Kasuari: Physics Education Journal (KPEJ) 8(2) (2025) 500-509
P-ISSN: 2615-2681
E-ISSN: 2615-2673

Kasuari: Physics Education Journal (KPEJ)
Universitas Papua
website: https://journalfkipunipa.org/index.php/kpej

Development of Interactive Learning Media Using Articulate Storyline 3 Integrated with Problem Based Learning to Enhance Students' Critical Thinking on Temperature and Heat Concepts

Anggita Dewi Mithasari* & Yusman Wiyatmo
Program Studi Magister Pendidikan Fisika, FMIPA, Universitas Negeri Yogyakarta, Indonesia
*Corresponding author: anggitadewi.2023@student.uny.ac.id

Abstract: *This study aims to develop interactive learning media utilizing Articulate Storyline 3 integrated with a problem-based learning (PBL) model to enhance students' critical thinking skills, particularly on the topic of temperature and heat. The research employed a Research and Development (R&D) approach using the ADDIE model, which consists of Analysis, Design, Development, Implementation, and Evaluation stages. A large-scale field trial was conducted involving 100 eleventh-grade students from MAN 3 Banyumas. The implementation phase adopted a pretest-posttest control group design to measure the media's effectiveness. The results showed that the developed media is highly practical, as indicated by an average score of 90.43% from students and 93.05% from physics teachers, categorized as "very practical." Statistical analysis demonstrated a significant improvement in students' critical thinking abilities, with a partial eta squared value of 0.949 and Cohen's f of 4.31, signifying a very large effect size. The media features include interactive simulations, animations, quizzes, and a game-based approach that allows learners to engage in higher-order thinking through real-world problem-solving tasks. The integration of PBL strategies into interactive digital media provides students with opportunities to analyze, evaluate, and construct solutions collaboratively, fostering deep conceptual understanding.*

Keywords*: articulate storyline 3, critical thinking competence, interactive media, problem-based learning approach, temperature and heat*

Pengembangan Media Pembelajaran Interaktif Menggunakan Articulate Storyline 3 Terintegrasi Problem Based Learning untuk Meningkatkan Kemampuan Berpikir Kritis Siswa pada Konsep Suhu dan Kalor

Abstrak: Penelitian ini bertujuan untuk mengembangkan media pembelajaran interaktif menggunakan Articulate Storyline 3 yang diintegrasikan dengan model Problem Based Learning (PBL) untuk meningkatkan kemampuan berpikir kritis peserta didik, khususnya pada materi suhu dan kalor. Penelitian ini menggunakan metode Research and Development (R&D) dengan model pengembangan ADDIE yang terdiri dari tahapan Analisis, Desain, Pengembangan, Implementasi, dan Evaluasi. Uji coba lapangan skala besar dilakukan dengan melibatkan 100 siswa kelas XI dari MAN 3 Banyumas. Fase implementasi menggunakan desain eksperimen kelompok kontrol pretest-posttest untuk mengukur efektivitas media. Hasil penelitian menunjukkan bahwa media yang dikembangkan tergolong sangat praktis dengan skor rata-rata sebesar 90,43% dari siswa dan 93,05% dari guru fisika. Analisis statistik menunjukkan peningkatan signifikan pada kemampuan berpikir kritis siswa dengan nilai partial eta squared sebesar 0,949 dan nilai Cohen's f sebesar 4,31, yang termasuk dalam kategori efek sangat besar. Fitur media meliputi simulasi interaktif, animasi, kuis, dan permainan edukatif yang mendorong peserta didik untuk berpikir kritis melalui penyelesaian masalah kontekstual. Integrasi strategi PBL dalam media digital interaktif memberikan peluang bagi siswa untuk menganalisis, mengevaluasi, dan merancang solusi secara kolaboratif, sehingga meningkatkan pemahaman konseptual secara mendalam.

Kata kunci: articulate storyline 3, keterampilan berpikir kritis, media interaktif, problem based learning, suhu dan kalor

INTRODUCTION

According to the Indonesian Dictionary (KBBI), physics is described as a branch of science that studies matter and energy, encompassing various phenomena such as light, heat, and sound (Abidin, 2021). Despite its relevance, many students perceive physics as difficult and unappealing due to its heavy reliance on mathematical formulas, which often results in disengagement and limited enthusiasm for learning (Cahyadi, 2019). Consequently, it is essential to explore alternative instructional strategies that foster greater student interest and active engagement in physics learning. Education itself serves as a deliberate and structured process aimed at cultivating students' full potential, including their intellectual, moral, spiritual, and social capacities to meet both personal and societal demands (Rahman et al., 2022).

In the context of 21st-century education, schools play a critical role in preparing students to thrive in a globalized and highly competitive world (Fikri et al., 2020). Current educational frameworks emphasize the development of six core competencies known as the 6Cs: critical thinking, citizenship, creativity, character, collaboration, and communication. Among these, critical thinking is particularly vital, as it equips students with essential cognitive abilities for analyzing information, solving complex problems, and making reasoned decisions. Inductive reasoning allows learners to recognize patterns, analyze open-ended problems, establish causal relationships, and process data, while deductive reasoning supports logical problem-solving and the ability to distinguish facts from opinions (Saputra, 2020). Critical thinking is widely recognized as a fundamental skill for the 21st century, as it empowers students to approach challenges systematically and develop informed solutions (Susilowati et al., 2017). Nevertheless, some educational institutions have yet to fully integrate critical thinking into their curricula. Learners who possess well-developed critical thinking skills are generally more adept at addressing academic and real-world problems (Mulyani, 2022). Therefore, incorporating higher-order thinking questions (HOTS) into instructional design is crucial to stimulate students' analytical reasoning.

Physics offers numerous topics suitable for fostering critical thinking, one of which is the subject of temperature and heat. This topic covers key concepts such as temperature measurement and thermal expansion, which students frequently encounter in real-life contexts. However, many learners struggle to grasp these concepts due to their abstract and mathematical nature, often resulting in unsatisfactory academic performance (Affandy et al., 2019). Consequently, interactive learning media that visualize these concepts can serve as an effective tool to enhance students' conceptual understanding and critical thinking abilities.

The application of interactive media in education facilitates deeper engagement and comprehension by providing dynamic and accessible learning experiences. Among the various available multimedia tools, Articulate Storyline 3 stands out for its versatility in creating interactive and adaptive instructional materials (Indirawati, 2021). This software features user-friendly navigation and presentation layouts, as well as animation and simulation capabilities that allow for more engaging instructional delivery (Junpahira & Pahlevi, 2023). Previous research by Bunga et al. (2022) showed that interactive learning media developed using Articulate Storyline 3 was considered very practical and significantly improved students' understanding of heat-related concepts. By incorporating interactive elements such as animations, virtual experiments, and simulations, Articulate Storyline 3 supports meaningful learning experiences that promote concept mastery. As the latest version of the Articulate software suite, Storyline 3 offers advanced capabilities for developing multimedia-based learning resources (Wahyuni et al., 2023). This

innovation has motivated researchers to design and evaluate interactive learning media utilizing this platform.

Traditional instructional models frequently rely on teacher-centered approaches, where educators dominate the delivery of course material (Nurlina et al., 2020). Expository teaching methods, which emphasize direct verbal explanations from teachers, often fail to actively engage students in the learning process, potentially leading to boredom and limited understanding (Ahmar et al., 2020). In contrast, problem-based learning encourages learners to take responsibility for analyzing and solving real-world problems, with teachers serving as facilitators who guide the learning process (Meilasari et al., 2020). Therefore, this study seeks to develop and assess the implementation of a problem-based learning model designed to strengthen students' critical thinking competencies.

Observations and interviews conducted at MAN 3 Banyumas indicated that while existing instructional media—such as textbooks and PowerPoint presentations—are in use, they remain limited in fostering interactive and engaging learning experiences. To promote greater student involvement and active learning, innovation in instructional media is required. As a result, this research focuses on developing interactive learning media utilizing Articulate Storyline 3, integrated with problem-based learning, to enhance students' critical thinking skills in mastering the concepts of temperature and heat.

METHOD

This research adopts a research and development (R&D) methodology, which focuses on systematically designing, producing, and evaluating educational products to determine their feasibility and effectiveness. The R&D approach involves a series of structured stages that integrate empirical evidence to produce educational tools applicable in both academic and non-academic contexts (Okpatrioka, 2023).

The development model employed in this study is the ADDIE framework, which consists of five sequential stages: Analysis, Design, Development, Implementation, and Evaluation (Pranata et al., 2021). The interactive learning media was created using Articulate Storyline 3, a software application compatible with both computers and smartphones, with the primary objective of enhancing students' critical thinking abilities during the learning process. The detailed stages of the ADDIE development process applied in this study are as follows in Figure 1.

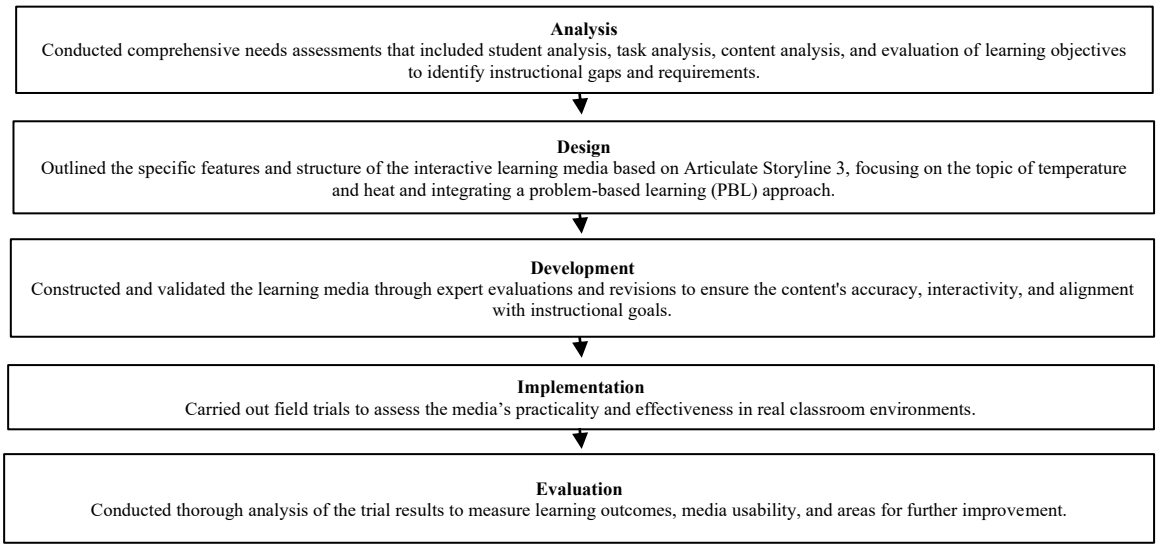

Figure 1. ADDIE Research and Development Steps

The experimental design utilized in this study follows the One-Group Pretest-Posttest Design, which enables the comparison of students' performance before and after exposure to the developed learning media (Oktavia et al., 2019). The design framework for the limited-scale trial is presented in Table 1.

Table 1. Trial Design

Class	Pre test	Treatment	Post test
Contrast 1	O_1	X_1	O_2
Contrast 2	O_1	X_2	O_2
Experiment	O_1	X_3	O_2

The trial involved eleventh-grade students during the even semester, comprising two control groups and one experimental group. The field implementation was conducted at MAN 3 Banyumas with a total sample of 100 students: 34 students in Class XI A, 34 in Class XI B, and 32 in Class XI C. Both test-based and non-test-based instruments were employed for data collection. The cognitive assessments consisted of pretest and posttest instruments containing 10 multiple-choice items designed to evaluate students' critical thinking performance. Non-test instruments included practicality questionnaires administered to both students and physics teachers.

Data analysis procedures incorporated normality testing, homogeneity testing, and effect size calculations. The normality test was conducted using the Shapiro-Wilk test via SPSS software to determine whether the data were normally distributed. The criteria for interpreting the normality results are displayed in Table 2.

Table 2. Criteria for Normality Testing

Distribution Status	Significance value
Normally distributed	>0,05
Not normally distributed	<0,05

The homogeneity test, conducted using Levene's test in SPSS, assessed whether the data across groups were homogeneous. A significance value greater than 0.05 indicated homogeneity. Furthermore, the effect size test was conducted using Cohen's f formula to measure the magnitude of the treatment's effect, with interpretation guidelines shown in Table 3.

Table 3. Effect Size Interpretation Criteria

Effect size value	Interpretation
$0,5 > \delta$	Large
$0,3 < \delta < 0,5$	Medium
$0 < \delta < 0,3$	Small

(Cohen, 1988)

RESULTS AND DISCUSSION

The development of the interactive learning media using Articulate Storyline 3 in this study was guided by instructional design principles, subject-specific content on temperature and heat, as well as detailed storyboards prepared during the design phase. Several initial interface examples of the problem-based interactive learning media for this

topic are illustrated in Table 4.

Table 4. Initial Interface Display of Articulate Storyline 3 Media

No	Illustration	Section
1		Cover
2		Login
3		Pop Menu
4		Temperature and Heat Material

No	Illustration	Section
5		Game
6		Quis

Table 4 presents the initial interface layout of the interactive learning media developed using Articulate Storyline 3. The media includes several key components such as a cover page, login interface, pop-up menu, content display for temperature and heat, game-based activities, and interactive quizzes. These elements were deliberately designed to enhance student engagement and support differentiated learning paths. The use of gamification and visually rich content in educational media can significantly improve learners' motivation and retention (Indirawati, 2021). Furthermore, the inclusion of multimedia features such as simulations, animations, and responsive feedback aligns with Mayer's Cognitive Theory of Multimedia Learning, which suggests that learners achieve better outcomes when instructional materials integrate both verbal and visual components (Mayer, 2009). Thus, the media interface is not only user-friendly but also pedagogically grounded to facilitate meaningful learning experiences.

To evaluate the practicality of the developed media, a questionnaire was administered to 32 students in Class XII C at MAN 3 Banyumas. The responses were converted into scores using a four-level rating scale. The detailed outcomes of students' assessments are presented in Table 5.

Table 5. Students' Practicality Assessment Results

Aspect	Score (%)	Category
Content/Material	89,26	Very Practical
Usability	91,21	Very Practical
Usefulness	90,82	Very Practical
Average	90,43	Very Practical

Table 5 shows that the average practicality score of the developed learning media, as assessed by students, reached 90.43%, which falls into the "very practical" category.

Specifically, the content/material aspect scored 89.26%, usefulness scored 90.82%, and ease of use received the highest score at 91.21%. These findings indicate that the interactive media based on Articulate Storyline 3 provides an engaging, user-friendly, and relevant learning experience for students. This is consistent with the findings of Bunga et al. (2022), who demonstrated that the use of interactive media significantly improves students' conceptual understanding, especially in abstract physics topics. Similarly, practicality evaluations were also conducted by physics teachers, with the results shown in Table 6.

Table 6. Physics Teachers' Practicality Assessment Results

Aspect	Score (%)	Category
Content/Material	89,58	Very Practical
Usability	95,83	Very Practical
Usefulness	93,75	Very Practical
Average	93,05	Very Practical

The evaluation results provided by physics teachers, as shown in Table 6, yielded an average practicality score of 93.05%, which also falls into the "very practical" category. The highest score was observed in the aspect of ease of use (95.83%), followed by usefulness (93.75%), and content/material (89.58%). These results suggest that the developed media is highly feasible for instructional use and can be effectively integrated into classroom teaching. According to Wahyuni et al. (2023), multimedia learning tools that incorporate visual simulations and animations such as those created using Articulate Storyline 3 can enhance student engagement and improve comprehension of complex science concepts. The normality test results are summarized in Table 7.

Table 7. Results of Normality Testing

Category	Class	Shapiro Wilk
		Sig
Pretest (Critical Thinking Skills)	XIA	0,336
	XIB	0,099
	XIC	0,206
Posttest (Critical Thinking Skills)	XIA	0,052
	XIB	0,100
	XIC	0,254

Table 7 displays the results of the Shapiro-Wilk normality test for pretest and posttest scores across three groups: XI A, XI B, and XI C. The significance values for all datasets were greater than 0.05, indicating that the data distributions for students' critical thinking scores before and after the intervention are normal. This result justifies the use of parametric statistical analyses, such as ANOVA, for further examination. According to Oktavia et al. (2019), verifying data normality is an essential step in ensuring the validity and reliability of statistical inferences in educational research. Employing normally distributed data increases the robustness of effect size calculations and supports the generalizability of the study's findings. This analysis confirms that the developed media can be evaluated using rigorous statistical procedures, thereby strengthening the credibility of the research results. The homogeneity test was conducted using Levene's test, with the outcomes summarized in Table 8.

Table 8. Homogeneity Testing Results

Category	Levene Statistic
	Sig
Critical Thinking Skills Pretest	0,533
	0,564
	0,564
	0,501
Critical Thinking Skills Posttest	0,994
	0,960
	0,960
	0,991

The Levene's test outcomes shown in Table 8 indicate that the significance values for both pretest and posttest critical thinking scores across the three groups are greater than 0.05. This means the data meet the assumption of homogeneity of variance, which is a prerequisite for conducting ANOVA. Homogeneous data implies that the variance in students' performance is consistent across the groups, thereby reducing the likelihood of bias in treatment effects. As stated by Oktavia et al. (2019), maintaining data homogeneity is crucial when analyzing intervention effectiveness because unequal variances can distort statistical comparisons. These findings confirm that the comparison of critical thinking outcomes between groups can be performed with confidence, and that observed improvements are likely attributable to the implemented media and instructional model rather than pre-existing differences among groups. The effect size analysis was performed using Cohen's f formula. The detailed results are presented in Table 9.

Table 9. Effect Size Analysis Results

Variable	Partial Eta Squared	Sig.	Cohen's f	Category
Critical Thinking Skills	0,949	0,000	4,31	Very large

The analysis results indicate a partial eta squared value of 0.949, and a Cohen's f value of 4.31, both reflecting a very large effect size. These outcomes confirm that the use of Articulate Storyline 3 media, integrated with problem-based learning strategies, is highly effective in enhancing students' critical thinking performance on temperature and heat concepts. The application of problem-based learning supported by e-learning has been shown to improve students' science process skills by engaging learners in inquiry, experimentation, and problem-solving activities during online learning environments (Patabang et al., 2020). Similarly, the integration of interactive digital media with a problem-based learning approach has been found to significantly enhance students' academic performance due to its emphasis on interactivity and problem-solving skills (Junpahira & Pahlevi, 2023). Similarly, Wahyuni et al. (2023) revealed that multimedia learning tools enhanced with Storyline 3 helped students better understand abstract physics concepts through the use of simulations, animations, and narrative elements. The use of interactive media encourages student engagement and supports deep conceptual learning, especially in topics such as temperature and heat. Therefore, integrating interactive digital platforms with problem-based strategies can be an effective instructional approach for improving critical thinking in science education.

CONCLUSION

The findings of this study demonstrate that the development of interactive learning media using Articulate Storyline 3, combined with a problem-based learning framework, was successfully implemented. The instructional media produced for the topic of temperature and heat was found to be highly practical for use in classroom settings, as reflected by the average practicality scores of 90.43% from student assessments and 93.05% from evaluations by physics teachers — both classified under the "very practical" category. Furthermore, the media effectively enhanced students' critical thinking abilities, as evidenced by a partial eta squared value of 0.949 and a Cohen's f score of 4.31, indicating a very strong effect. This study was limited to a single school context with a relatively small sample of participants, and the critical thinking skills were assessed only through multiple-choice questions without the inclusion of written responses or behavioral observations. Future research should consider implementing the developed media across broader educational settings and diverse student populations. It is also recommended to incorporate more comprehensive assessment methods such as essay-based tests, interviews, or classroom observations to better capture students' higher-order thinking processes.

BIBLIOGRAPHY

Abidin, Z. (2021). Terminologi Satuan Ukuran yang Disediakan Kamus Besar Bahasa Indonesia (KBBI) Daring Unit of Measure Terminology Provided by KBBI Online. *Tuahtalino*, *15*(2), 310. https://doi.org/10.26499/tt.v15i2.3946

Affandy, H., Aminah, N., S., & Supriyanto, A. (2019). Analisis Keterampilan Berpikir Kritis Siswa pada Materi Fluida Dinamis di SMA Batik 2 Surakarta. *Jurnal Materi dan Pembelajaran Fisika (JMPF)*, *9*(1), 25–33. https://doi.org/10.20961/jmpf.v9i1.31608

Ahmar, H., Budi, P., Ahmad, M., Mushawwir, A., & Khaidir, Z. (2020). Penerapan Model Pembelajaran Problem Based Learning : Literature Review. *Jurnal Keperawatan Muhammadiyah*, 1(1), 10–17. http://journal.um-surabaya.ac.id/index.php/JKM

Atris Yuliarti Mulyani. (2022). Pengembangan Critical Thinking dalam Peningkatan Mutu Pendidikan di Indonesia. *DIAJAR: Jurnal Pendidikan dan Pembelajaran*, *1*(1), 100–105. https://doi.org/10.54259/diajar.v1i1.226

Bunga, L. S., Rahayu, A., & Prawiyogi, A. G. (2022). Pengembangan Media Pembelajaran Interaktif Menggunakan Articulate Storyline 3 pada Materi Kalor. *Kasuari: Physics Education Journal*, *5*(1), 20–30. https://doi.org/10.34311/kpej.v5i1.456

Cahyadi, R. A. H. (2019). Pengembangan Bahan Ajar Berbasis ADDIE Model. *Halaqa: Islamic Education Journal*, *3*(1), 35–42. https://doi.org/10.21070/halaqa.v3i1.2124

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences (2nd ed.)*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Fikri, A., Rahmawati, A., & Hidayati, N. (2020). Persepsi Calon Guru PAI terhadap Kompetensi 6C dalam Menghadapi Era 4.0. *At-Ta'dib: Jurnal Ilmiah Prodi Pendidikan Agama Islam*, *12*(1), 89-100. https://doi.org/10.47498/tadib.v12i01.331

Indirawati, L. (2021). Articulate Storyline: Interactive Teaching Tools. *Jurnal Pendidikan Indonesia*, *2*(1), 24–35. https://doi.org/10.54371/jpi.v2i1.112

Junpahira, S. V., & Pahlevi, T. (2023). Pengaruh Penggunaan Multimedia Interaktif Articulate Storyline 3 Berbasis Problem Based Learning terhadap Hasil Belajar Siswa Kelas XI MP di SMK Nurul Islam Gresik. *Jurnal Dimensi Pendidikan dan Pembelajaran*, *11*(2), 149–171. https://doi.org/10.24269/dpp.v11i2.7220

Mayer, R. E. (2009). *Multimedia learning* (2nd ed.). Cambridge University Press. https://doi.org/10.1017/CBO9780511811678

Meilasari, S., Damris M, D. M., & Yelianti, U. (2020). Kajian Model Pembelajaran Problem Based Learning (PBL) dalam Pembelajaran di Sekolah. *BIOEDUSAINS:Jurnal Pendidikan Biologi dan Sains*, *3*(2), 195–207. https://doi.org/10.31539/bioedusains.v3i2.1849

Nurlina, N., Lestari, R. A., & Riskawati, R. (2020). Application of Learning Models Conceptual Understanding Procedures by Using Experimental Methods on Understanding Physics Concepts of Students. *Journal of Physics: Conference Series*, *1572*(1). https://doi.org/10.1088/1742-6596/1572/1/012009

Okpatrioka. (2023). Research and Development (R&D) Penelitian yang Inovatif dalam Pendidikan. *Dharma Acariya Nusantara: Jurnal Pendidikan, Bahasa dan Budaya*, *1*(1), 86–100. https://doi.org/10.47861/jdan.v1i1.154

Oktavia, M., Prasasty, A. T., & Isroyati. (2019). Uji Normalitas Gain untuk Pemantapan dan Modul dengan One Group Pre and Post Test. *Simposium Nasional Ilmiah dengan Tema: (Peningkatan Kualitas Publikasi Ilmiah Melalui Hasil Riset dan Pengabdian kepada Masyarakat)*, *1*(1), 596–601. https://doi.org/10.30998/simponi.v0i0.439

Patabang, I., Yusuf, I., Allo, A. Y., & Widyaningsih, S. W. (2020). The Application of Problem Based Learning Models with E-Learning during the Covid-19 Pandemic to Students' Science Process Skills of Class XI IPA Students at SMA Santo Paulus Manokwari. *Kasuari: Physics Education Journal (KPEJ)*, *3*(2), 118-127. https://doi.org/10.37891/kpej.v3i2.154

Pranata, W., Budijanto, B., & Utomo, D. H. (2021). Buku Suplemen Geografi Berstruktur A-CAR dengan Model Pengembangan ADDIE. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, *6*(2), 185. https://doi.org/10.17977/jptpp.v6i2.14441

Rahman, A., Munandar, S. A., Fitriani, A., Karlina, Y., & Yumriani. (2022). Pengertian Pendidikan, Ilmu Pendidikan dan Unsur-unsur Pendidikan. *Al Urwatul Wutsqa: Kajian Pendidikan Islam*, *2*(1), 1–8. https://doi.org/10.53801/auw.v2i1.38

Saputra, H. (2020). Kemampuan Berfikir Kritis Matematis. *Perpustakaan IAI Agus Salim Metro Lampung*, *2*(1), 1–7. https://doi.org/10.31227/osf.io/j2vba

Susilowati dkk. (2017). Analisis Keterampilan Berpikir Kritis Siswa Madrasah Aliyah Negeri di Kabupaten Magetan. *Prosiding Seminar Nasional Pendidikan Sains*. *4*(1), 223–229. https://doi.org/10.31227/osf.io/uqny3

Wahyuni, I., Megalina, Y., Tanjung, R., Amdani, K., & Lubis, R. H. (2023). Development of Interactive Multimedia Based on Case Method Assisted by Articulate Storyline 3 in General Physics. *Jurnal Penelitian Pendidikan IPA*, *9*(11), 9652–9659. https://doi.org/10.29303/jppipa.v9i11.5685