 5(3), 3449–3459. <https://doi.org/10.37985/jer.v5i3.1389>
- Cahyani, V., & Ahmad, F. (2024). Efektivitas Problem Based Learning terhadap Keterampilan Berpikir Kritis, Hasil belajar dan Motivasi Siswa. *Venn: Journal of Sustainable Innovation on Education, Mathematics and Natural Sciences*, 3, 76–82. <https://doi.org/10.53696/venn.v3i2.155>
- Herlina, H. (2024). Peningkatan Motivasi Belajar melalui Implementasi Problem Based Learning di Sekolah Dasar. *Journal of Education Research*, 5(1), 142–147. <https://doi.org/10.37985/jer.v5i1.750>
- Kurniawati, R., Rahman, M. F., & Sehabuddin, A. (2024). Pengaruh Model Pembelajaran Problem Based Learning Berbantuan Media Mind Mapping Meningkatkan Kemampuan Berpikir Kritis dan Motivasi Belajar. *Jurnal Pendidikan Ekonomi*

- (*JURKAMI*), 9(2), 447–459. <https://doi.org/10.31932/jpe.v9i2.3645>
- Lestari, W. M., Ashari, A., & Ngazizah, N. (2021). Model Pembelajaran Problem Based Learning Untuk Peningkatan Motivasi Belajar dan Kemampuan Berfikir Kritis. *Jurnal Pendidikan Dasar*, 2(2), 93–105.
- Marlinda, H., Alim, J. A., & Ikhsan. (2025a). Pengaruh Model Pembelajaran Problem Based Learning (PBL) Berbantuan Youtube Terhadap Kemampuan Berpikir Kritis dan Motivasi Belajar Matematika Siswa Kelas IX. *Jurnal Kiprah Pendidikan*, 4(2), 71–86. <https://doi.org/10.33578/kpd.v4i2.273>
- Marlinda, H., Alim, J. A., & Ikhsan. (2025b). Pengaruh Model Pembelajaran Problem Based Learning (PBL) Berbantuan Youtube Terhadap Kemampuan Berpikir Kritis dan Motivasi Belajar Matematika Siswa Kelas IX. *Jurnal Kiprah Pendidikan*, 4(2), 71–86. <https://doi.org/10.33578/kpd.v4i2.273>
- Maulana, I., Lengkong, I. K., Hafidhah, H., & Madhakomala, M. (2025). Improving Digital Literacy Skills With The Application Of Deep Learning Technology In Absorbing Information, Creating Information, And Evaluating And Creating Learning. *Jurnal Edusci*, 2(6), 281–296. <https://doi.org/10.62885/edusci.v2i6.806>
- Muhfahroyin, M. (2009). Memberdayakan Kemampuan Berpikir Kritis Siswa Melalui Pembelajaran Konstruktivistik. *Jurnal Pendidikan dan Pembelajaran Universitas Negeri Malang*, 16(1), 88–93.
- Muhfahroyin, M. (2010). Meningkatkan Kemampuan Berpikir Kritis Dan Pengembangan Karakter Melalui Think Pair Square Share (Tpss) Dalam Lesson Study. *Bioedukasi (Jurnal Pendidikan Biologi)*, 3(1). <https://doi.org/10.24127/bioedukasi.v3i1.226>
- Muhfahroyin, M., Rachmadiarti, F., Mahanal, S., Zubaidah, S., & Siagiyanto, B. E. (2023). Improving critical thinking of low ability students through TPS and PBL integration in biology learning. *Journal of Turkish Science Education*, 20(4), 606–618. <https://doi.org/10.36681/tused.2023.034>
- Nusantari, D. O., Kristiana, R., & Septhiani, S. (2019). *Effect Size untuk Menghitung Efektivitas Penyuluhan tentang Kesehatan Reproduksi*.
- Pamungkas, R. S. A., & Wantoro, J. (2024). Peningkatan Kemampuan Berpikir Kritis melalui Model Problem Based Learning dalam Pembelajaran PPKn Sekolah Dasar. *Jurnal Basicedu*, 8(2), 1286–1297. <https://doi.org/10.31004/basicedu.v8i2.7360>
- Prasetya, I. G. a. S., Agustini, K., & Sudarma, I. K. (2022). Pengaruh Problem Based Learning Berbantuan Multimedia terhadap Motivasi Belajar dan Berpikir Kritis Mata Pelajaran Kimia SMA. *Jurnal Teknologi Pembelajaran Indonesia*, 12(2), 143–153. https://doi.org/10.23887/jurnal_tp.v12i2.1208
- Raharja, K. a. T., Parwati, N. N., & Sudatha, I. G. W. (2023). Pengaruh Problem Based Learning Flipped Classroom Berbantuan Video Interaktif Terhadap Kemampuan Berpikir Kritis dan Motivasi Belajar Matematika. *Jurnal Teknologi Pembelajaran Indonesia*, 13(1), 21–31. https://doi.org/10.23887/jurnal_tp.v13i1.1981
- Rapsan. (2026). Pengaruh Media Pembelajaran Interaktif Aplikasi Canva Terhadap Hasil Belajar Dan Keterampilan Berpikir Kritis Siswa Sma It Granada Materi Keanekaragaman Hayati. *BIOLOVA*, 7(1), 51–58. <https://doi.org/10.24127/biolova.v7i1.6544>
- Sibagariang, F. M., Diwanti, D. R., Haq, K. A., & Pratama, A. Y. (2024a). Peningkatan Motivasi Belajar Siswa dengan Menggunakan Model Pembelajaran Problem-Based Learning pada Mata Pelajaran IPAS Kelas IV. *Jurnal Basicedu*, 8(4), 2411–2419. <https://doi.org/10.31004/basicedu.v8i4.7869>
- Sibagariang, F. M., Diwanti, D. R., Haq, K. A., & Pratama, A. Y. (2024b). Peningkatan Motivasi Belajar Siswa dengan Menggunakan Model Pembelajaran Problem-Based

- Learning pada Mata Pelajaran IPAS Kelas IV. *Jurnal Basicedu*, 8(4), 2411–2419. <https://doi.org/10.31004/basicedu.v8i4.7869>
- Siregar, A. H., Yarmi, G., & Suhandoko, A. D. J. (2025). Pengaruh Model Problem-Based Learning dan Motivasi Belajar Siswa terhadap Kemampuan Berpikir Kritis Siswa Kelas V di Sekolah Dasar Wilayah 3 Kecamatan Koja. *Jurnal Pendidikan Indonesia*, 6(5), 2498–2518. <https://doi.org/10.59141/japendi.v6i5.7790>
- Syaifuddin, S., & Junaedi, J. (2025). Conceptual Analysis of It Media Integration In The Digital Islamic Education Curriculum As An Effort To Strengthen The Character Of Junior High School Students: A Library Perspective. *Jurnal Edusci*, 2(6), 260–280. <https://doi.org/10.62885/edusci.v2i6.805>
- Tampi, F. L., Dengah, J. I., & Masinambow, D. A. (2025). Uncover Creative Thinking Skills Development in Accelerated Class: (case study: National Plus School in North Sulawesi, Indonesia). *Jurnal Edusci*, 2(6), 297–306. <https://doi.org/10.62885/edusci.v2i6.930>