



Effect of Using E-Module Media Through a Problem-Based Learning Approach on Higher Order Thinking Skills in Economics Lessons in High School

Lin Nurbudiyani¹

ARTICLE INFO

Article History:

Received: 22 October 2024

Received in revised form: 13 December 2024

Accepted: 30 March 2025

DOI: 10.14689/ejer.2025.117.20

Keywords

Use of E-module, Media, PBL Approach, HOTS, Economics, Indonesia

ABSTRACT

Purpose The purpose of this study is to analyze the effect of using e-modules through a problem-based learning approach, understood as an independent variable (X), on students' high-order thinking skills (HOTS), understood as a dependent variable (Y), and divided into two classes, namely: the experimental class and the control class of students at Muhammadiyah Palangkaraya High School. **Methodology.** This research method employs a quasi-experimental design with a non-equivalent control group. The sample of this study was determined through purposive sampling, with $N = 64$ and $\alpha = 0.05$. **Results** The results of the hypothesis test on the post-test results using the T-test at $\alpha = 0.05$ yielded a significant result. (2-tailed) A value of 0.00 indicates a positive influence on students' high-order thinking skills through the use of e-modules with a problem-based learning approach. The findings of this study suggest that students' HOTS in the experimental group significantly increased, with an N-gain value of 0.60,

placing them in the high category, compared to the control group, which had an N-gain value of, placing them in the low category. The improvement of students' higher-order thinking skills, as indicated by creating or producing a product, received a value of 0.67. The experimental group showed a strong interest in using e-modules through a PBL approach, with a response rate of 86%. **Implications for research and practice.** This finding confirms the importance of using e-modules as a learning medium through a PBL approach in improving understanding and building HOTS students, especially in economics subjects.

© 2025 Ani Publishing Ltd. All rights reserved.

Introduction

Learning activities are a vital component of education, shaping the knowledge, attitudes, and skills of students to achieve the intended goals, (Aslan, 2021). The quality of learning requires various changes, (Firdaus & Pahlevi, 2022), particularly in the methods,

¹ Department of Economic Education, University of Muhammadiyah Palangkaraya, Indonesia, ORCID: <https://orcid.org/0000-0001-8864-9063>, Email: innurbudiyani11@gmail.com

*Correspondence: innurbudiyani11@gmail.com

approaches, learning strategies, and the use of learning modules, (Holliday & Li, 2004). Therefore, learning activities must be carried out actively, independently, inspiringly, and fun, so that they can give birth to active participation by providing sufficient space for students to form and develop their' high-level thinking skills, (Karatsiori, 2023), which include the ability to analyze, evaluate, and create or produce a product, especially in economics lessons at the high school level, (Hsu & Wu, 2023).

However, in reality, many students still struggle to develop higher-order thinking skills, especially in economics subjects at the high school level, (Yerimadesi et al., 2023). Several factors can cause this. First, the use of less innovative, independent, and inspiring learning methods results in a learning process that is more focused on memorization rather than analytical skills. Second, the use of traditional learning modules remains. Based on the learning conditions above and to develop students' higher-order thinking skills, quality learning is necessary using the Problem-Based Learning (PBL) approach and through E-Module media, (Karlen et al., 2023). This approach is expected to create a more active, interactive, and enjoyable learning environment, encouraging students to think more deeply, analyze various economic issues, evaluate them, provide alternative solutions, and ultimately create a product relevant to everyday life, (Sajja et al., 2023).

The learning approach above is more focused on solving real-world problems that are more relevant to economic learning materials, providing students with opportunities to encounter real financial issues in society and find various solutions independently, (Nurrahman et al., 2025). This approach also trains students' higher-order thinking skills, (Alanazi et al., 2024). The use of this E-module media aims to provide teaching materials that are more interactive and flexible, making it easier for students to access learning materials. This research study differs from previous studies, such as those of Zulfi Idayanti, (Zulfi & Muh. Asharif, 2024), Eka Fitriana, (Fitriana et al., 2024), Edi Supriyadi, (Supriyadi et al., 2024), Yuniarti, (Yuniarti & Astuti, 2022) and Poppy Yaniawati, (Yanlawati et al., 2021). Thus, most previous studies have focused on only one aspect and have not been systematically linked to examine their impact on the use of e-modules, especially in developing higher-order thinking in students. Therefore, a discussion on the effect of using e-modules through the PBL approach on improving students' HOTS in Economics learning at SMA Muhammadiyah Palangkaraya has not been conducted by previous researchers, (Wijayanto et al., 2023b).

This study specifically aims to determine the influence of using e-modules through the Problem-Based Learning approach on improving students' high-level thinking skills. Thus, the results of this study are expected to make a significant contribution to the use of e-modules through the PBL approach in developing and enhancing students' high-level thinking skills, which other educational institutions can then apply to improve the quality of learning and the quality of graduates in schools.

Literature Review

E-Modules in Learning Activities

The use of e-modules is an integral part of learning activities and is viewed as a means to enhance learning effectiveness and achieve learning objectives, (Rusli et al., 2024). Thus, e-modules are the primary source of learning activities, designed and compiled in digital

format through electronic platforms such as websites, mobile applications, or learning management systems, which contain various learning concepts and materials to build student competencies (Koth et al., 2021). Therefore, the existence of e-modules needs to be compiled systematically, clearly, have objectives to be achieved, use methods, sources and learning evaluation, based on the concept of mastery learning which includes; self-instruction, self-contained, containing unified material, stand alone or making e-modules that are not dependent on other learning materials, and adapting to developments in knowledge and technology (Sholihah et al., 2023).

In this context, e-modules offer a more dynamic, flexible, and student-centered learning experience, enabling students to learn independently at their own pace and according to their individual abilities (Delita et al., 2022). As Jesi Alexander Alim stated in his research, e-modules can help improve students' learning comprehension (Alim et al., 2025). Additionally, Tommy Tanu Wijaya and Yiming Cao, revealed that the use of e-modules can build learning motivation and enhance student skills (Wijaya et al., 2025). E-modules enable learning to be more interesting, practical, efficient, and interactive because they are operated through software (Budiarto et al., 2025). Thus, the development of e-modules must be structured based on competencies and learning outcomes, which are then packaged systematically, making it easier for students to learn independently, both directly and remotely, (Suwandi et al., 2023). This approach increases students' knowledge and insight, and helps them solve various difficulties faced when understanding the material presented (Yunus et al., 2025).

Problem-Based Learning Approach

Problem-based learning is a learning approach model that focuses on solving real-world issues relevant to everyday life, while also improving critical thinking and problem-solving skills, thereby facilitating the acquisition of new knowledge (Tanna et al., 2022). According to Mirjam Brassler and Jan Dettmers, problem based learning is part of a curriculum development and teaching system that develops problem-solving strategies in learning (Brassler & Dettmers, 2017), by placing students in an active role as problem solvers, through the process of identifying, analyzing, and solving problems, so that in the end it can encourage students to develop skills, think critically and be able to solve problems in everyday life (Chien, 2019).

In this context, problem-based learning is not merely an approach focused on learning subject matter, but rather on building students' understanding through practical experiences in addressing real-world problems (Jia et al., 2024). Therefore, the teacher's role in this PBL approach is more that of a facilitator, guiding students through the learning process rather than being the primary source of information. Therefore, students are expected to be more actively involved, both asking questions and collaborating with other students to find various practical solutions (Mantri, 2013). Thus, to provide convenience in implementing problem-based learning through the use of e-modules, according to Min Liu, it is necessary to pay attention to several principles, including: a) learning is student-centered, learning in PBL must be centered on students, b) authentic problems from the organizing focus for learning, the problems presented are real, c) new information is acquired through self-directed learning, in the problem-solving process, if students do not understand and know the basic knowledge, then they can search for themselves through

other sources, (d) learning occurs in small groups, building interactions and exchanging ideas in building knowledge collaboratively, e) teachers act as facilitators, the presence of teachers plays a role as facilitators, and monitors the development of student learning activities, so that they can encourage them in achieving the desired targets (Liu et al., 2023).

The Concept of Higher-Order Thinking Skills

High-level thinking skills are an educational concept that is by the current independent learning curriculum (Yosepha et al., 2023), thus HOTS is built based on Bloom's taxonomy, to prepare human resources in facing the industrial revolution and have skills, by requiring students to be able to develop their thinking frameworks both critically, creatively, and innovatively (Jia et al., 2024), so that they can solve various problems in the learning process (Nguyễn & Nguyễn, 2017). According to Lewis and Smith, high-level thinking in students can be developed if they have knowledge stored in their memory and connect it with other information (Changsri et al., 2024), allowing them to obtain answers and make informed decisions. Meanwhile, according to Tushar Gupta and Lokanath Mishra, HOTS is a higher-level thinking concept that is higher than just memorizing learning materials (Marlena et al., 2022), the above view as also emphasized by Bruce Torff, HOTS is defined as the potential to use critical thinking to face new challenges and have not been thought of by students before (Torff, 2003). At the same time, Parama Kwangmuang, explains that HOTS is a strategic thinking concept that aims to solve a problem, by analyzing, evaluating, and synthesizing or producing a prediction (Azid et al., 2022).

The Relationship between The Use of E-Module Media and PBL on HOTS

E-modules are an integral part of the learning process, serving as the primary source of learning activities designed and arranged in a digital format through electronic platforms. This approach aims to provide a more dynamic and flexible learning experience, enabling students to learn independently by accessing e-modules anywhere and at any time (Hamzah et al., 2022). In this context, the effectiveness of using e-modules relies on a problem-based learning approach, which aims to solve real-world problems, especially in economics lessons. Consequently, the relationship between e-modules and the problem-based learning approach can be well established, thereby improving understanding and developing students' high-level thinking skills (Zohar & Dori, 2003).

The integration of e-modules and problem-based learning approaches is effective in developing and improving students' higher-order thinking skills (Delita et al., 2022). Therefore, PBL provides students with opportunities to be directly involved in the problem-solving process, which requires them to think critically, analytically, and creatively (Gholami et al., 2016). In the problem-based learning approach, students are invited to explore various sources of information, discuss solutions with their peers, and communicate their understanding in a broader context. This view is part of the characteristics of higher-order thinking, which goes beyond remembering, understanding, and applying, and also demands the ability to analyze, evaluate, and create (Resnick, 2023). Based on these steps, students are trained to think more critically and realistically, a skill that is highly needed in the ever-changing world of education, especially in economics learning, which is complex due to its numerous problems (Wijayanto et al., 2023a).

Methodology

Research design

This study used a quasi-experimental method, with a nonequivalent control group design (Hastjarjo, 2019). Therefore, this study involved two groups, consisting of an experimental class and a control class, which were not selected randomly, with the research design shown in Table 1:

Table 1

Non-equivalent Control Group Design Research

Group	Pretest	Implementation	Posttest
Experimental Class	O1	XE	O2
Control Class	O1	XK	O2

Description:

O1 : pretest

O2 : posttest

XE : use of E-Modules through the PBL approach in experimental classes

XK : conventional learning in the control class

Thus, the two classes above were given different treatments (Hastjarjo, 2019); the experimental class was given a learning experience using e-modules through a problem-based learning approach. In contrast, the control class received conventional learning. Before applying the learning model, the researcher conducted a pretest and followed it with a posttest to assess the students' high-level thinking skills related to economic learning materials (Miller et al., 2020).

Sampling and population

The population of this study was all students of class XI-A and XI-B of SMA Muhammadiyah Palangkaraya, the sample of this study used a purposive sampling technique based on the same level of ability and homogeneity with 260 respondents, and consisted of two variables, namely the independent variable (X) regarding the use of E-modules through a Problem Based Learning approach, and the dependent variable (Y) regarding high-level thinking skills (HOTS) in economic subjects (Cook et al., 1979).

Research instrument and data collection

This research instrument utilises a questionnaire comprising 18 question items to validate the feasibility of using e-modules through the Problem-Based Learning approach. Researchers use a graded scale composed of five forms of assessment, including: 0, 1, 2, 3 and 4. Meanwhile, to test high-level thinking skills in students, researchers use a Likert scale and are descriptive which includes: strongly agree (SS = 5), agree (S = 4), enough (C = 3), disagree (TS = 2), strongly disagree (STS = 1), while statements that support negative traits are the opposite, namely: SS = 1, S = 2, C = 3, TS = 4, STS = 5. The form of the instrument used in this study is presented in Table 2:

Table 2*Questionnaire on the Use of E-Modules Through the PBL Approach*

Aspect	Questionnaire Indicators
<i>E-Module Components Through a Problem Based Learning Approach</i>	Efficiency of e-module use Clarity of discussion of material Ease of explanation of lesson material Suitability of material to learning media Discussion material is more structured Discussion material is more structured E-module use is more communicative and interactive
<i>Economics Learning Design</i>	Relevance of learning objectives and achievements Suitability of material to learning objectives Ease of learning material and easy to understand Stages of the problem-based learning approach Suitability of material and learning evaluation Learning models able to improve student abilities Ease of material explanation through learning media Depth of material coverage in daily life
<i>Higher Order Thinking Skills</i>	Analytical skills Evaluative skills Create or produce products in economics lessons

Data analysis

The analysis of this research data used IBM SPSS 25 software through normality, homogeneity, and hypothesis testing, with the following research hypotheses:

$$H_0: \mu = \mu_0$$

$$H_1: \mu \neq \mu_0$$

Description

- μ : Average HOTS of experimental class students using e-modules and through the PBL approach
- μ_0 : Average HOTS of control class students with conventional learning
- H_0 : The null hypothesis is that there is no difference between the average HOTS scores of the experimental group and the control group students who did not use the e-module and through PBL.
- H_1 : Alternative hypothesis: There is a difference in the average HOTS results between students in the experimental group and those in the control group who did not use e-modules and the PBL approach.

Results*Students' Initial Abilities Before Using E-Modules and PBL*

Based on the results of the pre-test on the high-level thinking skills of students obtained from the experimental group and the control group before using the learning e-module, it can be seen in [Table 3](#):

Table 3

HOTS Students' Initial Pre-Test Results

HOTS Indicator	Group	
	Experiment	Control
Lowest Score	1	3
Highest Score	14	14
Mean	8,53	9,06
Median	9	9,50
Mode	8	6
Standard Deviation	2,77	3,07

The table thus reveals that the distribution of pretest data in both the experimental group and the control group has a highest score of 14%, and the lowest score for the experimental group is 1%. In comparison, the control group has an average score of 3%, while the experimental group has an average score of 8.53%. The control group's average score is 9.06%. The median scores for the experimental and control groups are 9% and 9.50%, respectively. The scores that often appear in the experimental group are 8%, and in the control group, they are 6%. In terms of standard deviation, the experimental group achieved a value of 2.77%, while the control group achieved a value of 3.07%. [Figure 1](#) depicts the average scores of the pretest results for the experimental and control groups more clearly.

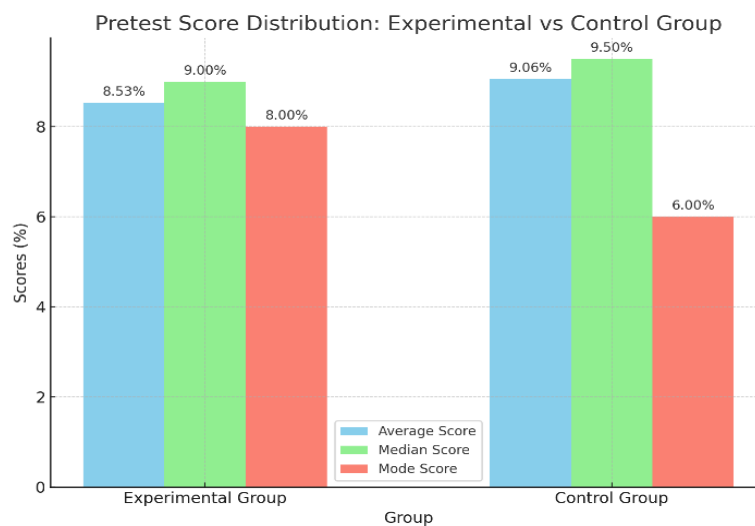


Figure 1: *Average Value of Experimental Group and Control Group*

[Figure 1](#) shows that the average pretest scores of both groups are relatively low; the experimental group's score is 8.53, and the control group's is 9.06. The difference in the average scores of the two groups is minimal, only 0.53. Thus, it can be concluded that there

is no significant difference between the scores of the experimental group and the control group. This suggests that both groups have the same initial knowledge.

Meanwhile, the data obtained regarding the high-level thinking skills of students in grades XIA and XIB of SMA Muhammadiyah, which consists of three indicators, including: analyzing, evaluating, creating or producing products, based on the pretest results in the experimental group and control group can be seen in Table 4.

Table 4

Initial Results of Students' HOTS Ability.

Student HOTS Indicators	Maximum Scores	Pre-test			
		Eksperimen		Control	
		%	X	%	X
Analytical skills	9	4,41	34%	4,66	37%
Evaluative skills	6	2,28	37%	2,34	38%
Ability to Create	4	1,84	46%	2,06	52%

Thus, the percentage of pre-test results for the experimental group and the control group, based on the HOTS indicator, shows that the experimental group's ability to analyze students was 37%. In comparison, the control group's 34% is only a 3% difference; thus, the initial knowledge, based on the indicator of ability to analyze, is not significantly different between the two groups. At the same time, the pre-test results showed that the experimental group scored 37% and the control group scored 38%. The difference between the two is only 1%, and it is said that the ability to analyze them is not significantly different. Meanwhile, the indicator of creating or producing a product can show that the pre-test results of the experimental group are 46%, while the control group is 52%; the difference between the two is only 6%; thus, the ability to create or produce a product for the two groups is not much different either.

Post-test Student Final Ability

Thus, the post-test results of the experimental and control groups after using the e-module through the problem-based learning approach and conventional learning in the control group can be explained in Table 5:

Table 5

Post-test Results of E-Module Use through PBL

Use of E-Modules through PBL	Group	
	Experiment	Control
Lowest Score	10	7
Highest Score	23	19
Mean	17,22	13,06
Median	18	14
Mode	18	14
Standard Deviation	3,31	3,06

The table above indicates that the distribution of pre-test results yielded the highest score in the experimental group at 23%, while for the control group, it was 19%. While the lowest score for the experimental group was 10%, and the control group's lowest score was

7%, the experimental group's average score was 17.22%. In contrast, the average score for the control group was 13.06%. The middle or median score in the experimental group was 18%, and in the control group, it was 14%. This is consistent with the scores often observed in the experimental group, which is 18%, and the control group, which is 14%. The standard deviations in the experimental and control groups were 3.31 and 3.06, respectively.

Thus, the post-test results in both the experimental and control groups showed an increase compared to the previous pre-test results. The average score of the experimental group was 17.22, while the average score of the control group was 13.06. The experimental group experienced an increase of 8.69%, while the control group also experienced a rise of 4%. The difference in the average scores of the two groups was 4.16. Thus, it can be concluded that there is a significant difference between the average scores of the experimental group and the control group, indicating that the two groups possess different high-level thinking abilities.

Based on the post-test results above, the students' high-level thinking skills, which include three indicators – namely, the ability to analyze, evaluate, and create or produce a product – can be explained in Table 6.

Table 6

Final HOTS Student Post-test Results

Student HOTS Indicators	Maximum Scores	Post-test			
		Experiment		Control	
		%	\bar{X}	%	\bar{X}
Analytical skills	13	9,41	74%	6,69	55%
Evaluative skills	6	4,53	73%	3,94	64%
Ability to Create	5	3,28	82%	2,44	61%

It is thus evident that the post-test results based on the HOTS indicator for the analytical ability aspect show that the experimental group obtained 74%. In comparison, the control group received 55%. Both groups experienced a significant increase, with the experimental group showing a 40% increase. In contrast, the control group achieved only 18%, thus indicating that the post-test value of the experimental group is higher than that of the control group. Regarding the evaluation ability aspect, the experimental group achieved a 73% success rate, while the control group achieved a 64% success rate. Thus, the experimental group experienced a 9% increase, and the control group experienced a 26% increase. If expressed as a percentage, the post-test value of the experimental group is higher than that of the control group. In the aspect of creating or producing a product based on the HOTS indicator after the post-test, the experimental group obtained 82% and the control group 61%, thus the two groups above experienced a significant increase, the experimental group experienced a rise of 36% and the control group was 9%, therefore the experimental group is higher than the control group.

Improving Students' Higher-Order Thinking Skills

The average N-gain score determined the increase in students' high-level thinking skills within each group. By calculating the difference between the post-test and pre-test scores, the results of the N-gain scores in the experimental group and the control group can be seen in Table 7:

Table 7

Results of the Average N-gain Value Against Student HOTS

Group or class	N-gain	Description
experiment	0,60	currently
control	0,28	low

It is thus evident that the N-gain score for the experimental group was 0.60%, experiencing an increase in students' high-level thinking skills and was in the medium category, while the control group was 0.28% and could be categorized as low, thus the form of N-gain increase in high-level thinking skills of students in grades XI-A and XI-B of SMA Muhammadiyah Palangkaraya based on the HOTS indicator in the experimental and control groups is evident in [Table 8](#).

Table 8

N-Gain on Higher Level Thinking Ability for Each Indicator

Student HOTS Indicators	N-gain			
	Experiment	Description	Control	Description
Analytical skills	0,58	currently	0,25	low
Evaluative skills	0,33	currently		low
Ability to Create	0,67	currently		low

It is thus evident that there is a difference between the average N-gain score on the indicator of students' higher-order thinking skills for the control and experimental groups; thus, the average N-gain score on the ability to analyze the experimental group was 0.58%, and the control group only got 0.25%. While on the indicator of evaluating ability, the average N-gain score was 0.33% for the experimental group and 0.25% for the control group. Furthermore, the indicator of creating or producing a product in economics learning got an average N-gain score for the experimental group of 0.67% and the control group 0.27%, thus the results of the N-gain score above show an increase in students' higher-order thinking skills in the experimental group that used e-modules through a problem-based learning approach much higher compared to the control group that used conventional learning. Thus, the form of students' higher-order thinking skills in each indicator, both the experimental and control groups, can be seen in [Figure 2](#):

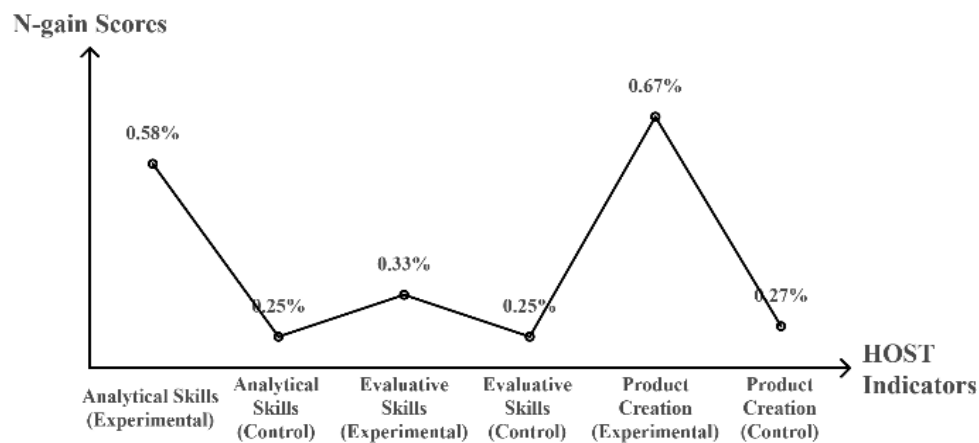


Figure 2: Comparison of N-gain Scores in HOTS Indicators

Results of Student HOTS Questionnaire Analysis

Based on the results of the questionnaire regarding students' high-level thinking skills based on the percentage, both the experimental group and the control group results are presented in Table 9:

Table 9

Pre-test and Post-test Results Based on Student HOTS Indicators

Student HOTS Indicator	Percentage			
	Experimental group		Control group	
	Pretest	Post test	Pretest	Post test
Analytical skills	67%	77%	67%	70%
Evaluative skills	73%	87%	74%	80%
Ability to Create	80%	93%	84%	87%

It is thus evident that the experimental class experienced a significant increase in the results of the pre-test and post-test, thus the results of the pre-test percentage on the HOTS indicator for its ability to analyze showed that the initial percentage of the experimental group and the control group was balanced at 67%, while the percentage of the post-test score of the experimental and control groups was quite different from the experimental group at 77%, while the control group was only 70%. Furthermore, the results of the pre-test showed that the percentage of the indicator on the ability to evaluate for the experimental group was 73%. In comparison, the control group had a rate of 74%. This increase is evident in the post-test score percentage, where the experimental group achieved 87%, compared to the control group's 80%. In the last indicator, namely creating or producing a product, the pre-test percentage of the experimental group was 80%, while the control group was 84%, the results of the post-test score percentage of the experimental group was 93% and the control group was 87%, thus the experimental group experienced an increase compared to the control group, as presented in Table 10:

Table 10

N-Gain Higher Level Thinking Ability Based on Indicators

Student HOTS Indicators	N-gain			
	Experiment	Description	Control	Description
Analytical skills	0,31	currently	0,09	low
Evaluative skills	0,53	currently	0,23	low
Ability to Create	0,63	currently	0,18	low

This indicates that the average N-gain score for students' higher-order thinking skills varies, with the experimental group achieving 0.31 for the analytical ability indicator and the control group 0.09. The evaluation ability indicator, on the other hand, had an average N-gain score of 0.53 for the experimental group and 0.23 for the control group. Furthermore, the experimental group's ability to create or produce products scored 0.63, while the control group scored 0.18. These results indicate that the increase in students' higher-order thinking skills per indicator in the experimental group, which used e-modules through a problem-based learning approach, was higher than in the control group, which received conventional learning only.

Thus, the data processing obtained from the experimental group was then calculated as a percentage and interpreted in terms of student responses to the use of e-modules through a problem-based learning approach in economics subjects, as shown in Table 11.

Table 11

Results of Student Response Analysis on the Use of E-Modules through the PBL Approach

Indicators of E-Module and PBL Usage for HOTS	Response	Description
Student responses to the use of e-modules through the Problem-Based Learning approach	88%	very good
Students' high-level thinking skills after using e-modules through the Problem-Based Learning approach	85%	very good
The advantages of student learning with the use of e-modules through the Problem-Based Learning approach	86%	very good

The percentage of student responses to the use of e-modules through the problem-based learning approach is included in the outstanding category with a rate of 86%, so that it makes it easier for students to understand the lesson, this can be shown by their ability to analyze, evaluate and create or produce a product, especially in economics learning.

Normality, Homogeneity and Hypothesis Tests

The normality test was conducted to determine the results of the pre-test and post-test, using the Shapiro-Wilk test via IBM SPSS statistical 25 software on the experimental and control groups, as shown in [Table 12](#):

Table 12

Results of the Normality Test of the Pre-test and Post-test of the Experimental and Control Groups

Shapiro-Wilk	Pre test		Post test	
	Experimental Group	Control Group	Experimental Group	Control Group
Sig. α	0,078	0,399	0,126	0.427
Sig. > 0,05 (5%) = H0 is accepted Normally distributed data				

Based on the results of the normality test, the significance is measured. The value of the pre-test and post-test data in both groups is greater than 0.05. The pre-test data for the experimental group is 0.078%, and for the control group, it is 0.399%. The post-test data for the experimental group is 0.126, and for the control group, it is 0.427. Thus, it can be concluded that the pre-test and post-test data of the two groups are normally distributed.

Meanwhile, a homogeneity test was conducted on the pre-test and post-test data to determine whether the experimental group and the control group had homogeneous variances. The results of this test are presented in [Table 13](#).

Table 13

Results of the Pre-test and Post-test Homogeneity Test

Lavene Statistic	Pre-test	Post-test
sig. α	0,327	0,601
Decision	sig.> 0,05 = H0 is accepted Homogeneous data	

Based on the results of the homogeneity test, it was decided that if the significance level is greater than 0.05 (sig. > 0.05), then H0 is accepted, and is stated to have the same or homogeneous variance, as in table 4.8 which shows that the sig. of the pre-test and post-test data of both groups is greater than 0.05, which is 0.327 for the pre-test and 0.601 for the post-test. Thus, it can be concluded that both groups have the same variance.

Meanwhile, this hypothesis test employs parametric statistical analysis using the t-test in SPSS Statistics 23 software, which indicates that the pre-test and post-test results for both the experimental and control groups are normally distributed and homogeneous. The results of this hypothesis test can be seen in [Table 14](#):

Table 14

Results of Pre-test and Post-test Hypothesis Testing

	<i>Pre test (Uji T)</i>	<i>Post test (Uji T)</i>
Sig. (2-tailed)	0,471	0,000
α		0,05
Decision	H1 is rejected	H1 accepted

Based on the results of the hypothesis test, it can be explained that if the significance level is greater than 0.05 (sig. > 0.05), then H0 is accepted and H1 is rejected, as presented in Table 4.10, which shows the significance level. (2-tailed) The value of the pre-test results is greater than 0.05, namely, 0.471. Therefore, it can be concluded that there is no difference in the average pre-test scores between the experimental group and the control group. Regarding the post-test results, the significance is (2-tailed) value is smaller than 0.05, namely 0.000, and it is concluded that there is a difference in the average post-test results in the experimental group and the control group, thus there is a difference in the high-level thinking skills of students in the experimental group who used e-modules through a problem-based learning approach compared to the control group who only used conventional learning.

Discussion

Thus, the discussion of the effect of using e-modules through the Problem-Based Learning approach on increasing HOTS of class XI-A students or the experimental group and class XI-B or the control group at SMA Muhammadiyah Palangkaraya is divided into several stages. First, based on the test results from the initial stage, before using e-modules and the PBL approach ([Habibi et al., 2025](#)), both the experimental group and the control group showed relatively low scores, as indicated by the pre-test results, with an average of 8.53% for the experimental group. In comparison, the control group achieves 9.06%, and neither of the two groups above has reached half of the maximum score. This condition is caused by students' weak ability to think at a high level, as well as their lack of experience with e-modules and conventional learning methods, which prevents them from solving various problems in everyday life. Because he cannot analyse, evaluate, and create or produce a product, especially in economics lessons, ([Dias-Oliveira et al., 2024](#)).

Thus, after the two groups above received good learning activity services, a significant difference can be observed. The experimental group achieved a higher score than the control group, with an average score of 17.22, compared to 13.06 for the control group. The difference above occurred because the experimental group used e-modules through a

problem based learning approach, (Yew & Goh, 2016), so that the average high-level thinking skills of students can increase and can solve problems in learning, especially those related to everyday life, as Reda Prasetya, et al. in his research explained that the use of e-modules can help and make learning effective well (Prasetya et al., 2022), even Wahyu Istuningsih, et al. in his research also revealed that the use of e-modules can foster learning motivation, (Annam et al., 2024), learning independence, develop students' high-level thinking skills and improve student literacy (Alyusfitri et al., 2024), especially in economics lessons.

Meanwhile, in the final results, the overall score based on each HOTS indicator experienced a significant increase. In the analytical ability indicator, the experimental group achieved 74% and showed an increase compared to the control group, which gained only 55%. During the evaluation of the ability indicator, the experimental group completed a score of 73%, while the control group scored 64%. This was because the use of e-modules presented through a problem-based learning approach was able to build students' mindsets, as evidenced by the results of the student questionnaire, where 86% stated that learning using e-module media was seen as much more fun (Laidsaar-Powell et al., 2024), engaging, and challenging. In terms of the ability to create or produce a product, the experimental group achieved a score of 82%, while the control group scored only 61%. This indicator experienced a significant increase because each student was able to identify, analyse, and stimulate their abilities, allowing them to produce a product, especially in economics learning, (Adu & Zondo, 2024).

Thus, both groups experienced an increase, as evident from the N-gain results obtained by the experimental group, which was 0.60 and fell within the medium category. In contrast, the control group only experienced an increase of 0.28, which fell within the low category. This is because the experimental group used e-modules in learning activities through a problem-based learning approach, so that it can encourage students to be more active in building their knowledge and can improve students' high-level thinking skills far beyond the control group, (Ibrahim et al., 2020), as the results of student responses in the experimental group on the use of e-modules are in the outstanding category with a percentage of 86%, and indicates that students in the experimental group are more enthusiastic and more interested in the use of e-modules, (Srikan et al., 2021).

Conclusion

Based on the results of the analysis carried out on the two hypotheses above, this study can conclude that the variable of using e-modules through a problem-based learning approach, as an independent variable, has a positive and significant influence on improving students' high-level thinking skills, which are understood as dependent variables. Partially, the use of e-modules through a problem-based learning approach shows a powerful and positive influence on building students' high-level thinking skills, as demonstrated by the experimental group, which outperforms the control group that does not use e-modules. Thus, students' high-level thinking skills increased by 0.60% based on the N-gain results, compared to the control group, which achieved only 0.28%. Additionally, students' responses to the use of e-modules through a problem-based learning approach fell into the outstanding category, with a percentage of 86%. Therefore, the use of e-modules is considered essential to continue being used as a learning medium,

especially in economics and other subjects, so that it can improve students' understanding and help them develop high-level thinking skills.

References

- Adu, E. O., & Zondo, S. S. (2024). Enhancing Teachers' Digital Skills in Teaching of Economics in South African Secondary Schools. *International Journal of Educational Research Open*, 6, 100310. <https://doi.org/10.1016/j.ijedro.2023.100310>
- Alanazi, A. A., Osman, K., & Halim, L. (2024). Effect of Scaffolding Strategies and Guided Discovery on Higher-Order Thinking Skills in Physics Education. *Eurasia Journal of Mathematics, Science and Technology Education*, 20(9), em2496. <https://doi.org/10.29333/ejmste/14980>
- Alim, J. A., Hermita, N., Putra, Z. H., & Oktaviani, C. (2025). Development of a Stem-Based E-Module Using the Mikir Model on Energy Sources Material to Enhance Students' Critical Thinking Skills. *Frontiers in Education*, 10. <https://doi.org/10.3389/educ.2025.1635133>
- Alyusfitri, R., Gistituati, N., & Fauzan, A. (2024). The Effectiveness and Relationship of Student Responses toward Learning Outcomes Using Interactive Multimedia-Based E-Modules in Elementary Schools. *International Electronic Journal of Elementary Education*. <https://doi.org/10.26822/iejee.2024.354>
- Annam, S., Ramdani, A., Makhrus, M., & Sarkingobir, Y. (2024). Development and Validation of E-Modules Integrated with Pbl and Local Wisdom to Enhance Critical Thinking and Problem-Solving Skills. *Pedagogy Review*, 3(2), 104-115. <https://doi.org/10.61436/pedagogy/v3i2.pp104-115>
- Aslan, A. (2021). Problem- Based Learning in Live Online Classes: Learning Achievement, Problem-Solving Skill, Communication Skill, and Interaction. *Computers & Education*, 171, 104237. <https://doi.org/10.1016/j.compedu.2021.104237>
- Azid, N., Ali, R. M., El Khuluqo, I., Purwanto, S. E., & Susanti, E. N. (2022). Higher Order Thinking Skills, School-Based Assessment and Students' Mathematics Achievement: Understanding Teachers' Thoughts. *International Journal of Evaluation and Research in Education (IJERE)*, 11(1), 290. <https://doi.org/10.11591/ijere.v11i1.22030>
- Brassler, M., & Dettmers, J. (2017). How to Enhance Interdisciplinary Competence – Interdisciplinary Problem-Based Learning Versus Interdisciplinary Project-Based Learning. *Interdisciplinary Journal of Problem-Based Learning*, 11(2). <https://doi.org/10.7771/1541-5015.1686>
- Budiarto, M. K., Asrowi, Gunarhadi, Sunardi, & Rahman, A. (2025). Effect of Ict-Based Learning Media on Student Learning Outcomes: A Scoping Review. *Journal of Learning for Development*, 12(2), 347-363. <https://doi.org/10.56059/jl4d.v12i2.1354>
- Changsri, N., Inprasitha, M., Tang, K., Boonsena, N., & Pattanajak, A. (2024). The Use of Pattern Blocks in Developing Students' Higher-Order Thinking Skills. *International Journal for Lesson & Learning Studies*, 13(4), 246-264. <https://doi.org/10.1108/ijlls-04-2023-0038>
- Chien, C.-W. (2019). Influence of Problem-Based Learning (Pbl) on Taiwanese Elementary School Pre-Service English Teachers' Pedagogical Content Knowledge. *Education* 3-13, 48(5), 550-564. <https://doi.org/10.1080/03004279.2019.1633373>
- Cook, T. D., Campbell, D. T., & Day, A. (1979). *Quasi-Experimentation: Design & Analysis Issues for Field Settings* (Vol. 351). Houghton Mifflin Boston.

- <https://dickyh.staff.ugm.ac.id/wp/wp-content/uploads/2009/ringkasan%20buku%20quasi-experimentakhir.pdf>
- Delita, F., Berutu, N., & Nofrion, N. (2022). Online Learning: The Effects of Using E-Modules on Self-Efficacy, Motivation and Learning Outcomes. *Turkish Online Journal of Distance Education*, 23(4), 93-107. <https://doi.org/10.17718/tojde.1182760>
- Dias-Oliveira, E., Pasion, R., Vieira da Cunha, R., & Lima Coelho, S. (2024). The Development of Critical Thinking, Team Working, and Communication Skills in a Business School—a Project-Based Learning Approach. *Thinking Skills and Creativity*, 54, 101680. <https://doi.org/10.1016/j.tsc.2024.101680>
- Firdaus, R., & Pahlevi, T. (2022). The Development of Problem-Based Learning E-Modules on Correspondence Materials. *JINOTEP (Jurnal Inovasi dan Teknologi Pembelajaran): Kajian dan Riset Dalam Teknologi Pembelajaran*, 9(2), 145. <https://doi.org/10.17977/um031v9i22022p145>
- Fitriana, E., Djono, D., & Sumaryati, S. (2024). Possibilities for Using E-Modules in Vocational High Schools to Facilitate Critical Thinking Skills. *IJORER : International Journal of Recent Educational Research*, 5(3), 656-665. <https://doi.org/10.46245/ijorer.v5i3.595>
- Gholami, M., Moghadam, P. K., Mohammadipoor, F., Tarahi, M. J., Sak, M., Toulabi, T., & Pour, A. H. H. (2016). Comparing the Effects of Problem-Based Learning and the Traditional Lecture Method on Critical Thinking Skills and Metacognitive Awareness in Nursing Students in a Critical Care Nursing Course. *Nurse Education Today*, 45, 16-21. <https://doi.org/10.1016/j.nedt.2016.06.007>
- Habibi, M. W., Buditjahjanto, I. G. P. A., & Rijanto, T. (2025). Fostering and Developing Computational Thinking in Vocational High School through Project-Based Learning (Pbl). *TEM Journal*, 1610-1620. <https://doi.org/10.18421/tem142-58>
- Hamzah, H., Hamzah, M. I., & Zulkifli, H. (2022). Systematic Literature Review on the Elements of Metacognition-Based Higher Order Thinking Skills (Hots) Teaching and Learning Modules. *Sustainability*, 14(2), 813. <https://doi.org/10.3390/su14020813>
- Hastjarjo, T. D. (2019). Rancangan Eksperimen-Kuasi. *Buletin Psikologi*, 27(2), 187. <https://doi.org/10.22146/buletinpsikologi.38619>
- Holliday, W., & Li, Q. (2004). Understanding the Millennials: Updating Our Knowledge About Students. *Reference Services Review*, 32(4), 356-366. <https://doi.org/10.1108/00907320410569707>
- Hsu, C.-Y., & Wu, T.-T. (2023). Application of Business Simulation Games in Flipped Classrooms to Facilitate Student Engagement and Higher-Order Thinking Skills for Sustainable Learning Practices. *Sustainability*, 15(24), 16867. <https://doi.org/10.3390/su152416867>
- Ibrahim, N. N., Ayub, A. F. M., & Yunus, A. S. M. (2020). Impact of Higher Order Thinking Skills (Hots) Module Based on the Cognitive Apprenticeship Model (Cam) on Student's Performance. *International Journal of Learning, Teaching and Educational Research*, 19(7), 246-262. <https://doi.org/10.26803/ijlter.19.7.14>
- Jia, T., Sitthiworachart, J., & Morris, J. (2024). Screen-Based Simulation Supporting Problem-Based Learning to Improve Football Tactics. *The Open Sports Sciences Journal*, 17(1). <https://doi.org/10.2174/011875399x311682240419063944>

- Karatsiori, M. (2023). In the Pursuit of "Quality Education": From Ancient Times to the Digital Era, Can There Be a Consensus? *Cogent Education*, 10(2). <https://doi.org/10.1080/2331186x.2023.2286817>
- Karlen, Y., Bäuerlein, K., & Brunner, S. (2023). Teachers' Assessment of Self-Regulated Learning: Linking Professional Competences, Assessment Practices, and Judgment Accuracy. *Social Psychology of Education*, 27(2), 461-491. <https://doi.org/10.1007/s11218-023-09845-4>
- Koth, A. J., Focken, A. G., Lyden, E. R., & Yoachim, S. D. (2021). Effectiveness of an E-Module at Teaching Novice Learners Critical Thinking Skills Related to Dentistry. *Journal of Dental Education*, 85(12), 1879-1888. <https://doi.org/10.1002/jdd.12757>
- Lidsaar-Powell, R., Giunta, S., Butow, P., Keast, R., Koczwara, B., Kay, J., Jefford, M., Turner, S., Saunders, C., Schofield, P., Boyle, F., Yates, P., White, K., Miller, A., Butt, Z., Bonnaudet, M., & Juraskova, I. (2024). Development of Web-Based Education Modules to Improve Carer Engagement in Cancer Care: Design and User Experience Evaluation of the E-Triadic Oncology (Etrio) Modules for Clinicians, Patients, and Carers. *JMIR Medical Education*, 10, e50118. <https://doi.org/10.2196/50118>
- Liu, M., Cai, Y., Han, S., & Shao, P. (2023). Understanding Middle School Students' Self-Efficacy and Performance in a Technology-Enriched Problem-Based Learning Program: A Learning Analytics Approach. *Journal of Educational Technology Systems*, 51(4), 513-543. <https://doi.org/10.1177/00472395231174034>
- Mantri, A. (2013). Working Towards a Scalable Model of Problem-Based Learning Instruction in Undergraduate Engineering Education. *European Journal of Engineering Education*, 39(3), 282-299. <https://doi.org/10.1080/03043797.2013.858106>
- Marlena, N., Patrikha, F. D., & Dwijayanti, R. (2022). Electronic Modules in an Indonesian Higher Education: Conceptualisation, Development and Application. *AL-ISHLAH: Jurnal Pendidikan*, 14(3), 3943-3954. <https://doi.org/10.35445/alishlah.v14i3.1473>
- Miller, C. J., Smith, S. N., & Pugatch, M. (2020). Experimental and Quasi-Experimental Designs in Implementation Research. *Psychiatry Research*, 283, 112452. <https://doi.org/10.1016/j.psychres.2019.06.027>
- Nguyễn, T. M. T., & Nguyễn, T. T. L. (2017). Influence of Explicit Higher-Order Thinking Skills Instruction on Students' Learning of Linguistics. *Thinking Skills and Creativity*, 26, 113-127. <https://doi.org/10.1016/j.tsc.2017.10.004>
- Nurrahman, C. K., Rusdarti, R., & Prihandono, D. (2025). Development of a Problem Based Learning E-Module on Students Critical Thinking Abilities. *Journal of Economic Education*, 13(2), 135-141. <https://doi.org/10.15294/jeec.v13i2.28410>
- Prasetya, R., Rusdarti, R., & Prihandono, D. (2022). Development of E-Modules with Problem-Based Learning (Pbl) to Increase Economic Learning Outcomes. *Journal of Economic Education*, 11(1), 93-102. <https://proceeding.unnes.ac.id/ISET/article/view/2002>
- Resnick, M. S. (2023). Teachers' Presentation of Higher-Order Thinking Questions and Student Engagement: Missing out on Hot Opportunities. *Thinking Skills and Creativity*, 50, 101412. <https://doi.org/10.1016/j.tsc.2023.101412>
- Rusli, N. S., Ibrahim, N. H., Hanri, C., & Surif, J. (2024). E-Module Problem-Based Learning on Chemical Equilibria to Improve Students' Higher-Order Thinking Skills: An

- Analysis. *International Journal of Evaluation and Research in Education (IJERE)*, 13(1), 454. <https://doi.org/10.11591/ijere.v13i1.25972>
- Sajja, R., Sermet, Y., Cwiertny, D., & Demir, I. (2023). Platform-Independent and Curriculum-Oriented Intelligent Assistant for Higher Education. *International Journal of Educational Technology in Higher Education*, 20(1). <https://doi.org/10.1186/s41239-023-00412-7>
- Sholihah, S. N., Susanti, & Wulandari, S. S. (2023). Development of an Electronic Module (E-Module) Based on the Independent Learning Curriculum in Economics Subject for Class X Sma. *Jurnal Pendidikan Ilmu Sosial*, 33(2), 287-301. <https://doi.org/10.23917/jpis.v33i2.3476>
- Srikan, P., Pimdee, P., Leekitchwatana, P., & Narabin, A. (2021). A Problem-Based Learning (Pbl) and Teaching Model Using a Cloud-Based Constructivist Learning Environment to Enhance Thai Undergraduate Creative Thinking and Digital Media Skills. *International Journal of Interactive Mobile Technologies (ijIM)*, 15(22), 68. <https://doi.org/10.3991/ijim.v15i22.24963>
- Supriyadi, E., Turmudi, T., Afgani Dahlan, J., & Juandi, D. (2024). Development of Sundanese Gamelan Ethnomathematics E-Module for Junior High School Mathematics Learning. *Malaysian Journal of Learning and Instruction*, 21(2), 139-178. <https://doi.org/10.32890/mjli2024.21.2.6>
- Suwandi, R. A., Suciati, S., & Suranto, S. (2023). Validity and Effectiveness of E-Modules Based on Discovery Learning Combined with Scaffolding Questions to Improve Science Literacy Skills. *The International Journal of Interdisciplinary Educational Studies*, 19(1), 1-23. <https://doi.org/10.18848/2327-011x/cgp/v19i01/1-23>
- Tanna, D. P., Lathigara, D. A., & Bhatt, D. N. (2022). Implementation of Problem Based Learning to Solve Real Life Problems. *Journal of Engineering Education Transformations*, 35(S1), 103-111. <https://doi.org/10.16920/jeet/2022/v35is1/22015>
- Torff, B. (2003). Developmental Changes in Teachers' Use of Higher Order Thinking and Content Knowledge. *Journal of Educational Psychology*, 95(3), 563-569. <https://doi.org/10.1037/0022-0663.95.3.563>
- Wijaya, T. T., Cao, Y., Xiao, X., Rahmadi, I. F., & Gong, Y. (2025). Perspectives of Secondary School Teachers on the Strengths and Limitations of Digital Mathematics Textbooks: An Exploratory Research in China. *Humanities and Social Sciences Communications*, 12(1). <https://doi.org/10.1057/s41599-025-04541-4>
- Wijayanto, B., Sumarmi, S., Hari Utomo, D., Handoyo, B., & Aliman, M. (2023b). Problem-Based Learning Using E-Module: Does It Effect on Student's High Order Thinking and Learning Interest in Studying Geography? *Journal of Technology and Science Education*, 13(3), 613. <https://doi.org/10.3926/jotse.1965>
- Wijayanto, B., Sumarmi, S., Utomo, D. H., Handoyo, B., & Aliman, M. (2023a). Development of E-Module Based on Geospatial Technology to Improve Tpack Competencies of Geography Pre-Service Teacher: A Needs Analysis Review. *TEM Journal*, 1190-1200. <https://doi.org/10.18421/tem122-65>
- Yaniawati, P., Al-Tammar, J., SupiAnti, I. I., Md Osman, S. Z., & Saeful Malik, A. (2021). Using of Sigil Software in Math Education: E-Module Development and Effects on Self-Regulated Learning Skills. *Journal for the Education of Gifted Young Scientists*, 9(3), 251-268. <https://doi.org/10.17478/jegys.954829>

- Yerimadesi, Y., Warlinda, Y. A., Rosanna, D. L., Sakinah, M., Putri, E. J., Guspatni, G., & Andromeda, A. (2023). Guided Discovery Learning-Based Chemistry E-Module and Its Effect on Students' Higher-Order Thinking Skills. *Jurnal Pendidikan IPA Indonesia*, 12(1), 168-177. <https://doi.org/10.15294/jpii.v12i1.42130>
- Yew, E. H. J., & Goh, K. (2016). Problem-Based Learning: An Overview of Its Process and Impact on Learning. *Health Professions Education*, 2(2), 75-79. <https://doi.org/10.1016/j.hpe.2016.01.004>
- Yosepha, A., Ali, M., Wahyudin, D., & Rusman, R. (2023). The Role of Multi-Dimensional Curriculum Design in Improving Higher-Order Thinking Skills. *International Journal of Learning, Teaching and Educational Research*, 22(7), 219-239. <https://doi.org/10.26803/ijlter.22.7.12>
- Yuniarti, F., & Astuti, B. (2022). Development of Tutoring E-Modules through Metacognitive Strategies to Improve Self-Regulated Learning for Junior High School Students. *AL-ISHLAH: Jurnal Pendidikan*, 14(3), 2657-2676. <https://doi.org/10.35445/alishlah.v14i3.1327>
- Yunus, Suwito, D., Indriyanti, A. D., Pambudi, R. G., & Sari, D. P. (2025). Development of Welding Technique Teaching Module Based on Augmented Reality integrated (Ari) Equipped with 3d Animation Simulation to improve 21st Century Skills of Vocational High School Students. *Cogent Education*, 12(1). <https://doi.org/10.1080/2331186x.2025.2505279>
- Zohar, A., & Dori, Y. J. (2003). Higher Order Thinking Skills and Low-Achieving Students: Are They Mutually Exclusive? *The journal of the learning sciences*, 12(2), 145-181. https://doi.org/10.1207/S15327809JLS1202_1
- Zulfi, I., & Muh. Asharif, S. (2024). E-Modul Sebagai Bahan Ajar Mandiri Untuk Meningkatkan Hasil Belajar Peserta Didik. *Jurnal Penelitian dan Pengembangan Pendidikan*, 8(1), 127-133. <https://doi.org/10.23887/jppp.v8i1.61283>