



Developing the MONESI Educational Game Integrating Surabaya Semanggi Local Wisdom to Enhance Students' Critical Thinking Skills

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Abstract: This study aims to develop valid and effective problem-based learning media integrated with the local wisdom of Surabaya clover plants to train students' critical thinking skills, called MONESI (Monopoli Education Semanggi). This study uses a research and development (R&D) method with the ADDIE model, which consists of the analysis, design, development, implementation, and evaluation stages. The subjects of this study were 36 tenth-grade high school students in Surabaya. The research instruments used included a validation sheet and a critical thinking skills test. Data analysis techniques included descriptive validity analysis, Aiken's V validity index analysis, Cronbach's alpha reliability test, and Paired-Samples T-Test analysis using IBM SPSS Statistics version 27.0. The results of the study indicate that the MONESI game achieved an average validity score of 3.87 across all assessment aspects, which falls within the high validity (HV) category, with an average validity index of 0.960 (≥ 0.75), while the Cronbach's alpha reliability test yielded a value of 0.842 (≥ 0.5). Based on these two results, it can be concluded that the MONESI game has a high level of reliability and is suitable for use as a learning medium. Analysis of the critical thinking skills test results using the t-test yielded a significance value of $0.00 < 0.05$, indicating a significant improvement in students' critical thinking skills following the implementation of the MONESI game. This improvement was evident across all critical thinking indicators: interpretation (0.16), analysis (0.23), inference (0.26), explanation (0.27), and evaluation (0.37). Thus, the MONESI game can be considered effective in developing students' critical thinking skills regarding the topic of water pollution.

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Introduction

In the Society 5.0 era, critical thinking is considered an essential skill for addressing increasingly complex challenges and rapid technological developments (Nada et al., 2024). Critical thinking enables individuals to analyze information, evaluate evidence, and make informed decisions through logical reasoning (Yin, 2026). These skills also help students solve problems and adapt to the continuous development of science and technology in everyday life (Nugroho & Dingot, 2024). Therefore, critical thinking skills, including interpretation, analysis, inference, explanation, and evaluation, need to be developed through the learning process (Mahmudah et al., 2024).

Although critical thinking skills are essential in the Society 5.0 era, various international and national assessments indicate that Indonesian students' critical thinking

abilities remain relatively low. The 2018 and 2022 PISA results showed that Indonesian students' literacy and reasoning skills were still below the OECD average, while the 2024 Minimum Competency Assessment (AKM) categorized students' cognitive abilities as moderate (Firdha & Rizka, 2023). This condition is influenced by several factors, including low learning motivation, limited student engagement, and the continued use of teacher-centered learning practices (Adnin et al., 2023). In addition, the lack of innovative and contextual learning media reduces students' opportunities to actively develop their critical thinking skills during the learning process (Ramadani et al., 2025).

One effort to improve students' critical thinking skills is through the development of innovative and contextual learning media that actively engage students in the learning process. Game-based learning has the potential to increase motivation, participation, and cognitive engagement by creating enjoyable and interactive learning experiences (Adventyana et al., 2023). Educational monopoly games can also train critical thinking skills through activities that involve decision-making, problem-solving, and situational analysis during gameplay (Rahmadani et al., 2023). To make learning more meaningful, learning media should be integrated with local wisdom so that students can relate scientific concepts to real experiences in their surrounding environment (Askodrina, 2021).

One form of local wisdom relevant to integrating biology learning is the semanggi plant (*Marsilea crenata* L.), a cultural and culinary icon of Surabaya (Humaida et al., 2021). The water fern is an aquatic plant with ecological value due to its role as a phytoremediation agent in reducing water pollution (Rulitasari & Fida, 2020). The potential of the semanggi plant is relevant to the subject of environmental change, particularly the sub-subject of water pollution, which requires students to analyze the impact of human activities on the environment and design solutions to environmental problems (Sari & Tarzan, 2023).

The integration of local wisdom about clover plants into learning aligns with the Merdeka Curriculum, which emphasizes the development of critical thinking competencies and students' ability to respond to environmental issues in context (Aulia et al., 2023). The environmental change material in the Biology E phase provides students with space to develop critical thinking skills through the analysis of environmental problems in their immediate surroundings (Kusuma & Herlina, 2024). In this study, the MONESI (Monopoli Education Semanggi) learning media was developed to train students' critical thinking skills through the application of the Problem-Based Learning (PBL) model and the Culturally Responsive Teaching (CRT) approach. Unlike existing PBL or CRT-based learning media that generally focus on digital platforms or conventional discussion activities, MONESI integrates a monopoly-based game format with local environmental issues to create interactive, contextual, and student-centered learning experiences.

The monopoly-based format was chosen because it allows students to actively engage in problem-solving, discussion, decision-making, and evaluation through competitive and collaborative gameplay. This format also increases students' motivation and participation during learning activities. In addition, the concept of clover (semanggi) was selected because it represents one of Surabaya's local wisdom icons, closely related to environmental conservation and phytoremediation in aquatic ecosystems, making it relevant to the topic of environmental change and water pollution. This learning media is optimized through the PBL model, which emphasizes authentic problem-solving as the basis of learning, thereby encouraging students to analyze environmental issues and formulate solutions systematically (Fadhil & Sunu, 2021). In addition, integrating local wisdom about clover through the CRT approach allows students to relate their cultural experiences and the surrounding



environmental context to the concept of environmental change, making learning more meaningful and relevant (Girsang et al., 2024).

Research on the application of the PBL model and local wisdom-based learning, when implemented separately, has shown that they effectively enhance students' critical thinking skills and environmental awareness (Purnamasari et al., 2021). Other studies have also reported that integrating the PBL model with the CRT approach positively affects students' critical thinking skills (Adelia et al., 2025). However, research integrating an educational Monopoly game based on local wisdom regarding clover plants with the PBL model and the CRT approach in high school biology instruction remains limited. Therefore, this study aims to address this gap by developing the MONESI learning medium, which is valid and effective in fostering students' critical thinking skills.

Research Method

This study employs a research and development (R&D) method using the ADDIE model (Branch, 2008), which includes the stages of analysis, design, development, implementation, and evaluation, with the aim of producing MONESI (Semanggi Educational Monopoly) game-based media using Problem-Based Learning (PBL) and Culturally Responsive Teaching (CRT) to train students' critical thinking skills. The analysis stage was conducted by examining learning needs based on the learning outcomes of phase E in the environmental change sub-material on water pollution, the characteristics of tenth-grade students, and the potential of local wisdom regarding the Surabaya clover plant. The design stage included designing the MONESI media blueprint, compiling game components, and developing validation instruments and critical thinking skills tests aligned with PBL syntax, the CRT approach, and critical thinking indicators.

The development stage involved creating the MONESI game product, which was then validated by subject matter experts, media experts, and biology teachers to gather input as a basis for revision. The implementation stage was conducted with 36 tenth-grade students at a high school in Surabaya, using a one-group pretest-posttest design to assess the effectiveness of the media in training critical thinking skills. The research subjects were selected using a purposive sampling technique, based on the suitability of the class to the research objectives, namely students who had studied material on environmental change and were actively involved in Biology learning activities. The evaluation stage was carried out formatively and summatively based on the results of validity, reliability, and media effectiveness tests. Validity data analysis used average scores and Aiken's V validity index; instrument reliability was analyzed using Cronbach's alpha; and media effectiveness was analyzed using a Paired-Samples T-Test assisted by IBM SPSS Statistics version 27.0.

Results and Discussion

The MONESI game developed in this study is an educational monopoly game that integrates the local wisdom of Surabaya clover plants, the PBL learning model, the CRT approach, and environmental change material, specifically the topic of water pollution, for 10th-grade high school students. MONESI is designed as an interactive group-based board game that includes a game board with 24 squares, question cards, quiz cards, fun fact cards, advantage cards, and multiplayer components such as currency, building properties, price multiples, and a knowledge garden that serves as a reinforcement for reflection and self-regulation. Each game component contains contextual problems and data-based questions that are structured and designed to train students' critical thinking skills, including interpretation, analysis, inference, explanation, and evaluation through activities such as problem

identification, cause-and-effect analysis, solution formulation, and collaborative decision-making.

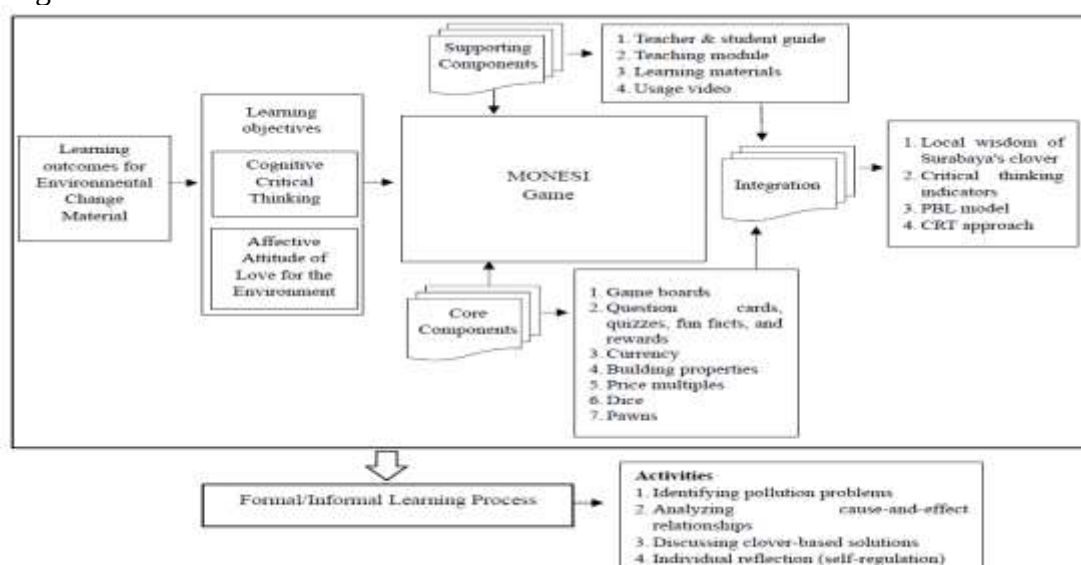


Figure 1. MONESI Game Blueprint

Figure 1 shows that MONESI was designed as an integrated learning system that combines learning objectives, media components, and the integration of the PBL model with the CRT approach in environmental change learning. The development of MONESI refers to the learning outcomes of the Merdeka Curriculum Phase E, which emphasizes students' ability to formulate solutions to environmental problems at local, national, and global levels. Based on these learning outcomes, MONESI is designed to develop students' critical thinking and environmental awareness through contextual and interactive learning activities. These objectives serve as the foundation for the design of all MONESI learning components and activities.

MONESI consists of supporting and core components designed to support contextual and interactive learning activities in the classroom. The supporting components include teaching modules, learning materials, instructional videos, and teacher and student guides developed in accordance with the PBL model and CRT approach to facilitate the implementation of structured learning activities. Meanwhile, the core components are presented as an educational Monopoly-style game, including a game board, question cards, quiz cards, bonus cards, and multiplayer elements that create collaborative and competitive learning experiences. The game components are designed to integrate critical thinking indicators, including interpretation, analysis, inference, explanation, and evaluation, through contextual problem-solving activities related to environmental change and water pollution topics.

MONESI Game Validation Results

The MONESI game developed was validated by education and subject-matter experts, as well as biology teachers. The validation of the MONESI game was reviewed across seven assessment aspects: content suitability, integration of CRT and PBL models, critical thinking, local wisdom, environmental awareness, learning motivation, and readability and appropriateness of language. The summary of the validation assessment results is presented in the following table.

Table 1. Summary of MONESI Game Validation Results

Assessment Aspects	Average Score	Category
Content Suitability	4	Highly valid
Integration of CRT and PBL Models	3,83	Highly valid
Critical Thinking	3,91	Highly valid
Local Wisdom	4	Highly valid
Environmental Attitude	4	Highly valid
Learning Motivation	3,83	Highly valid
Readability and Language Appropriateness	3,58	Highly valid
Overall Average	3,87	Highly valid

Based on Table 1, the MONESI game obtained an average validity score for all assessment aspects of 3.87, which is categorized as highly valid (HV). These results indicate that MONESI meets the criteria for educational media suitability, consistent with the findings of Widiyawanto et al. (2025), who found that educational games that receive high levels of agreement from the majority of respondents are suitable for supporting the learning process. The high validation score indicates that the MONESI game has met the overall feasibility standards. In more detail, the validation results show that every aspect of the MONESI game assessment is in the highly valid category. The aspects of content suitability and local wisdom each received an average score of 4, indicating that the material presented was in line with the sub-material on water pollution and the learning objectives, and was integrated with local wisdom about clover plants, making learning contextual and close to the students' real experiences. This finding is in line with Dulmen et al. (2022), which shows that instructional media designed in accordance with learning objectives, content characteristics, and student experiences have greater potential to support active student engagement and optimize the attainment of competencies in the learning process.

The integration of the CRT approach and the PBL model yielded an average score of 3.83, indicating that the MONESI game can support problem-based learning integrated with students' cultural contexts, thereby encouraging students to actively participate and construct their own understanding during the learning process. This finding aligns with the research by Bowyer & Joseph (2026), which explains that learning that combines contextual problems with the CRT approach can enhance students' emotional engagement and active participation in the learning process. Additionally, the critical thinking aspect received a score of 3.91, indicating that MONESI is effective in developing high-order thinking skills in interpretation, analysis, inference, explanation, and evaluation. These results are supported by research by Syauqi & Yuni (2023), which shows that educational games include Higher Order Thinking Skills (HOTS) questions help students develop critical thinking skills.

The environmental awareness aspect received a score of 4, and the learning motivation aspect received a score of 3.83, indicating that MONESI not only helps foster students' environmental awareness but also enhances their interest and engagement during the learning process. These results are supported by the research of Jaaska et al. (2022), which explains that game-based learning can increase student motivation and engagement through active, interactive, and collaborative learning experiences, making learning more engaging and meaningful. Meanwhile, the readability and appropriateness of the language aspect received a score of 3.58, indicating that the language used in MONESI is communicative and easy to understand, making it suitable as a learning support medium. This finding aligns with the research by Desantis et al. (2023), which shows that learning media with clear, communicative language appropriate to students' characteristics can improve understanding of the material and enhance the effectiveness of the learning process. In

addition to calculating the average validity score, the researchers also calculated the average validity criteria index of the MONESI game using Alken's validity analysis technique, resulting in the following average validity index.

Table 2. MONESI Game Validity Index

Item	Validator			S ₁	S ₂	S ₃	Σs	V	Description
	I	II	III						
Item 1-28	105	111	110	77	83	82	242	0.960	HIGH

In Table 2, the MONESI game validity index obtained an average of $0.960 \geq 0.75$, indicating that the MONESI game is valid and suitable for use as a learning medium. This is in line with the validity index criteria, which state that an index value ≥ 0.75 indicates a good level of expert agreement on the suitability of a development product, so that the learning media developed can be used in the learning process (Fadjeri & Anisa, 2022). Meanwhile, the results of the Cronbach's alpha reliability test for the MONESI game using the SPSS application obtained the following results:

Table 3. Results of the Cronbach's Alpha Reliability Test of the MONESI Game Reliability Statistics

Cronbach's Alpha	N of Items
.842	3

Table 3 shows that the reliability test of the MONESI game indicates a Cronbach's alpha value of 0.842, which is ≥ 0.5 , indicating that the overall MONESI game instrument has a high level of reliability. This value indicates that the instrument has good internal consistency and can provide stable assessment results when used under relatively similar conditions. This finding aligns with Sobiri & Nashrullah (2026) research, which states that instruments with high Cronbach's alpha values demonstrate good internal consistency, making the resulting data reliable for use in educational research. Furthermore, a study by Cioffi et al. (2024) explains that a reliable instrument not only supports measurement accuracy but also strengthens the validity of research results as it consistently measures the same aspects across various use conditions.

MONESI Game Effectiveness Results

Data on critical thinking skill achievement were obtained by comparing pretest and posttest results. These results were used to analyze the effectiveness of the MONESI game in training students' critical thinking skills. The pretest and posttest consisted of 15 multiple-choice and 5 essay questions, validated by three validators (two lecturers and one biology teacher). The analysis of the effectiveness data used the Paired-Samples T-Test in the SPSS application, producing the following image.

Table 4. Paired Sample T-Test Results

		N	Correlation	Sig.
Pair 1	PRE & POST	36	.924	.000

Based on Table 4, the significance value of the critical thinking skills test results ($0.00 < 0.05$) indicates a difference in student learning outcomes before and after using the MONESI game. These results indicate that the MONESI game is effective in developing students' critical thinking skills on the topic of water pollution. This finding aligns with the research by Liu & Pasztor (2022) in the context of problem-based learning in Europe, which showed that problem-based learning can enhance critical thinking skills because students are encouraged to analyze problems, discuss solutions, and make decisions collaboratively. Furthermore, the Monopoly-based game format in MONESI also supports active and interactive learning, as found by Fouilloux et al. (2025) in a study on game-based learning in the United States, which showed that educational games can increase student engagement

through exploration, strategy development, and social interaction during the learning process, thereby helping students understand the learning material more easily.

These findings are further supported by a study by Mao et al. (2021) in China, which showed that game-based learning has a positive impact on students' critical thinking skills because it fosters problem-solving activities, collaboration, and active student engagement during the learning process. These results are further supported by a literature review conducted by Katual et al. (2025), which explains that game-based learning can enhance critical thinking skills through problem-solving activities, strategic thinking, collaboration, and decision-making during gameplay, as students actively engage in thinking while completing tasks, thereby making the learning process more meaningful. Thus, the effectiveness of the MONESI game is not only relevant in the context of learning based on Surabaya's local wisdom but also aligns with various international studies on the application of game-based learning and problem-based learning in developing students' critical thinking.

In line with these findings, the effectiveness of the MONESI game is not only demonstrated by the overall significance test results but also requires further analysis improvements in each critical thinking skill indicator trained. Therefore, to obtain a more comprehensive picture of the contribution of the MONESI game to the development of students' abilities, a comparative analysis of pretest and posttest scores for each indicator was conducted, which will be presented in Figure 2. Based on Figure 2, it is evident that there was an increase in student learning outcomes across all critical thinking indicators following instruction using the MONESI game. The interpretation indicator increased by 0.16, the analysis indicator by 0.23, the inference indicator by 0.26, the explanation indicator by 0.27, and the evaluation indicator by 0.37. This improvement indicates that the MONESI game not only impacts overall final achievement but is also capable of gradually developing each component of critical thinking through features and activities designed to align with the characteristics of each indicator.

The largest increase was observed in the evaluation indicator because the MONESI game's mechanics require students not only to understand the material on water pollution and local knowledge regarding clover plants but also to make the most appropriate decisions when answering question cards, quiz cards, or managing game strategies. This process helps students become accustomed to comparing multiple answer options, assessing the accuracy of information based on scientific evidence, and considering the consequences of each decision repeatedly, resulting in the highest improvement in the evaluation indicator compared to other critical thinking indicators. This finding aligns with the research by Chen et al. (2021), which shows that game-based learning can improve critical thinking skills by engaging students in decision-making, problem analysis, and the evaluation of various answer alternatives during the learning process.

The study by Lin et al. (2023) also shows that game-based learning can develop decision-making and evaluation skills because students are constantly faced with situations that require them to consider solutions and consequences. Furthermore, the smallest improvement was observed in the interpretation indicator because, prior to playing the MONESI game, the majority of students had already mastered the foundational skills of interpretive assessment, namely understanding data presented in the form of images, graphs, or tables, so that the training of interpretive skills during the game did not yield a significant improvement compared to other critical thinking indicators. This indicates that students' initial interpretation skills were already sufficiently strong, leaving less room for improvement compared to more complex critical thinking indicators. This finding aligns with research explaining that interpretation indicators tend to be easier for students to master than

other higher-order critical thinking indicators because they relate to the foundational ability to understand visual and textual information (Agus & Purnama, 2022). Furthermore, other studies have also shown that most students generally meet the interpretation indicators before mastering more complex critical thinking indicators such as analysis, evaluation, and inference (Wulandari & Warmi, 2022).

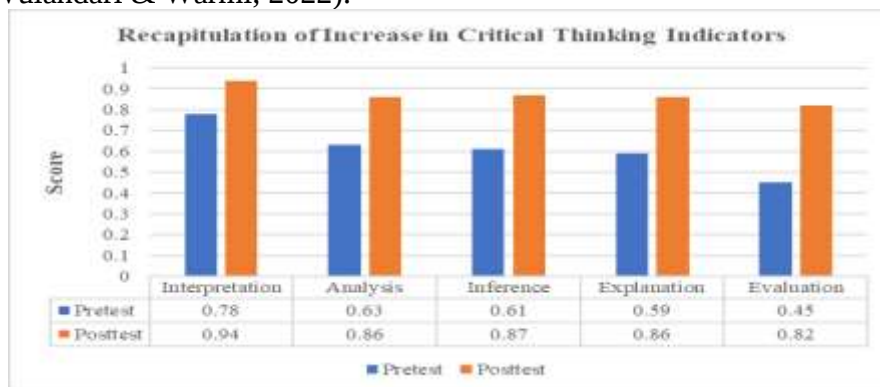


Figure 2. Critical Thinking Indicator Increase Graph

The improvement in the analysis indicator was influenced by the inclusion of HOTS-oriented questions in the MONESI game, which trained students to identify relationships between concepts and analyze problems systematically (Rizki et al., 2024). In addition, the improvement in inference and explanation indicators indicates that MONESI encourages students to draw conclusions and explain answers based on available evidence during gameplay. Contextual and essay-based questions also provide opportunities for students to develop logical reasoning and communicate their ideas coherently (Baruno et al., 2025). Therefore, the integration of various game components in MONESI creates active and meaningful learning experiences that support the development of students' critical thinking.

Conclusion

The MONESI game, developed through the integration of the PBL model, the CRT approach, and the local wisdom of the Surabaya clover plant, has proven to be highly valid and reliable as a biology learning medium on the topic of water pollution to train students' critical thinking skills. The implementation of the MONESI game significantly improved students' critical thinking skills in all indicators, including interpretation, analysis, inference, explanation, and evaluation. The highest indicator increase occurred in the evaluation indicator, while the lowest was in the interpretation indicator. Based on the results of this study, it can be concluded that the MONESI game can be used as an effective, contextual, and interactive learning medium to support the development of students' critical thinking skills in biology learning.

Recommendation

Teachers should utilize MONESI not merely as a game but as a structured tool to trigger 'problem orientation' and 'group investigation' phases, which are often challenging to implement in conventional settings. Meanwhile, for future researchers, MONESI games have the potential to be developed using models, learning approaches, and other biology materials that are contextual and oriented towards local wisdom in other regions.

References

- Adelia, N., Anas, M. T., & Siti, A. (2025). Peningkatan Hasil Belajar Peserta Didik melalui Model Pembelajaran Problem-Based Learning (PBL) dengan Pendekatan Culturally Responsive Teaching (CRT) di Kelas IV C SDN Pandanwangi 3. *Pendas*, 10(2). <https://doi.org/10.23969/jp.v10i02.25972>
- Adnin, I., Sapriya, Riska, N., Abhi, R. R., Siska, D., Agung, N. P. (2023). Analisis Implikasi Penerapan Pembelajaran Berdiferensiasi Terhadap Kemampuan Berpikir Kritis Peserta Didik Pada Pembelajaran PKN. *Educatio*. 18(2):304-314. <https://doi.org/10.29408/edc.v18i2.24310>
- Adventyana, B. D., Hasna, S., Lara, S., Patricia, B. J. G., & Yunita, Y. I. (2023). Media Pembelajaran Digital sebagai Implementasi Pembelajaran Inovatif untuk Sekolah Dasar. *Jurnal Pendidikan dan Konseling*, 5(1). <https://doi.org/10.31004/jpdk.v5i1.11640>
- Agus, I., & Purnama, A. N. (2022). Eksplorasi kemampuan berpikir kritis matematika berdasarkan keyakinan (belief) siswa. *Jurnal Tadris Matematika*, 5(1), 17–28. <https://doi.org/10.21274/jtm.2022.5.1.17-28>
- Askodrina, H. (2021). Penguatan Kecerdasan Perspektif Budaya dan Kearifan Lokal. *Jurnal Pendidikan dan Pemikiran*, 16(1). <https://doi.org/10.55558/alihda.v16i1.52>
- Aulia, D., Hadiyanto., & Rusdinal. (2023). Analisis Kebijakan Kurikulum Merdeka melalui Implementasi Proyek Penguatan Profil Pelajar Pancasila di Sekolah Dasar. *JPSD*, 11(1):122-133. <https://doi.org/10.22219/jp2sd.v11i1.25923>
- Baruno, Y. H. E., Juliana, L., Yosua, P., & Hafsa, S. I. R. S. (2025). Pengaruh Pembelajaran Kontekstual terhadap Motivasi dan Berpikir Kritis Siswa. *Ahsani Taqwim*, 2(1). <https://doi.org/10.63424/ahsanitaqwim.v2i1.201>
- Branch, R. M. (2009). Instructional design: The ADDIE approach. *Springer Science Bussiness Media*, Inc.
- Bowyer, B., & Joseph, K. (2026). Inquiry-Based and Culturally Responsive Learning Opportunities in Social Studies: A Panel Study of Their Relationships to Civic Development. *Theory & Research in Social Education*. <https://doi.org/10.1080/00933104.2026.2621322>
- Chen, L. X., Su, S. W., Liao, C. H., Yan, J. Y., & Yuan, S. M. (2026). The impact of computational thinking teaching aids on secondary students: A digital game application. *Thinking Skills and Creativity*, 62, 102222. <https://doi.org/10.1016/j.tsc.2026.102222>
- Cioffi, A., Silvia, G., Raffaella, P., & Italo, T. (2024). Validation of Two Anxiety Scales for Physics Undergraduate Courses Through Confirmatory Factor Analysis and Rasch Analysis. *Physical Review Physics Education Research*, 20(1). <https://doi.org/10.1103/PhysRevPhysEducRes.20.010126>
- Desantis, W. J., Marcia, A. B. D., Bruce, M. S., & Jacob, C. G. (2023). Impact of Data-Driven Feedback and Coaching on Preservice Teacher's Questioning Skills for Higher Order Thinking within a Mixed Reality Simulation Environment. *Education Sciences*, 13(596). <https://doi.org/10.3390/educsci13060596>
- Dulmen, V., Talitha, C. S., Birgit, P., & Susan, M. (2022). Teacher and student engagement when using learning materials based on the context of cutting-edge chemistry research. *Research in Science & Technological Education*, 41(4):1617-1638. <https://doi.org/10.1080/02635143.2022.2070147>
- Fadhil, A. R., & Sunu, K. (2021) Validitas Lembar Kerja Peserta Didik Terintegrasi Sikap Peduli Lingkungan berbasis Problem Based Learning pada Materi Perubahan

- Lingkungan untuk Melatihkan Keterampilan Pemecahan Masalah Kelas X SMA. *BioEdu*, 10(2):292-301. <https://doi.org/10.26740/bioedu.v10n2.p326-334>
- Fadjeri, A., & Anisa, D. N. (2022). Pengujian Validitas pada Pengembangan Media Pembelajaran berbasis ICT. *Jurnal Pendidikan Surya Edukasi*, 8(1). <https://doi.org/10.37729/jpse.v8i1.1955>
- Firdha, Y., & Rizka, E. F. (2023). Analisis Rendahnya Literasi Sains Peserta Didik Indonesia: Hasil PISA dan Faktor Penyebab. *Lentera Sains*, 13(1):11-19. <https://doi.org/10.24929/lensa.v13i1.283>
- Fouilloux, C. A., Jonathan, S. C., Naing, N., Margene, A., & Jessica, L. H. (2026). Game Design as a STEM Pedagogy. *Journal of Microbiology & Biology Education*, 27(1). <https://doi.org/10.1128/jmbe.00173-25>
- Girsang, B., Indra, M., & Usnidar, N. (2024). Penerapan Model PBL terhadap Hasil Belajar Murid Melalui Pendekatan CRT. *Journal Mathematics Education Sigma*. <https://doi.org/10.30596/jmes.v5i2.20786>
- Jaaska, E., Jere, L., Jaakko, K., & Osmo, K. (2022). Game-Based Learning and Student's Motivation in Project Management Education. *Project Leadership and Society*, 3. <https://doi.org/10.1016/j.plas.2022.100055>
- Katual, D., Roelien, G., & Lynette, D. (2023). Game-Based Learning to Improve Critical Thinking and Knowledge Sharing: Literature Review. 67. <https://journals.issn.org/index.php/jisss/article/view/4170>
- Kusuma, A. M., & Herlina, F. (2024). Pengembangan Flipbook Ekosistem berbasis Problem-Based Learning untuk Melatihkan Keterampilan Berpikir Kritis Peserta Didik Kelas X SMA. *BioEdu*, 13(1):155-163. <https://doi.org/10.26740/bioedu.v13n1.p155-163>
- Lin, W., Jui, Y. W., & Hsiu, P. Y. (2022). Learning Information Ethical Decision Making with a Simulation Game. *Frontiers in Psychology*, 13. [10.3389/fpsyg.2022.933298](https://doi.org/10.3389/fpsyg.2022.933298)
- Liu, Y., & Pásztor, A. (2022). Effects of problem-based learning instructional intervention on critical thinking in higher education: A meta-analysis. *Thinking Skills and Creativity*, 45, 101069. <https://doi.org/10.1016/j.tsc.2022.101069>
- Mahmudah, D. N. U., Aning, W. Y., Nailil, I., Nur, W., & Sri, H. L. (2024). Analisis Keterampilan Berpikir Kritis Murid pada Materi Sistem Tata Surya. *Jurnal Media Akademik*, 2(11). <https://doi.org/10.62281/v2i11.964>
- Mao, W., Yunhuo, C., Ming, M. C., & Hao, L. (2021). Effects of Game-Based Learning on Student's Critical Thinking A Meta-Analysis. *Sage Journals*, 59(8). <https://journals.sagepub.com/doi/abs/10.1177/07356331211007098?>
- Nada, B., Melfirosha, U., Utami, Q. R., Muhamad, P. (2024). Disparitas dan Sinergitas Epistemologi Filsafat Farabi dan Ibnu Sina dalam Pendidikan 5.0. *Refleksi*, 24(2). <https://doi.org/10.14421/ref.v25i2.5754>
- Nugroho, J., & Dingot, H. I. (2024). Strategi Membangun Keterampilan Berpikir Kritis untuk Generasi Alpha Z. *Transparansi*, 7(1):46-55. <https://doi.org/10.31334/transparansi.v7i1.3752>
- Purnamasari, S., Rapa, W., & Tasah, D. (2021). Efektivitas Implementasi Pembelajaran Inkuiri Berbasis Kearifan Lokal terhadap Hasil Belajar Murid. *Jurnal PGSD UNIGA*. <https://doi.org/10.52434/jpgsd.v1i2.2047>
- Rahmadani, A., Andy, A., Nafiah, N. S. R., Yulia, M. H., & Anatri, D. (2023). Model Problem Based Learning berbasis Media Permainan Monopoli dalam Meningkatkan Pemahaman Siswa Sekolah Dasar. *Jurnal Pendidikan Citra Bakti*, 10(1). <https://jurnal.citrabakti.ac.id/index.php/jil/article/view/1415/477>



- Ramadani, N., Muh Khaerul, U. BK., Moh Rudini. (2025). Analisis Peran Guru dalam Mengembangkan Kemampuan Berpikir Kritis (Konteks Implementatif Kurikulum Merdeka). *Pendas*, 10(3). <https://doi.org/10.23969/jp.v10i03.31656>
- Rulitasari, D., & Fida, R. (2020). Semanggi Air (*Marsilea crenata*) Sebagai Agen Fitoremediasi LAS Detergen. *Lentera Bio*, 9(2):99-104. <https://doi.org/10.26740/lenterabio.v9n2.p99-104>
- Sari, A., & Tarzan, P. (2023). Pengembangan LKPD berbasis Mind Mapping Materi Ekosistem untuk Meningkatkan Hasil Belajar Murid kelas X SMA. *BioEdu*, 12(3):695-706. <https://doi.org/10.26740/bioedu.v12n3.p694-705>
- Sobiri, M., & Nashrullah. (2026). Analisis Validitas dan Reliabilitas Instrumen Penelitian dalam Pendekatan Kuantitatif. *Psikosospen*, 2(1). <https://publisherqu.com/index.php/psikosospen/article/view/4042>
- Syauqi, M. A. I. Q. A., & Yuliani. (2023). Pengembangan Permainan KARZIM (Kartu Enzim) berbasis Team Games Tournament untuk Melatih Keterampilan HOTS Siswa SMA. *Bioedu*, 12(3):735-743. <https://doi.org/10.26740/bioedu.v12n3.p734-742>
- Widiyawanto, D. S., & Laurensia, M. P. (2025). Pengembangan Media Pembelajaran Bhinneka Boardgame (BHINBO) untuk Meningkatkan Hasil Belajar Materi Keberagaman Budaya Kelas IV SDN 101912 Pagar Merbau. *Jurnal Pendidikan Dasar*, 5(4). <https://doi.org/10.37081/jipdas.v5i4.3170>
- Wulandari, L. K., & Sifak, I. (2026). Pengembangan E-LKPD Learning Cycle 5E Sistem Imun untuk Melatih Keterampilan Berpikir Kritis. *Bioedu*, 15(1):208-217. <https://doi.org/10.26740/bioedu.v15n1.p208-217>
- Yin, S. (2026). Examining Critical Thinking in EAP Speaking Assessment: An Argument-Based Validation Study. *Thinking Skills and Creativity*. <https://doi.org/10.1016/j.tsc.2026.102253>