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THE EFFECT OF *THE PROBLEM BASED LEARNING* (PBL) MODEL ASSISTED BY *FLIPBOOK MEDIA* ON THE CRITICAL THINKING SKILLS OF STUDENTS IN PRIVATE HIGH SCHOOL PAB 8 SAENTIS CLASS XI ON THE MATERIAL OF THE HUMAN DIGESTIVE SYSTEM

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ABSTRACT
This study aims to determine the effect of the Problem Based Learning (PBL) model assisted by flipbook media on students' critical thinking skills in the topic of the human digestive system at SMA Swasta PAB 8 Saentis. This research employed a quantitative approach with an experimental design in the form of a pretest-posttest control group design. The research sample consisted of two classes: the experimental class, which received learning using the PBL model assisted by flipbook media, and the control class, which received conventional instruction. Data were collected through essay tests (pretest and posttest), observations, interviews, and questionnaires. The data were analyzed using normality, homogeneity, and t-tests with the help of SPSS version 25.0. The results showed a significant difference in the improvement of critical thinking skills between the experimental and control classes. The average posttest score in the experimental class was 78.67, higher than the control class which scored 62.50. The t-test results showed a significance value of 0.000 ($p < 0.05$), indicating that the PBL model assisted by flipbook media had a significant effect on students' critical thinking skills. Therefore, it can be concluded that the Problem Based Learning model supported by flipbook media is effective in enhancing students' critical thinking abilities in biology learning.

INTRODUCTIONS

Education in Indonesia still faces various challenges, one of which is the low ability of students' critical thinking. According to the 2018 International Student Assessment Program (PISA), Indonesian students show poor performance in literacy, numeracy, and problem-solving, including critical thinking skills. Some studies support these findings by showing that most Indonesian students are still not able to analyze information in depth and logically. This condition is exacerbated by low interest in reading, dominance of traditional teaching methods, and lack of exposure

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to reasoning-based questions. (*PISA 2018 Results (Volume I)* , 2019) (Rofi'ah & Rokhmaniyah, 2024; Sartika et al., 2022)

Critical thinking is one of the important skills of the 21st century that must be developed through education. Defining critical thinking as the ability to analyze, evaluate, and draw conclusions from information or arguments objectively and logically. In an educational context, critical thinking helps students understand concepts more deeply, solve complex problems, and make informed decisions. Effective learning should not only transfer knowledge but also encourage students to think reflectively and critically about the problems they face in their daily lives. Ennis (2015) (Ariyanti et al., 2024) (Scott, 2022)

However, in practice, learning in many schools in Indonesia is still teacher-centered and heavily reliant on lectures, thus making students passive. This approach fails to engage students in meaningful learning and does not provide adequate opportunities to develop critical thinking skills (Anisa et al., 2021). A learning environment that does not encourage exploration, discussion, and argumentation causes students to have difficulty understanding concepts meaningfully and contextually. (Nugroho & Setyarsih, 2023) (Sutarsa & Puspitasari, 2021)

In learning biology, critical thinking is very important, because the subject matter is closely related to real-life phenomena. One of the topics that requires critical thinking is the human digestive system. This topic not only demands students to understand the structure and function of the digestive organs, but also challenges them to analyze health problems and propose relevant solutions. Therefore, students must be trained to evaluate information, ask questions, and solve real-world problems that are relevant to their daily experiences. To overcome low critical thinking skills, a learning model is needed that activates student participation. One such model is Problem-Based Learning (PBL), which uses real-world problems as the foundation of learning. PBL encourages critical thinking through stages such as problem identification, data collection, analysis, and solution development. In this model, the teacher acts as a facilitator, and students collaborate in groups to solve the problems presented. (Sani & Ambarwati, 2024) (Indriani & Sakti, 2022) (Gunawan et al., 2022) (Ardiansyah et al., 2021) (Lunan & Astutik, 2023)

To optimize PBL, the use of engaging and interactive learning media is essential. One of the promising tools is the digital flipbook, which presents content in both visual and interactive formats. Flipbooks allow for the integration of text, images, animations, and videos that enhance students' understanding of complex concepts. This media can increase motivation to learn and foster critical thinking by providing an immersive and contextual learning experience. The integration of multimedia elements encourages students to actively explore, analyze, and synthesize information. (Purnomo et al., 2024; Sapiruddin et al., 2024) (Agrifina et al., 2025; Putra et al., 2024)

Previous research has shown that flipbooks can significantly improve students' conceptual understanding and critical thinking, especially on complex biology topics such as the human digestive system. Flipbooks help visualize abstract biological processes that are difficult to explain only through lectures, making it easier for students to follow the flow of the material and develop arguments based on scientific evidence. (Sakinah et al., 2025) (Ananti & Anggraini, 2023)

Observations at the PAB 8 Saentis Private High School revealed that teachers have never used flipbook media or implemented problem-based learning in biology classes. The teaching process is still lecture-based, and teachers have not measured students' critical thinking skills systematically. Students also have difficulty answering essay questions that require reasoning. Teachers believe that flipbooks can help students visualize biological concepts, especially the digestive system, and hope that integrating PBL with flipbooks will improve students' critical thinking skills.

In response to this, this study aims to examine the influence of the Problem Basd Learning model supported by flipbook media on students' critical thinking skills in studying the human digestive system. This study aims to assess the effectiveness of this integrated approach and identify differences in students' critical thinking abilities before and after its implementation. These findings are expected to contribute to the development of more effective and innovative learning strategies for biology education at the high school level.

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METHOD

This study uses a quantitative experimental research method with *a Pretest-Posttest Control Group Design*. This research was carried out in July 2025 at Private High School PAB 8 Saentis, involving two classes: the experimental class (XI Science 1) and the control class (XI Science 2), each consisting of 30 students, with a total of 60 participants. The experimental class was taught using *the Problem Based Learning* (PBL) model assisted by *flipbook* media, while the control class received learning through conventional teaching methods. Both groups were given the same material on the human digestive system but differed in their approach to learning. The sampling technique used is *Cluster Random Sampling*, by selecting whole classes that are assumed to be homogeneous. Both classes received *a pretest* and *posttest* to measure critical thinking skills before and after treatment. The design of the study is shown in Table 1:

Table 1. Pretest-Postcates Control Group Design

Group	Pre-test	Treatment	Post-tests
Experimental	O1	X	O2
Control	O1	–	O2

Note:

- O1 = Pretest (before treatment)
- X = Treatment (PBL with flipbook media)
- O2 = Posttest (after treatment)

Data Collection Techniques

Data collection techniques include tests, observations, and interviews. The test consisting of six essay questions is given as a pre-test and post-test to measure students' critical thinking skills on the topic of the human digestive system. Before being given, the test questions are validated by a biological materialist. The observation instruments include teacher and student observation sheets. Teacher observation sheets are used to assess teaching activities during learning, while student observation sheets are used to evaluate learning activities using the Problem-Based Learning (PBL) model. Data analysis included normality and homogeneity tests, followed by t-tests at a significance level of 5% (95% confidence interval), which were processed using SPSS.

Data Analysis Techniques

Data analysis was carried out using SPSS version 29, which involves:

- Normality test
- Homogeneity test, with the following criteria:
  - If Fcal < Ftable → homogeneous data
  - If Fcal > Ftable → data is not homogeneous
- Hypothesis testing used an independent sample t-test at a significance level of 0.05 (α=5%) and a confidence level of 95%.

The t-test formula used:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}(\frac{1}{n_1} = \frac{1}{n_2})}}$$

Note:

x_1 = Average value of the experimental class
x_2 = Average value of the control class
n_1 = Number of students in the experimental class
n_2 = Number of students in the control class
S^2_1 = Variance of experimental class
S^2_2 = Variance of the control class

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Research Procedure

This research consists of three stages: preparation, implementation, and completion. The preparation stage includes initial observation, selection of the research population, design of lesson plans (RPP), development of flipbook media, preparation of assessment blueprints, preparation of essay questions, and validation of question items by biologists. In the implementation stage, students are given an initial test consisting of six essay questions before the learning session. The digestive system material was then delivered using a flipbook containing learning activities that were in harmony with the syntax of Problem-Based Learning (PBL), as shown in Table 3.

Table 3. Syntax *of Problem Based Learning*

Phase	Teacher Activities
Stage 1 Orient students to problems	The teacher explains the learning objectives, explains the logistics needed, proposes a phenomenon or demonstration or story to raise a problem, motivates the student to get involved in the solution of the chosen problem.
Stage 2 Organizing students to learn	The teacher helps students to define and organize study tasks related to the problem.
Stage 3 Guiding individual and group investigations	The teacher encourages students to gather appropriate information, carry out experiments, to get explanations and problem-solving.
Stage 4 Develop and present works	The teacher assists students in planning and preparing appropriate work such as reports, as well as helping them to share assignments with their friends.
Stage 5 Analyze and evaluate the problem-solving process	The teacher helps students to reflect or evaluate their investigations and the processes they use.

(Source: Amalia, thesis)

The research scheme can be seen in Figure 1 below.

Figure 1. Problem-Based Learning Research Scheme
Source : Arends (2012)

RESULT AND DISCUSSIONS

Result

Before conducting the experimental phase, the researcher first developed a Flipbook-based learning media as a key component of learning intervention. These media are carefully designed to align with the learning objectives of the digestive system topic and have gone through expert validation to ensure their quality and suitability. After media validation, the researcher also validated research instruments, including essay test questions, observation sheets, and questionnaires, to ensure their effectiveness in accurately measuring students' critical thinking skills. The validation results are presented in the following table.

Table 3. Expert Instrument Validation

Validator	Percentage	Criterion

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Media Expert Validation	82,812%	Highly Worth It
Materials Expert Validation	92,187%	Highly Worth It

The results of media validation with a presentation value of 82.812% showed that it was included in the "very feasible" category based on the feasibility interpretation range of 81% to 100%. The results of the material validation with a presentation of 92.187% showed that the material was included in the category of very feasible. Therefore, it can be concluded that all research instruments meet the feasibility criteria and are appropriate to measure the variables in the study, although refinements based on validator feedback are recommended prior to implementation in the field. (Ayuardini, 2023; Tabbu et al., 2023)

The purpose of the validity test is to determine whether each item in the critical thinking test instrument accurately measures the desired indicator. The validity test was conducted using Pearson Product-Moment correlation with the help of SPSS version 25.0. The decision criteria for the validity test of the item are as follows:
a. If *the value of the r_hitung* >r_tabel, the item is declared valid.
b. If *the value of r_hitung* ≤ *r_tabel* , the item is declared invalid.
The main instruments, which included pre-post essay questions, observation sheets, and questionnaires, were validated using SPSS version 25. The results of the validation of the essay questions are presented below:

Table 4. Essay Test Question Item Validation Results

NOT.	**Thing**	**Number of *R***	**Category**
1	Item 1	0,764	Valid
2	Item 2	0,823	Highly Valid
3	Item 3	0,680	Valid
4	Item 4	0.712	Legitimate
5	Item 5	0.821	Highly Valid
6	Item 6	0,743	Valid

(Source: SPSS 25.0)

All items are categorized as valid to very valid, which indicates that the instrument is appropriate for use in the research.

Furthermore, a reliability test is carried out to determine the level of consistency or stability of instrument measurement results. The reliability test in this study used *Cronbach's Alpha formula* with the help of SPSS version 25.0. The results of the reliability analysis are presented in Table 5 below:

Table 5. Reliability

Reliability Statistics	
Cronbach's Alpha	0,722
Number of Items	6

(Source: SPSS 25.0)

Based on the above results, Cronbach's Alpha value of 0.722 is in the range of 0.60–0.79, this shows that the test instrument has good reliability and is suitable for use in the study.

Critical Thinking Ability Test Results

Pretest *and* Posttest *Results*

The following are descriptive statistics for pretest and posttest scores:

1. Experimental Class (XI Science 1)

Table 6. Results *of Pretest* and *Posttest* of Experimental Class

Statistics	**Pretest**	**Posttest**
Mean	34.87	78.67
Standard Deviation	6.09	6.56
Minimum Score	25	70

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Maximum Score	50	85

(Source: Researcher, 2025)

Descriptive statistics of the experimental class showed that students' pretest scores were relatively low, with an average of 34.87. After the learning process using the Problem-Based Learning (PBL) model assisted by flipbook media, the post score increased significantly to 78.67. This increase is also reflected in the increased minimum score from 25 to 70, and the standard deviation that remains under control. These findings show that the flipbook-media-assisted PBL model is effective in improving students' critical thinking skills, with an even improvement among learners. The following histogram illustrates the score distribution for the experimental class:

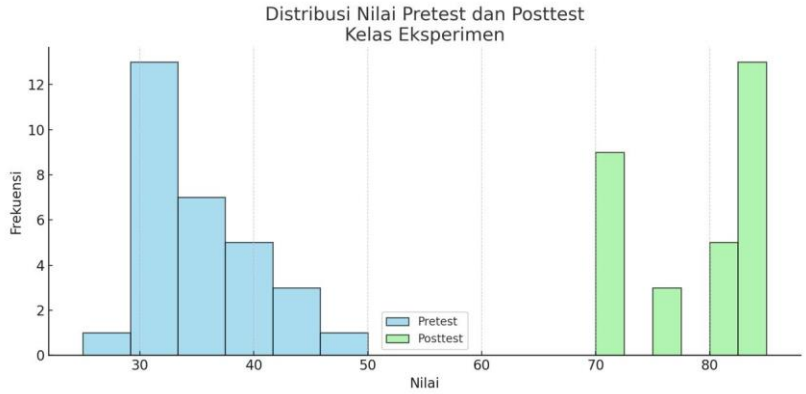

Figure 1. Distribution of Pretest and Posttest Scores in Experimental Classes

The histogram for the experimental class illustrates the distribution of pretest and post-learning scores of students with a PBL model assisted by flipbook media. Most pretest scores are concentrated in the range of 30–40, which indicates that a student's initial ability is relatively low and homogeneous. After the intervention, the postes score shifted significantly to a higher range, with the majority of scores being between 80–85. None of the students scored below 70, demonstrating the effectiveness of the flipbook-assisted PBL model in improving critical thinking skills evenly.

2. Control Class (XI Science 2)

Table 7. Control *Class* Pretest *and* Posttest Results

Statistics	**Pretest**	**Posttest**
Mean	34.53	78.67
Standard Deviation	4,98	5.53
Minimum Score	25	45
Maximum Score	45	75

(Source; Researcher, 2025)

In the control class that applied conventional learning methods, there was an increase in the average score from 34.53 to 62.50. However, the improvement is not as important as in the experimental class. Furthermore, the minimum posttest score remains low, which is 45, which indicates that conventional learning methods have an uneven impact on student performance. The following histogram shows the score distribution for the control class:

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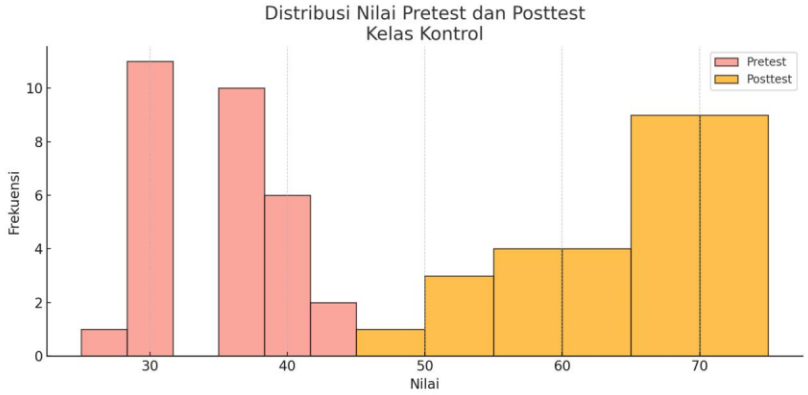

Figure 2. Distribution of Pretest and Posttest Scores in Control Classes

Histograms for control classes show the distribution of students' scores with conventional learning methods without special model intervention. Similar to the experimental class, most pretest scores are in the range of 30–40, which indicates comparable initial ability. After learning, postes scores are spread more widely between 45 and 75, with most students earning scores between 60–70. Some students still score below 60, which suggests that conventional learning is less effective in improving students' critical thinking skills equally.

3. Comparison of Critical Thinking Scores between Experimental Class and Control Class

The following histogram compares the critical thinking ability scores of the experimental class and the control class:

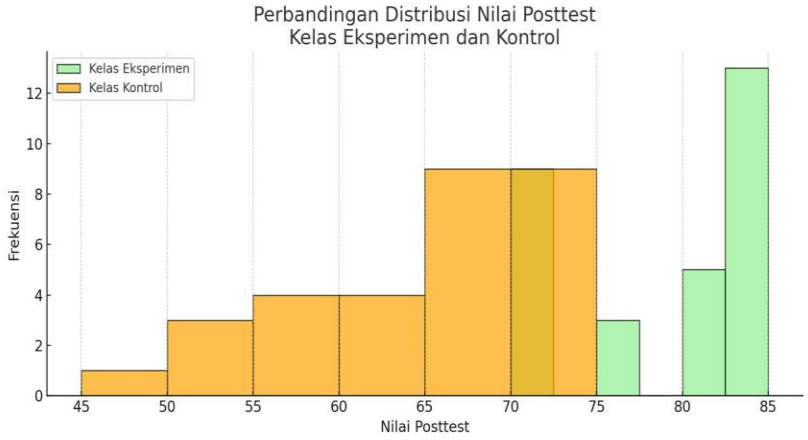

Figure 3. Comparison of Posttest Score Distribution of Experimental Class and Control Class

This histogram compares the distribution of posttest scores between the experimental class and the control class. In the experimental class, scores were highly concentrated in the range of 80–85, which reflects the effectiveness of the flipbook-assisted PBL model in improving student learning outcomes. In contrast, the control class showed a wider and lower distribution, mostly in the 60–70 range, with some scores below 60. This comparison visually shows that the flipbook-assisted PBL model is superior in improving students' critical thinking skills compared to conventional teaching methods.

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1. Normality Test

Normality tests were performed to determine whether the critical thinking ability data in the experimental and control classes were normally distributed. This test uses the Shapiro-Wilk Test because the number of samples in each group is less than 50 students. The results are presented below:

Table 8. Normality Test of Students' Critical Thinking Skills

Normality Test	**Kolmogorov-Smirnova**			**Shapiro-Wilk**		
	Statistics	Df	Sig	Statistics	Df	Sig
Pretest control	.172	30	.301	.810	30	.337
Posttest control	.224	30	.366	.863	30	.275
Pretest experiment	.280	30	.210	.747	30	.221
Posttest control	.145	30	.187	.856	30	.275

(Source: SPSS25.0) Based on the table above:

- The pretest data on the control class and the experimental class were not normally distributed (Sig. < 0.05).
- The posttest data in both classes had a significance value greater than 0.05, indicating a normal distribution.

Therefore, most of the posttest data used in further testing is normally distributed, and parametric statistical tests such as t-tests can be applied to analyze differences between groups.

2. Homogeneity Test

The homogeneity test was performed to determine whether the variance of critical thinking ability between the experimental class and the control class was the same (homogeneous). The test used is the Levene Test for Equality of Variance, as shown below:

Table 9. Test of Homogeneity of Students' Critical Thinking Ability

Variance Homogeneity Test	**Statistics**	**Df1**	**df2**	**Sig.**
Based on Average	3.105	1	58	.078
By Median	3.234	1	58	.058
Based on Median (adjusted df)	3.234	1	56.721	.058
Based on Trimmed Average	3.574	1	58	.071

(Source: SPSS25.0)

Because all significance values (Sig. > 0.05), it can be concluded that the data have a homogeneous variance.

3. T Test

Table 10. Independent Sample T Test for Critical Thinking Ability

Independent Sample Test	**Levene Test for Equality of Variance**	**t-test for Average Equivalence**
	F	Sig.
The same variance is assumed	3.445	.078
Equal variance is not assumed		

(Source: SPSS25.0)The t-test was used to determine whether there was a significant difference in students' critical thinking skills between the experimental class (which was taught using flipbook-media-assisted Problem-Based Learning) and the control class (which was taught using conventional methods). This test assumes the normality and homogeneity of the data, so that the results of the same variance assumption are used. The SPSS output shows:

- t-value = 7.405
- df = 58
- Significance (2-tails) = .000
- Average Difference = 22,723
- 95% CI: Bottom = 16,550, Top = 30,576

Due to the significance value (0.000) < 0.05, H_0 was rejected and H_1 accepted, indicating a significant difference in students' critical thinking ability posttest scores between the two classes.

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DISCUSSION

The results of the study showed that the application of *the Problem Based Learning* (PBL) model assisted by *flipbook* media significantly improved students' critical thinking skills. This is shown by the increase in the average posttest score in the experimental class of 78.67 compared to the pretest score of 34.87. This increase is higher than the control class which only increased from 34.53 to 62.50. In addition, the t-test results showed a significance value of 0.000 ($p < 0.05$), indicating a significant difference between the two groups.

These findings support the results of previous research by and which states that the PBL model is effective in improving critical thinking skills through an active and collaborative problem-solving approach. In this context, flipbook media acts as an interactive visual aid that strengthens students' understanding of biological concepts, especially the human digestive system. It also states that digital media such as Ardiansyah et al. (2021) Zahra et al. (2025) Wulandari et al. (2021) *flipbooks* are able to facilitate deeper information exploration as well as encourage students to think critically.

The increased critical thinking ability in the experimental class was also seen from the results of the questionnaire, where most students (93.3%) were in the "very critical" category, with an average questionnaire score of 91.3. This shows that the PBL learning approach with engaging and interactive media support is able to create meaningful learning experiences and stimulate higher-level thinking skills. Theoretically, these results are in line with the opinion that critical thinking involves the ability to analyze, evaluate, and make logical and reflective conclusions. The PBL model based on real problem solving encourages students to develop those skills, especially if supported by relevant learning media such as flipbooks. Ennis (2015)

Thus, it can be concluded that the *Problem Based Learning* (PBL) model assisted by *flipbook media* has a significant positive influence on improving students' critical thinking skills on the material of the human digestive system at Private High School PAB 8 Saentis. Students who were taught using PBL models and *flipbook* media achieved significantly higher critical thinking scores compared to those taught using conventional methods.

These findings are supported by relevant research. For example, it was found that PBL integrated with digital media significantly improved students' high-level thinking skills. Similarly, it reports that digital Anugraheni (2020) Anisa et al. (2021) *flipbooks* combined with problem-based learning strategies encourage students' engagement and conceptual understanding in science subjects. This learning confirms that integrating media with active learning models such as PBL can result in substantial improvements in students' cognitive outcomes.

CONCLUSION

Based on the results of research and data analysis, it can be concluded that the Problem Based Learning (PBL) model assisted by flipbook media has a significant effect on improving students' critical thinking skills on the material of the human digestive system at Private High School PAB 8 Saentis. This is evidenced by the higher average value of the experimental class posttest compared to the control class, as well as the t-test results which show a significance value of 0.000 ($p < 0.05$). The problem-based learning approach integrated with flipbook media is able to create an interactive and engaging learning process that encourages students to think analytically, reflectively, and solve problems logically. Therefore, the application of the PBL model assisted by flipbook media can be an effective alternative learning strategy to improve students' critical thinking skills, especially in biology materials that require in-depth conceptual understanding.

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