Kognitif
Jurnal Riset HOTS Pendidikan Matematika
Volume - 6 No - 1 2026 Page 1 – 12
ISSN 2776-9704 P-ISSN 2776-9984
https://doi.org/10.51574/kognitif.v6i1.4492

Enhancing High School Students' Critical Thinking through HOTS-Based Interactive E-Modules

Baiq Riska Bayu, Baiq Rofina Arvy, Ahmad Nasrullah

How to cite: Bayu, B. R., Arvy, B. R., & Nasrullah, A. (2026). Enhancing High School Students' Critical Thinking through HOTS-Based Interactive E-Modules. *Kognitif: Jurnal Riset HOTS Pendidikan Matematika*, *6*(1), 1 - 12. https://doi.org/10.51574/kognitif.v6i1.4492

To link to this artcle: https://doi.org/10.51574/kognitif.v6i1.4492

Kognitif: Jurnal Riset HOTS Pendidikan Matematika
https://doi.org/10.51574/kognitif.v6i1.4492 Volume 6, No 1, January - March 2026, pp. 1 – 12

Enhancing High School Students' Critical Thinking through HOTS-Based Interactive E-Modules

Baiq Riska Bayu[1*], Baiq Rofina Arvy[1], Ahmad Nasrullah[1]

[1]Mathematics Education Study Program, Faculty of Tarbiyah and Teacher Training, Universitas Islam Negeri Mataram

Article Info

Article history:

Received Dec 12, 2025
Accepted Dec 30, 2025
Published Online Jan 13, 2026

Keywords:

Interactive E-Module
High Order Thinking Skills (HOTS)
Critical Thinking

ABSTRACT

Critical thinking skills are a core competency in mathematics learning, particularly in addressing problems that require higher-level reasoning. However, empirical evidence indicates that students' critical thinking skills remain relatively low, resulting in limited ability to analyze, evaluate, and draw conclusions when solving complex mathematical problems. This study aimed to examine the effect of using Higher-Order Thinking Skills (HOTS)-based interactive e-modules on students' critical thinking skills in mathematics learning. A quantitative approach was employed using a pre-experimental one-group pretest–posttest design. The participants consisted of 31 tenth-grade students selected through a saturated sampling technique. The research instruments included observation sheets and a critical thinking skills test, both of which were validated by experts and met reliability criteria. Data were collected through the administration of pretests and posttests and analyzed using a paired-sample t-test to determine differences in students' critical thinking skills before and after the intervention. The results indicate that students' critical thinking skills prior to the implementation of the HOTS-based interactive e-modules were relatively low. Following the intervention, students' critical thinking skills showed a significant improvement, as evidenced by higher posttest scores compared to pretest scores and a statistically significant paired-sample t-test result ($p < 0.05$). These findings demonstrate that HOTS-based interactive e-modules have a significant positive effect on improving students' critical thinking skills in mathematics learning. Therefore, the use of HOTS-based interactive e-modules is recommended as an alternative instructional resource to support the development of students' higher-order thinking skills.

Corresponding Author:

Baiq Riska Bayu,
Mathematics Education Study Program,
Faculty of Tarbiyah and Teacher Training,
Universitas Islam Negeri Mataram,
Gajah Mada Street No. 100, Pagesangan, Mataram, Jempong Baru, Sekarbela District, Indonesia
Email: 220103067.mhs@uinmataram.ac.id

Introduction

The development of science and technology in the 21st century demands that the world of education produce human resources with high-level thinking skills (Qudsiah & Hayati, 2023). Most country nowadays develop their curriculum to promote thinking skills (Nasrullah, 2021). Critical thinking skill is one of the main competencies emphasized in various global education studies, including *the Programme for International Student Assessment* (PISA), which assesses students' literacy, numeracy, and reasoning skills in the context of problem-solving. The results of the 2022 PISA showed that Indonesian students' achievements in literacy, numeracy, and science are still ranked low compared to other countries, thus indicating that students' critical thinking skills, especially in mathematics learning, have not developed optimally (Solihin et al., 2024). Students' low critical thinking skills are inextricably linked to learning practices that are still dominated by conventional, teacher-centered approaches. Mathematics instruction tends to emphasize mastery of procedures and memorization of formulas, while opportunities for students to analyze, evaluate, and relate concepts to real-world contexts remain limited (Tanujaya, 2017). Therefore, learning innovations are needed that can facilitate students' active knowledge building and systematic critical thinking skills.

Critical thinking skills are an important foundation for developing higher-order thinking, as higher-order thinking processes require individuals to not only assess information but also understand, connect facts, draw conclusions, and apply them to problem-solving. This process occurs when someone acquires new knowledge and then relates it to prior knowledge to achieve specific goals. In higher-order thinking, students not only memorize formulas but also use logical reasoning to understand concepts and solve more challenging math problems (Carel et al. 2021). Based on initial observations conducted by researcher on May 27, 2025, in high schools, researcher found several things related to the implementation of mathematics learning, namely that some students still showed low critical thinking skills, while others were able to meet several established indicators. This was demonstrated through interactions during the learning process, where there were differences in the level of ability to understand, analyze, and defend arguments against the concepts being studied. In addition, the teacher also stated that only 11 out of 31 students (around 35%) consistently demonstrated critical thinking indicators throughout the learning process, such as the ability to analyze information, provide logical reasons, and evaluate mathematical arguments. Meanwhile, the other 20 students (64%) were still in the low to moderate category, indicated by difficulty in identifying problems, inaccurate reasoning, and inability to propose alternative solutions.

Several previous studies showed that the use media and innovative learning resources can improve students' critical thinking skills. Learning with the assistance of Edpuzzle interactive video has significant affect in promoting student's critical thinking skills (Widia & Nasrullah, 2025). Pramudita and Rahayu (2024) found that discovery learning-based e-modules significantly improved high school students' conceptual understanding and critical thinking (Sulistyorini et al. 2018). Therefore, the implementation of *HOTS*-based interactive e-modules is expected to be a solution to address the low critical thinking skills of high school students. As an alternative, students' low critical thinking skills can be overcome by utilizing interactive e-modules based on Higher Order Thinking Skills (HOTS). *HOTS* -based interactive e-modules are digital learning tools designed to develop higher-order thinking skills through interactive presentations, encouraging students to actively interact with the material through engaging learning activities and presenting the material in an integrative manner, integrating various learning elements (text, images, videos, real-world contexts, and critical thinking exercises) to help students fully understand concepts (Nastiti et al. 2022).

Kognitif: Jurnal Riset HOTS Pendidikan Matematika
https://doi.org/10.51574/kognitif.v6i1.4492 Volume 6, No 1, January - March 2026, pp. 1 – 12

Similarly, a study by Imansari & Sunaryantiningsih (2017) found that implementing *HOTS -based learning* in the form of digital modules was more effective than traditional lecture methods. This research is supported by Saputri & Herman (2021), who found that the use of e-modules increased learning independence, student engagement, and a more meaningful understanding of mathematical concepts. Various previous studies have shown that learning oriented towards *Higher Order Thinking Skills* (HOTS) has a positive impact on students' critical thinking skills. Sunarya (2018) found that the application of learning models that emphasize active student involvement can significantly improve learning outcomes and critical thinking skills. Other studies also report that the use of HOTS-based digital modules and e-modules can improve students' conceptual understanding, learning independence, and critical thinking skills. However, most of these studies still focus on general learning models or media and have not specifically examined the use of HOTS-based interactive e-modules designed according to the characteristics of mathematics learning at the secondary school level (Wibowo et al., 2025).

Theoretically, critical thinking skills are part of higher-order thinking skills that involve the process of analyzing, evaluating, and drawing conclusions (Setiawati et al., 2016). In Bloom's Taxonomy revised by Anderson and Krathwohl, higher-order thinking skills are in the cognitive domains of analysis (C4), evaluation (C5), and creation (C6) (Handayani et al., 2023). HOTS-based interactive e-modules are designed to accommodate these cognitive processes through the presentation of contextual, interactive, and challenging materials, thus aligning with constructivism theory which states that knowledge is built through active learning experiences. The novelty of this research lies in the use of HOTS-based interactive e-modules as a mathematics learning medium specifically aimed at improving students' critical thinking skills (Mari'a, 2021). Based on the description above, there is a gap in research on the influence of Higher Order Thinking Skills (HOTS)-based e-modules on improving students' critical thinking skills. To date, only a few quantitative studies have examined the influence of these three variables in the context of mathematics learning. Therefore, this study aims to obtain an empirical picture of the effectiveness of HOTS-based interactive e-modules in improving students' critical thinking skills. It is hoped that this study can provide theoretical and practical contributions to the development of innovative mathematics learning that is oriented towards the demands of the 21st century.

Method

Type of Research

Pre-experimental design was chosen because the school where the study was conducted only had one class at that level, so the researcher did not have the option to compare multiple classes or conduct random sampling. Therefore, the researcher used the existing class as the research sample. This method allows researchers to determine the effect of the treatment by comparing results before and after learning, even without a control group. Thus, the use of this design remains relevant because it can show changes in student abilities after being given the treatment.

Population and Sample

The population in this study was all 31 tenth-grade at SMA IT Yarsi Mataram in the odd semester of the 2025/2026 academic year students. This population was selected because they were directly involved in mathematics learning using interactive e-modules based on *Higher*

Order Thinking Skills (HOTS) and were the targets for measuring critical thinking skills. The sampling technique used was saturated sampling, where all members of the population were used as the research sample. This technique was chosen based on the consideration that the population size was less than 100 people, so the entire population was suitable for sampling so that the research results could fully describe the subject's condition. Thus, the sample in this study consisted of 31 10th-grade students. The type of research used is *Pre-Experimental design* with *One Group Pretest-Posttest Design* (Zakiah, 2017). This research was conducted in one class without a comparison group and used *a pretest and posttest.* The research design can be seen in Table 1

Table 1. Research Design

Pretest (O1)	Treatment (X)	Posttest (O2)
O1	HOTS-based interactive E-Module learning	O2

Information :
X : Learning using Interactive E-Modules
O1: *Pretest Score*
O2 : *Posttest Value*

Instrument

This study used instruments to observe and assess various natural and social events. The instruments used in this study consisted of:

Test Questions

The test questions were descriptive questions that measured students' ability to analyze, evaluate, and create mathematical concepts to solve everyday problems. The questions were structured based on critical thinking indicators, referring to Facione's opinion. The test results were analyzed to determine improvements in critical thinking skills after the implementation of the Interactive E-Module. In this study, the test used two descriptive questions focusing on trigonometry, as shown in Table 2.

Kognitif: Jurnal Riset HOTS Pendidikan Matematika
https://doi.org/10.51574/kognitif.v6i1.4492 Volume 6, No 1, January - March 2026, pp. 1 – 12

Table 2. Instruments Test

Test Questions	Characteristics
1. One afternoon, Rahmat and his friend decided to stop at the Hubbul Wathan Islamic Center Grand Mosque in Mataram to pray. After finishing their prayers, Rahmat went out first and stood in front of the main gate while waiting for his friend. From where he stood, he observed the main tower of the mosque, which is an icon of the city of Mataram. As he looked up at the top of the tower, Rahmat realized that his line of sight formed a 60° elevation angle with the ground. If the distance from the gate where he was standing to the base of the tower was approximately 56 meters, what was the distance between the two towers? tall tower If tall Grace 1.70 meters 	Students must select and use the correct trigonometric ratios, particularly the tangent, to determine the height of the tower. The solution process emphasizes not only arithmetic skills but also logical and systematic reasoning in developing the solution steps. At the end of the task, students are asked to draw a conclusion about the height of the tower that is accurate and reasonable, given the context of the problem. Thus, this problem measures students' critical thinking skills.
2. Prime Park Hotel & Convention Mataram, a 10-story high-rise building and a hotel icon in downtown Mataram, instructed the management to clean the windows to restore the hotel's appearance. Mr. Andi was assigned to use an extendable telescopic aluminum ladder. According to occupational safety standards, the base of the ladder must be placed 4 meters from the wall to avoid pressing on the newly repaired building surface. To reach the windows on the first floor, the ladder must reach a height of 3 meters, while to clean the windows on the second floor, Mr. Andi must extend the ladder to a height of 6 meters. Before climbing, he must ensure that the angle between the ladder and the ground is in a safe and stable position. Based on this information, what is the angle between the ladder and the ground when the ladder is used to reach a height of 6 meters? 	Students must be able to analyze the relationship between angles, ladder length, and building height, then determine the angle between the ladder and the ground using trigonometric ratios. This problem emphasizes not only mathematical calculations but also requires students to evaluate safe and stable conditions based on the results of the calculations.

Prior to the study, the test instrument was validated by two validators: a Mathematics Education lecturer and a high school mathematics teacher with expertise in learning assessment. Validation was conducted to assess three main components: content accuracy, item construction quality, and language clarity. Assessments were given using a four-category scale, then analyzed using the Content Validity Index (CVI) at the item level (I-CVI) and the instrument level (S-CVI). Validation results showed that validator I gave a score of 15 out of 16 and validator 2 gave a score of 16 out of 16. The average I-CVI and S-CVI scores were in the "very good" category, so all items were declared valid in terms of content and suitable for use in the trial phase.

Observation sheets

Observation sheets are used to observe the implementation of learning activities during the research process. This instrument serves to record teacher activities during the implementation of the learning model, allowing researchers to assess the suitability of the implementation to the established learning plan.

Interactive E-Module

This interactive e-module served as a treatment instrument *given* to the experimental group. This means that the e-module was not only a teaching material but also part of the independent variable studied to measure the effect of its use on students' critical thinking skills.

Data Collection

The data collection techniques used were tests and observations. The critical thinking skills test was administered before treatment (pretest) to determine students' initial critical thinking skills and after treatment (posttest) to determine improvements in students' critical thinking skills.

Data analysis

The data were analyzed to test the effect of HOTS-based Interactive E-Modules on improving students' critical thinking. Before conducting the hypothesis test, there were prerequisite tests consisting of normality and homogeneity tests. The normality test used the Shafiro Wilk test due to the small sample size (less than 50). Data were declared normal if Sig. ≥ 0.05. Furthermore, the homogeneity test used the Levene test. Variances were considered homogeneous if Sig. ≥ 0.05. Linearity was tested to ensure that the relationship between the covariate (pretest) and the dependent variable (posttest) was linear. The assumption was met if > 0.05 in the Deviation from Linearity row. In addition, the homogeneity of the regression slope was tested to ensure that the relationship between the covariate and the posttest score was the same in all groups. Testing was carried out through group covariate interactions. The assumption was met if Sig. > 0.05. Hypothesis testing in this study was carried out using Paired Samples T-Test to test several hypotheses, namely: Decisions were made based on the significance value (Sig.), where Ho was rejected if Sig. ≤ 0.05, indicating a significant influence, and Ho is accepted if Sig. > 0.05, meaning there is no significant influence..

Results

The research was conducted over three learning sessions, from December 1, 2025, to December 15, 2025. Each session was conducted according to the school's learning time allocation, which was 2 x 45 minutes. The series of research activities began with a pretest *at* the first session to determine students' critical thinking skills before being given treatment. The first session focused on introducing HOTS-based interactive e-modules and learning materials with an emphasis on the ability to understand problems and interpret information contained in the questions. The second session focused on learning activities that required students to analyze problems, connect relevant concepts, and systematically develop solutions. This activity was conducted through HOTS-based practice questions available in the interactive e-module.

Kognitif: Jurnal Riset HOTS Pendidikan Matematika
https://doi.org/10.51574/kognitif.v6i1.4492 Volume 6, No 1, January - March 2026, pp. 1 – 12

The third meeting focused on strengthening evaluation and inference skills, where students were asked to reassess their problem-solving process and draw conclusions based on the results. At the end of the third meeting, students were given a posttest *to* measure their critical thinking skills after participating in the HOTS-based interactive e-module.

Prior to the hypothesis testing, the *pretest* and *posttest data* on students' critical thinking skills were subjected to prerequisite tests, including normality and homogeneity tests. The normality test was conducted to determine whether the data were normally distributed, while the homogeneity test was conducted to determine the similarity of data *variances* . The results of the normality test are shown in Table 3, and the results of the homogeneity test are shown in Table 3.

Table 3. Normality Test Results

Tests of Normality

	Shapiro-Wilk		
	Statistics	df	Sig.
Pretest	,933	31	,053
Posttest	,945	31	,112

Based on Table 3, the results of the normality test using Shapiro–Wilk show that the significance value of the pretest data is 0.053 and the posttest data is 0.112. Both significance values are greater than the 0.05 level, so it can be concluded that the pretest and posttest data on students' critical thinking skills are normally distributed.

Table 4. Homogeneity Test

		Levene Statistics	df1	df2	Sig.
Results	Based on Mean	3,565	1	60	,064
	Based on Median	2,116	1	60	,151
	Based on Median and with adjusted df	2,116	1	59,136	,151
	Based on trimmed mean	3,636	1	60	,061

Table 4 shows that the homogeneity test using Levene's test shows a significance value of 0.064 in the *"Based on Mean" row* . This value is greater than 0.05, thus concluding that *the pretest* and *posttest data* have homogeneous variance. Therefore, the research data meets all prerequisite tests. Hypothesis testing can be conducted using the *Paired Sample t-test* because all assumptions are met. The results of *the Paired Sample t-test* can be seen in Table 5

Table 5. *Paired Sample T-Test* Results

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Standard Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Pretest Posttest	-30,61290	17,12246	3,07528	-36,89347	-24.33234	-9,954	30	,000

Based on Table 5, the significance value (Sig. (2-tailed)) was 0.000, which is smaller than the significance level of 0.05. Thus, it can be stated that there is a significant difference between the pretest and posttest results of students' critical thinking skills. These results also indicate that the use of HOTS-based interactive e-modules provides a significant increase in students' critical thinking skills. The results of *the Paired Samples t-Test* showed that the average difference (*mean difference*) between the pretest and posttest scores was -30.61. A negative difference indicates that the posttest score is higher than the pretest score. Statistically, these results reinforce the descriptive findings that indicate an increase in the average score of students' critical thinking skills after participating in learning using HOTS-based interactive e-modules. Thus, it can be concluded that the implementation of HOTS-based interactive e-modules has a significant effect on improving students' critical thinking skills.

Discussion

This study aims to examine the effect of using interactive e-modules based on *Higher Order Thinking Skills* (HOTS) on improving students' critical thinking skills in mathematics learning. Based on the results of data analysis, it was found that the use of HOTS-based interactive e-modules had a significant effect on students' critical thinking skills. This was indicated by a significant difference between the *pretest* and *posttest results* , where the average posttest score was higher than the pretest, and was reinforced by the results of inferential statistical tests that showed a significance value of less than 0.05. Thus, the results of this study empirically answered the research problem formulation which stated that there was an effect of using HOTS-based interactive e-modules on improving students' critical thinking skills.

Based on the analysis of pretest and posttest data, it was found that students' critical thinking skills before the implementation of HOTS-based interactive e-modules were still relatively low. This condition was indicated by the low average pretest scores and students' limitations in solving questions that require high-level reasoning. This finding aligns with the results of *the Programme for International Student Assessment* (PISA), which showed that Indonesian students' reasoning and critical thinking skills are still in the low category compared to other countries. This indicates that previous mathematics instruction has not fully developed students' critical thinking skills optimally (Rohmatulloh, 2023).

After implementing learning using HOTS-based interactive e-modules, posttest results showed a significant increase in students' critical thinking skills. All students experienced an increase in scores, with the average *posttest score* being higher than the *pretest score* . This finding supports the opinion Syaidah et al., (2018) which states that learning designed at a high cognitive level (C4–C6) can improve the quality of students' thinking. Furthermore, these results are in line with research Jafnihirda et al. (2023) which concluded that HOTS-based e-modules are effective in significantly improving high school students' critical thinking skills.

Theoretically, the results of this study support the constructivism theory proposed by Piaget and Vygotsky, which states that knowledge is actively constructed through interactions and learning experiences (Winarni, 2024). HOTS-based interactive e-modules provide opportunities for students to construct knowledge through exploration, analysis, and reflection (Oktafiani et al., 2020). This is in line with the opinion of Putri et al. (2015) who emphasized that critical thinking skills can be developed effectively through learning that requires students' active involvement in higher-order thinking processes. When compared with previous research, the results of this study are in line with Hidayat (2019) which states that the use of digital media and HOTS-based learning is effective in improving students' critical thinking skills. The use of HOTS-based interactive e-modules systematically designed to train each critical thinking

Kognitif: Jurnal Riset HOTS Pendidikan Matematika
https://doi.org/10.51574/kognitif.v6i1.4492 Volume 6, No 1, January - March 2026, pp. 1 – 12

indicator, as well as presenting data on critical thinking skill improvement as a percentage for each indicator, is crucial. Thus, this study not only demonstrates the effectiveness of HOTS-based e-modules but also explains which aspects of critical thinking experience the most improvement.

Conclusion

Based on the results of the research and data analysis that have been conducted, it can be concluded that the use of interactive e-modules based on *Higher Order Thinking Skills* (HOTS) has a significant effect on improving students' critical thinking skills in mathematics learning. This influence is reflected in the existence of a significant difference between students' critical thinking skills before and after the implementation of HOTS-based interactive e-modules. This increase is supported by the results of inferential statistical tests that show a significance value smaller than the specified significance level, so that the research hypothesis stating that there is an effect of the use of HOTS-based interactive e-modules can be accepted empirically.

Conceptually, the implementation of HOTS-based interactive e-modules facilitates students' active involvement in the learning process and encourages the development of higher-order thinking skills. Students are not only focused on obtaining the final answer, but are also trained to comprehensively understand problems, analyze the relationships between concepts, evaluate solution strategies, and draw logical conclusions appropriate to the context of the mathematical problem. This demonstrates that HOTS-based interactive e-modules are effective as learning media that systematically support the development of students' critical thinking skills. This research contributes to the empirical evidence supporting the effectiveness of HOTS-based interactive e-modules as an alternative teaching material in mathematics, particularly in enhancing students' critical thinking skills. Furthermore, it provides a more detailed overview of critical thinking skill enhancement based on critical thinking indicators, thus providing a reference for educators in designing learning that focuses on higher-order thinking skills.

However, this study has limitations, including a design that did not involve a comparison group and a limited number of subjects per class. Furthermore, the implementation of the HOTS-based interactive e-module was relatively short, thus not fully reflecting the long-term impact on the development of students' critical thinking skills. Therefore, further research is recommended to employ a more robust experimental design involving a control group, expand the scope of research subjects, and implement HOTS-based interactive e-modules over a longer period. Further research could also examine the application of HOTS based interactive e-modules to different mathematics materials or at other educational levels to strengthen and expand the findings of this study.

Acknowledgments

The author expresses his sincere gratitude to all parties who have provided support and contributions to the implementation and preparation of this research. He also expresses his gratitude to the educational institution where the research was conducted for providing permission, facilities, and support, which enabled this research to proceed successfully. He also expresses his gratitude to the school, especially the principal, mathematics teachers, and all students who actively participated and cooperated throughout the research process. The author would also like to express his gratitude to his supervisor who provided direction, guidance, and constructive feedback from the planning stage through the preparation of this research report. Furthermore, he would like to express his deepest appreciation to the professionals and

colleagues who provided valuable advice, input, and academic assistance in improving this research. The author also expresses his gratitude to all parties who provided moral support, motivation, and indirect assistance, enabling the successful completion of this research. May all assistance and contributions be rewarded in the best possible way.

Conflict of Interest

The researcher revealed that there was no conflict interest.

Authors' Contributions

Author B.R.B. contributed to instrument development, research design, understanding the theoretical basis, data collection and processing, data analysis, presentation of results and discussion, revisions, and ensuring the overall consistency of the article. Author B.R.A. contributed to the development of the theoretical study and approved the final manuscript. Author A.N. contributed to the development of the theory and approved the final version of the article. The total percentage of author contributions in the conceptualization, drafting, and improvement of this article is: B.R.B.: 40%, B.R.A.: 30%, and A.N. 30%.

Data Availability Statement

The authors state that the data supporting the findings of this study will be made available by the corresponding author, [B.R.B.], upon reasonable request.

References

Carel, G., Jusniani, N., & Monariska, E. (2021). Kemampuan higher order thinking skills dalam pembelajaran metakognitif ditinjau dari persepsi siswa. *Pythagoras Jurnal Pendidikan Matematika*, *16*(2), 204–216. https://doi.org/10.21831/pythagoras.v16i2.37926

Handayani, Y., Asia, E., & Hidayat, S. (2023). Peningkatan Kemampuan High Order Thinking Skills (HOTS) melalui Project-Based Learning (PjBL) dalam Implementasi Kurikulum Merdeka. *PTK: Jurnal Tindakan Kelas*, *4*(1), 48–60. https://doi.org/10.53624/ptk.v4i1.236

Hidayat, D. (2019). Penerapan Reciprocal Teaching Untuk Meningkatkan Berpikir Kritis Dan Kemandirian Belajar Siswa MA. *Jurnal Derivat: Jurnal Matematika Dan Pendidikan Matematika*, *5*(1), 1–8. https://doi.org/10.31316/j.derivat.v5i1.141

Imansari, N., & Sunaryantiningsih, I. (2017). Pengaruh Penggunaan E-Modul Interaktif Terhadap Hasil Belajar Mahasiswa pada Materi Kesehatan dan Keselamatan Kerja. *VOLT : Jurnal Ilmiah Pendidikan Teknik Elektro*, *2*(1), 11. https://doi.org/10.30870/volt.v2i1.1478

Jafnihirda, L., Rizal, F., & Eka Pratiwi, K. (2023). Efektivitas Perancangan Media Pembelajaran Interaktif E-Modul. *INNOVATIVE: Journal Of Social Science Research*, *3*(1), 227–239. https://j-innovative.org/index.php/Innovative/article/view/2734

Mari'a, H. (2021). *Pengaruh Implementasi Model Pembelajaran Problem Solving Dipadukan Dengan Keterampilan Hots Terhadap Hasil The Effect Implementation Of Problem Solving Learning Models Combined With Hots Skills On Student Learning Outcome*. *10*(1). https://doi.org/10.26740/ujced.v10n1.p10-19

Nasrullah, A. (2021). The Effectiveness of Problem Posing Approach…. *Journal of Math*, *01*(02). https://jurnal.jurmat.com/index.php/jmt/index

Kognitif: Jurnal Riset HOTS Pendidikan Matematika
https://doi.org/10.51574/kognitif.v6i1.4492 Volume 6, No 1, January - March 2026, pp. 1 – 12

Nastiti, R. I., Purwaningsih, W. I., & Darmono, P. B. (2022). *Pengembangan E-Modul Berbasis Matematika Realistik Guna Menstimulasi Berpikir Kreatif pada Siswa SMP*. *4*(2), 1–12. https://doi.org/10.37729/jipm.v4i2.2397

Oktafiani, R., Julitasari, R. A., & Novitasari, A. (2020). Pengmbangan E-Modul Berbantuan Aplikasi Creator Book Untuk Meningkatkan Higher Order Thingking Skill (Hots) Peserta Didik Pada Mata Pelajaran Biologi. *Jurnal Ilmu Pendidikan*, *7*(2), 809–820. https://journal.unpas.ac.id/index.php/pendas/article/view/13059/5835

Putri, L. N., Ragil, I., Atmojo, W., Ardiansyah, R., & Saputri, I. (n.d.). *Analisis Instrumen Asesmen IPA Berdasarkan Teori Berpikir Kritis Facione*. *449*, 44–49. https://doi.org/10.20961/jpd.v9i2.59886

Qudsiah, J. R., & Hayati, N. (2023). *Pengembangan instrumen tes kategori higher order thinking skills (HOTS) pada mata pelajaran matematika kelas XI SMA*. *1*(1), 10–23. https://ejournal.radenintan.ac.id/index.php/tadzkiyyah/article/view/6889

Rohmatulloh. (2023). *Pengembangan E-Modul Interaktif Berbasis Problem Based Learning (Pbl) Untuk Meningkatkan Kemampuan Berpikir Kritis Matematis Peserta Didik*. *12*(4), 3599–3612. https://doi.org/10.24127/ajpm.v12i4.8172

Setiawati, W., Asmira, O., & Ariyana, Y. (2016). Penilaian Berorientasi Higher Order Thinking Skills. In *Modul Belajar Mandiri*. https://repositori.kemendikdasmen.go.id/15158/

Solihin, R. R., Susanto, T. T. D., Fauziyah, E. P., Yanti, N. V. I., & Ramadhania, A. P. (2024). The Efforts of Indonesian Government In Increasing Teacher Quality Based On PISA Result In 2022: A Literature Review. *Perspektif Ilmu Pendidikan*, *38*(1), 57–65. https://doi.org/10.21009/pip.381.6

Sulistyorini, S., Estiastuti, A., & Harmanto. (2018). Pengembangan Perangkat Pembelajaran Tematik Terpadu Model Discovery Learning Berorientasi Higher Order Thinking Skill (Hots) Siswa Sd Di Kota Semarang. *Jurnal Kreatif : Jurnal Kependidikan Dasar*, *8*(2), 103–113. https://journal.unnes.ac.id/nju/index.php/kreatif/article/view/16500/8391

Sunarya. (2018). Pengaruh Model Pembelajaran Inkuiri Terbimbing Terhadap Hasil Belajar Dan Kemampuan Berpikir Kritis Peserta Didik. *Jurnal Pijar Mipa*, *13*(2), 94–99. https://doi.org/10.29303/jpm.v13i2.468

Syaidah, N., Suana, W., Sesunan, F., & Newton, H. (2018). Universitas Papua Development of Tutorial Video For Higher Order Thinking Practice on the Topic of Newton ' s Law Pengembangan Video Tutorial Latihan Berpikir Tingkat Tinggi Materi. *Kasuari: Physics Education Journal*, *1*(2), 91–102. https://doi.org/10.37891/kpej.v1i2.28

Tanujaya, B. (2017). *Pengukuran Keterampilan Berpikir Kritis Siswa Sma Dalam Pembelajaran Matematika*. *July*. http://researchgate.net/publication/318721748_PENGUKURAN_KETERAMPILAN_BERPIKIR_KRITIS_SISWA_SMA_DALAM_PEMBELAJARAN_MATEMATIKA

Wibowo, H. A., Waluya, B., & Rosyida, I. (2025). Inkuiri Terbimbing untuk Meningkatkan Berpikir Kritis dan Kemandirian Belajar pada Materi Trigonometri Lanjut. *Sepren*, *7*(01), 10-22. https://doi.org/10.36655/sepren.v4i1

Widia, Y., & Nasrullah, A. (2025). Pengaruh Penerapan Model Flipped Classroom Menggunakan Video Interaktif Melalui Edpuzzle Terhadap Kemampuan Berpikir Kritis Siswa Sekolah Menengah Atas Negeri 1 Praya Barat. *Journal of Math Tadris*, *5*(1), 1–11. https://doi.org/10.55099/jurmat.v5i1.185

Winarni, S., Simanjuntak, R. P., Marlina, M., Rohati, R., & Kumalasari, A. (2024). Pengembangan e-modul interaktif untuk mendukung algebraic thinking pada materi turunan fungsi aljabar. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *13*(3), 791-803. https://doi.org/10.24127/ajpm.v13i3.8540

Zakiah, R. and H. wildani. (n.d.). *Desain Pre-Eksperimen dalam pendidikan*.

Author Biographies

	**Baiq Riska Bayu** was born in Kotaraja on March 13, 2002. She started her education at SDN 5 Kotaraja in 2009 and graduated in 2015. Then, she continued her education at SMPN 3 Sikur in 2015 and graduated in 2017. Then, she continued her education at SMAN 1 Sikur in 2017 and graduated in 2020. Currently, she is studying at the State Islamic University (UIN) Mataram, majoring in Mathematics Education. Email **:** 220103067.mhs@uinmataram.ac.id
	**Baiq Rofina Arvy** is a lecturer and researcher in the Mathematics Education Study Program, Faculty of Teacher Training and Education, State Islamic University of Mataram, Indonesia. Her research interests are mathematical representation. Email: baiqrofina@uinmataram.ac.id
	**Ahmad Nasrullah** is a lecturer in Mathematics Education at the State Islamic University (UIN) Mataram. His current research focuses on mathematics learning and mathematical thinking skills. Email: a hmadnasrullah@uinmataram.ac.id