



## Critical Thinking Skills Student Profile and PBL Needs Assisted by Android Physics Module

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**Abstract:** The research was conducted to analyze the level of students critical thinking skills and the requirements for implementing PBL using android modules to improve students critical thinking skills in physics. This research method was included in the preliminary research with a sample of 174 students in XI grade MIPA at Gresik State High School. Data collection is done by sharing critical thinking tests with students, conducting questionnaires for students, and conducting teacher interviews. The data is examined both qualitatively and descriptively to explain the research's findings. The results of this research showed that 1) many students still had a low level of critical thinking. Of the 174 students, 119 have low level, 44 have medium level, and 10 have high level. The evaluation indicator has the lowest average value, and the interpretation indicator has the highest average. Student critical thinking skills are higher for females than for males. The conclusion is that the skills to think critically is very important during learning, especially in physics. To improve the critical thinking skills of students, the way that can be done is by applying PBL-assisted android modules.

**Keywords:** critical thinking skills; PBL; physics

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### Introduction

The learning framework in the 21<sup>st</sup> century contains an understanding that highlights learners' knowledge, abilities, values, attitudes, and needs in everyday life (Gunadi et al., 2022). The students must learn a range of talents in order to succeed in 21<sup>st</sup> century living. Students must develop their critical thinking, creativity, communication, and cooperation (4C) skills (Weng et al., 2022; Agustin et al., 2021). 4C are abilities in life that can generate knowledge personally and can be used in society (Rudianto et al., 2022). Teachers must be proficient in 4C skills if they want to teach the students (Hidayatullah et al., 2021). Particularly in the sector of education, qualified human resources are expected to be able to provide new inventions. By improving skills and the quality of learning by using PBL, education in the 21<sup>st</sup> century prioritizes skills that may play a significant and pertinent role in this century (Bakri et al., 2021).

PBL is an instructional strategy focused on actual-life problems (Pristianti & Prahani, 2022). Student-centered learning is a component of PBL model. The PBL model not only transfers knowledge from teacher to student but also invites students to collaborate to discuss in solving existing problems (Bakri et al., 2021). To solve the existing problem, students' needs critical thinking skills (Rahmawati et al., 2021). PBL can help students develop their skills to think critically and solve the problem (Arzak & Prahani, 2023). In general, students feel that physics is a difficult lesson because it is abstract, they learn many concepts, and it takes a lot of practice to master it (Cawthorne, 2021). The use of PBL is crucial to improving students' skills for critical thinking, particularly in physics lessons. This is due to how applicable physics is in real-life situations (Santuthi et al., 2020). The application of PBL can overcome difficulties in understanding the lessons of physics. There is an influence on students' ability to think critically after applying the PBL model (Sun & Zhuang, 2022). Physics study highlights more emphasis on understanding than on memorizing (Fadilla et al., 2021).

According to (Facione, 2011), the critical thinking indicator used in this study consists of interpretation, which is the capacity to understand the meaning of something, inference, which is the capacity to draw a conclusion, analysis, which is the capacity to understand information more deeply, and evaluation, which is the capacity to assess the veracity of the conclusion that is drawn. It is feasible to assess students' critical thinking skills using these signs (Neswary & Prahani, 2022; Sunarti et al., 2023). To develop students' capacity for critical thought, more research and creativity are required. The goal of this study is to analyze methods for learning, such as learning models and media, and critical thinking indicators that are used to evaluate the success of learning targets. The PBL model may be used as a method of instruction with the use of android digital modules in physics lessons to improve students' critical thinking skills.

Today's learners must take advantage of technological advances (Huda et al., 2020; Kurniati et al., 2021). The Android digital module is an up-to-date learning media that utilizes technology as an attractive media and can be accessed spatially and indefinitely (Aminatun et al., 2022). The adoption of android-based e-modules is a study that reflects the changes brought about by 21<sup>st</sup> century, particularly in the field of education (Yamada, 2021). Android digital module is an interactive media that contain the learning materials (Liana & Nursuhud, 2020). Android-based learning media can facilitate teaching learning process for students and teachers as well as save student costs with android (Eriyanti & Rosiningtias, 2023; Asmianto et al., 2022). Due of its interactive content, digital android modules may be utilized as educational tools to raise student motivation levels and educational outcomes (Rany & Mundilarto, 2021). Based on the background described, the study will analyze students' skills to think critically as consideration in the use of media and learning models to improve students' critical thinking skills.

## Method

This study is a preliminary review of data analysis methodologies using qualitative descriptive analysis to analyze phenomena studied through the study of literature to strengthen the results of research obtained in making conclusions (Arzak & Prahani, 2023). This preliminary investigation was carried out to determine what conditions existed in the school and to get more thorough information about the research that would be carried out by the researchers. This study use descriptive research designs rather than hypothesis testing. The study's findings will be used to models and learning resources that could help students improve their critical thinking skills (Saphira & Prahani, 2022). The stag of this research is described in Figure 1.

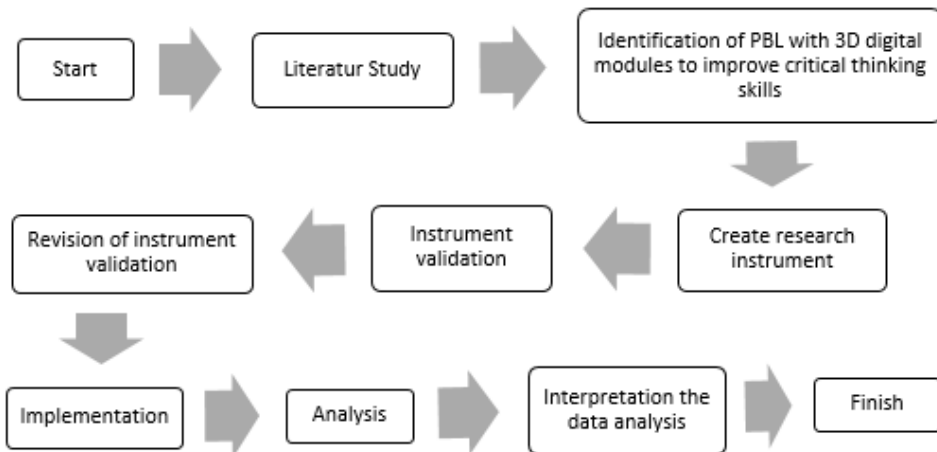


Figure 1. Research Stage

This research was conducted on 174 students in the XI IPA class at the 1st Gresik State High School. There are three types of data collected: 1) written test for students consisting of four critical thinking skills indicators, 2) questionnaire for students shared through google forms, 3) teacher interview. The written test consists of 8 questions that has applied the critical thinking skills indicator to measure students' critical thinking skills about linear motion. The quisioner is distributed via a google form with 10 statements that may be used to explain the situations of the physics learning process in the classroom. The purpose of the interview was to find out about physics learning, including whether or not the PBL model has been applied to help students improve their critical thinking skills and what the teachers thought of the 3D digital module based on android.

The level of students critical thinking skills is obtained by calculating points based on the subject of the test. Points are awarded under the following conditions: 1) If the answer is correct, complete, and systematic, then score 5; 2) if there are only 2 components, then score 3; 3) if there is only 1 component, then score 1; 4) if the answer is wrong or not correct, then score 0. The maximum score is 40. The final value is then calculated using the following formula 1.

$$Final\ score = \frac{Point\ earned}{maximum\ point} \tag{1}$$

The grouping of critical thinking skills levels of students follows the provisions presented in table 1.

Table 1. Critical thinking skills level category.

Range	Category
75 < Score ≤ 100	High
45 < Score ≤ 75	Medium
Score ≤ 45	Low

(Saphira & Prahani, 2022)

## Results and Discussion

### Students Critical Thinking Skills on Linear Motion Materials

This study was conducted to determine the level of critical thinking ability of the students. Measurement is done by giving questions in an essay that correspond to critical thinking indicators, according to Facione, among them interpretation, analysis, inference, and evaluation. From the tests carried out by the students, the level of critical thinking skills of the students is shown in Figure 2.

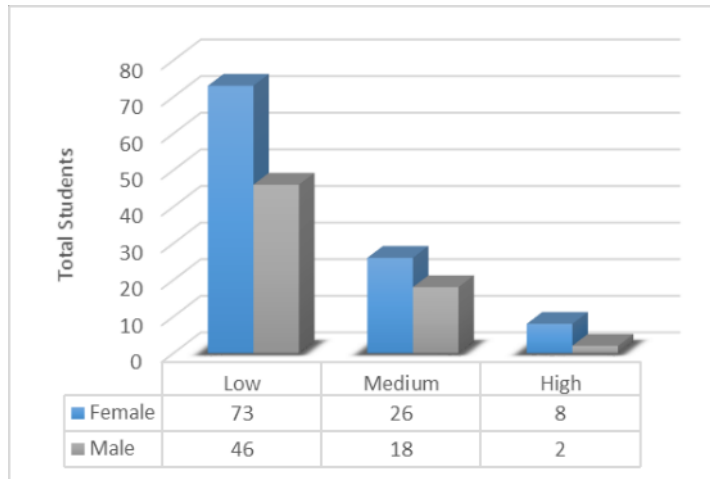


Figure 2. Students Critical Thinking Skills Level

Figure 2 shows the categories of critical thinking skills of students of different genders, namely female and male. Of the 174 students who had worked on the subject, only 10 had a high level of critical thinking, consisting of 8 female and 2 male. There were 44 students with an average critical thinking level, consisting of 26 female and 18 male. Students who were at a low critical thinking level were 119, consisting of 73 female and 46 male.

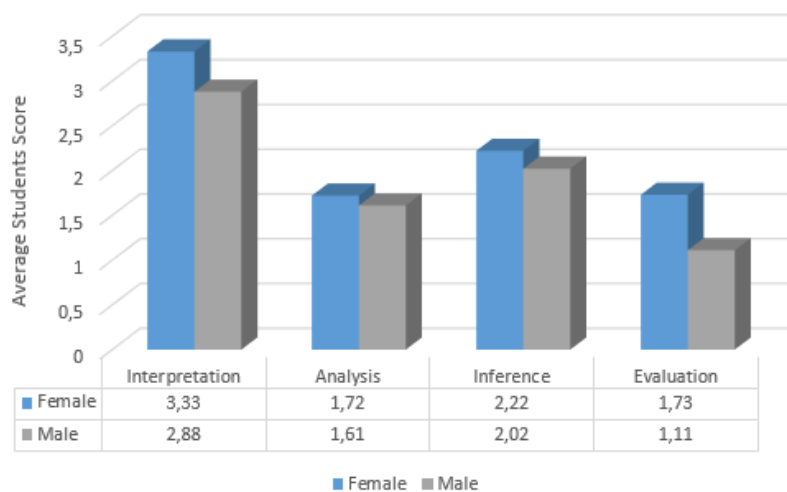


Figure 3. Students Critical Thinking Skills Level in Each Indicator

Figure 3 shows the average student score after working on the critical thinking skills test. There is an average difference between male and female students. According to figure 3, the average value of a student's critical thinking skills is higher for female students than for male students and the conditions are the same for each critical thinking skills indicator assessed. Interpretation indicators have high average values. This shows that students are able to understand and describe situations to be able to provide solutions to the problem that has been given. The second-highest indicator is inference, followed by the analysis indicator, and the last is evaluation. The low average value on the evaluation indicator indicates that students have not yet been able to explain in detail the assessment process they have undertaken to solve a given problem or have yet to provide detailed reasons for the conclusions they have drawn.

Examples of students questions and answers on each indicator, including interpretation, analysis, inference, and evaluation are provided below.

1. Interpretation

The indicator asks the student to understand the given problem. On this indicator, the student is asked to determine the movement of the boat. The question for the indicator of interpretation is shown in Figure 4. Student answers shown by Figure 5. The answer does not meet the criteria because the student was unable to describe the direction of a boat by the direction of the flow of water to calculate boat movement.

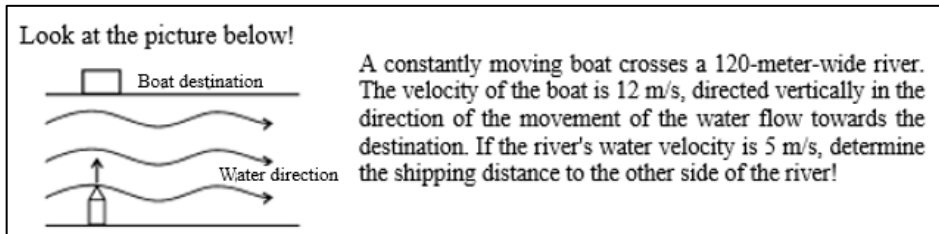


Figure 4. Question for Interpretation Indicator

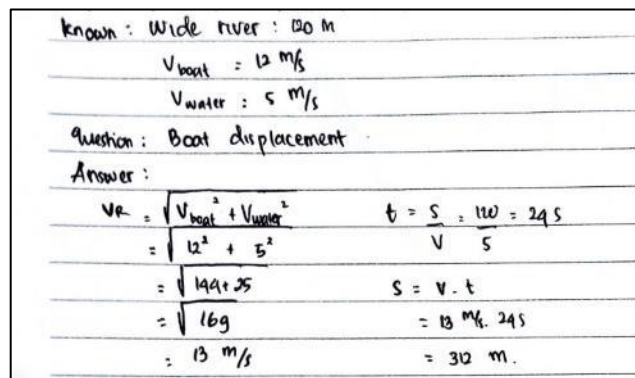


Figure 5. Students answer for interpretation indicator.

2. Analysis

The indicator analysis asks students to understand the given problem more deeply. On this indicator, students' are asked to determine the distance between two placement. The question for the analytical indicator is shown in Figure 6. Student answers shown by Figure 7. The answer does not meet the criteria because the student is unable to analyze the concept that the distance the police have traveled is equal to the distance a motorcycle driver has traveled.

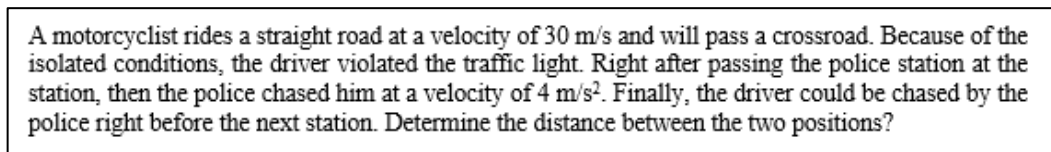


Figure 6. Question for analysis indicator

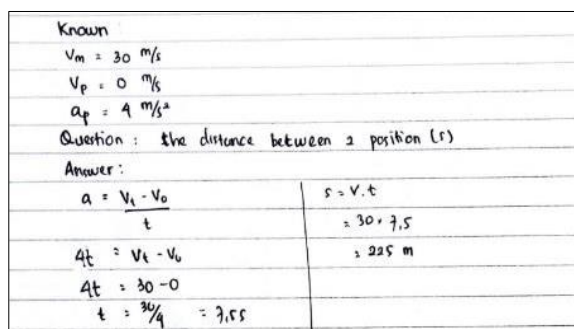


Figure 7. Students Answer for Analysis Indicator

### 3. Inference

The inference indicator asks students to draw conclusions. To draw a conclusion, they must know the necessary elements to be able to do so. The question for the inferential indicator is shown in Figure 8. The students are asked to determine how long the ball is in the air. In Figure 9 the student's answer is shown. The answer does not meet the criteria because the students' answer does not meet the criteria because to determine the time for ball is in the air it needs to know the time of the object when it rises and when it descends. The student's answer only responds to the time the ball takes when it goes down.

A ball is thrown vertically upwards at an initial velocity of 40 m/s ( $g = 10 \text{ m/s}^2$ ). Determine the total time the ball is in the air!

Figure 8. Question for Inference Indicator

Known:  $v_0 = 40 \text{ m/s}$   
 $g = 10 \text{ m/s}^2$   
 Question: how long the ball is in the air  
 Answer:  
 $v_t = v_0 + gt$   
 $0 = 40 + 10t$   
 $10t = 40$   
 $t = 4 \text{ s}$

Figure 9. Students Answer for Inference Indicator

### 4. Evaluation

The evaluation indicator asks the student to assess the credibility of the resulting conclusions. On the evaluation indicator, students are asked to determine the point with the greatest speed, accompanied by the correct proof. Students should be able to include a reason why they chose the point and be capable of analyzing the speed at each point. The question for the analysis indicator is shown in Figure 10. Student answers shown by Figure 11. The answer does not meet the criteria because the student is unable to provide proof of explanation related to the selected answer. Students only chooses point B without explaining why.

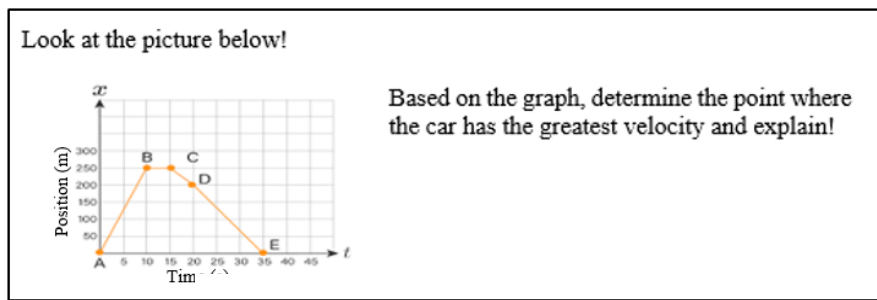


Figure 10. Question for Evaluation Indicator

The car has the highest velocity when its in point B.

Figure 11. Students answer for evaluation indicator

### Results of student's Response to Physics Learning

To find out how students responded to their critical thinking skills, they were given a raft containing 10 statements about their physical learning experience during school. Students can choose the answers they think are appropriate. There are four choices of answers: strongly disagree, disagree, agree, and strongly agree. The results of the lifts that have been filled by the students can be seen in Table 2. Critical Thinking Level Table 2.

Table 2. Critical Thinking Level

No	Statement	Percentage			
		Strongly Disagree	Disagree	Agree	Strongly Agree
1	Physics learning is boring and difficult	12%	32%	49%	7%
2	Linear motion topic is very important to study.	2%	11%	56%	31%
3	Linear motion topic is easy to understand.	4%	37%	44%	15%
4	Teachers use the method of lectures more often.	3%	12%	48%	37%
5	I can easily understand the material using the methods used by the teacher.	9%	27%	41%	23%
6	Critical thinking is necessary during the study of physics.	1%	8%	43%	48%
7	I've learned to improve my critical thinking skills	3%	23%	48%	26%
8	I have trouble working tests that require critical thinking skills.	5%	24%	51%	20%
9	I'm bored to study with books all the time.	2%	12%	49%	37%
10	I'm interested in studying physics with an android-based digital module.	4%	15%	43%	38%

Table 2 shows that physics is one of the difficult and most boring subjects. In the following statement, the student agrees that linear motion material is crucial to studying. There are many students who find it difficult to study linear motion material. When teaching physics, teachers more often use the method of lectures. There are some students who have difficulty understanding material when using lecture methods during physics learning.

Most students strongly agree that critical thinking skills are required for learning physics. Students have already learned to improve their skills to think critically by working on matters. However, there are still many students who find it difficult to work on issues that require critical thinking skills to solve them. When studying, students more often use books as a learning medium. Most students get bored when learning using only a book medium. So we need interactive learning media when studying physics. Based on the lifts that have been filled by the students, many of them are interested in studying physics with the help of android-based digital modules.

### Teacher Interview

In addition to the education spread to students, the study also involved examining teachers' views related to learning models and media used to improve students' critical thinking skills in physics lessons. Results of teacher interview shown by Table 3.

Table 3. Results of Interview With Physics Teacher Regarding the Implementation of Physics Lesson

No.	Question	Answer
1.	Is critical thinking so necessary in physics lessons?	Physics is a lesson that is so closely related to everyday life that it requires critical thinking.
2.	Is there any attempt to improve students critical thinking skills?	Yes, of course.
3.	How to improve students' critical thinking skills on physics learning?	Students' critical thinking skills can be trained by asking basic questions related to an event or



No.	Question	Answer
4.	What media was used during physics studies?	phenomenon that is happening, then students are asked to analyze. During learning, typically use a whiteboard to explain materials, textbooks, power points, and videos that contain material explanations.
5.	Have you ever used teaching with the help of android digital modules?	I've never used an application like that.
6.	How do you react to the Android digital module if it's used during the physics learning process?	Very interesting and very helpful during the learning process.

Table 3 shows the response of physics teachers about students critical thinking skills in physics lessons. Based on the results of an interview with one of the physics teachers, the response was that the skills to think critically is essential in learning physics because it is closely related to everyday life. An attempt to improve the skills to think critically has been made by giving basic questions related to material related to the occurring event or phenomenon, which students are then asked to analyze.

During school physics, he still used a simple method of explaining material on a board with the help of textbook media and sometimes showing power points or videos containing learning material. The teacher's response to the use of Android-based digital modules was welcomed positively because they had never used the media before.

A lot of research has been done to find out the impact of the use of digital modules and the implementation of PBL during physics learning by combining the application of PBL with a commonly used technology, namely Android. To strengthen researchers' understanding of the implementation of PBL with Android-based digital modules, researchers analyzed previous studies, whose results can be seen in Table 4.

**Table 4. Relevant Research**

Author	Research Purpose	Result
(Sujanem & Putu Suwindra, 2023)	Analyses the effectiveness of interactive e-modules through the PBL model to improve students' skills to think critically on physics lessons.	Students' critical thinking skills improved after implementing the PBL model assisted with interactive modules and students' interest in interactive e-modules with PBL was very high.
(Parno et al., 2019)	Prove the influence of PBL on students' skills to think critically on optical material.	Implementation of the PBL model successfully improved students' skills to think critically higher than conventional learning, so PBL is recommended as a learning model that can improve students' thinking skills on optical material.
(Adhelacahya, 2023)	Improve students critical thinking skills with electronic module	Students' critical thinking skills improves after implementing PBL assisted electronic modules. Students' post-test scores are significantly improved.
(Liana & Nursuhud, 2020)	Analyze the effectiveness of interactive multimedia through PBL's approach to students' skills to think critically.	Classes that used interactive modules with a PBL approach experienced higher improvements in critical thinking than classes that used books from teachers during learning.
(Nurmahasih & Jumadi, 2023)	Analyze the implementation of PBL model to improve students 21 <sup>st</sup> century learning outcomes.	Application of PBL can improve students' critical thinking skills. There was a significant 20% increase in students' post-test scores.
(Suharno et al., 2022)	Analyze how well high school students' critical and creative thinking skills are being improved	Students' critical thinking skills have improved from low to medium levels, allowing the use of PBL in physics modules to successfully improve high school students' critical thinking skills.



Author	Research Purpose	Result
(Serungke et al., 2020)	by utilizing modules as learning tools. Shows the effects of using a PBL model with virtual labs on students' critical thinking skills and learning achievements.	Score for classes that used the PBL model better than conventional classes. The PBL model effectively improves students critical thinking skills and learning achievements.
(Samadun & Dwikoranto, 2022)	Analyze the implementation and effectiveness of the PBL model to improve students skills to think critically in physics material.	The PBL model is very effective to apply in the classroom as it improves critical thinking skills of students in physics material.

### Discussion

Critical thinking skills are the process of making rational decisions about what to do and what to believe. Critical thinking skills are needed to find a solution to the problem (Sari et al., 2021). Someone with critical thinking skills can search, understand, and evaluate a statement by analyzing relevant things rationally and logically in the process of decision making (Samadun & Dwikoranto, 2022; Hariadi et al., 2022). According to the past research, Male and female students showed different levels of critical thinking skills. The results of this study are relevant to the past research that female students have higher critical thinking skills than male student. The average score of female students is higher than male students (Nurmahasih & Jumadi, 2023; Darmaji et. al., 2022; Ali & Awan, 2021). This is because male female students have different knowledge, interest, and learning styles from male students (Sultan et al., 2020). In terms of higher order thinking skills, female students score better than male students because they can assimilate information quickly, respond to it in a systematic way, and have better long-term memory (Rahmadita et al., 2021).

Several studies state that the PBL model can improve students critical thinking skills (Arini & Rahayu, 2023). PBL is an innovative learning strategy that can be used in the 21<sup>st</sup>. Physics learning using the PBL model can improves students' critical thinking skills (Parno et al., 2021; Fadilla et al., 2021; Wenno et al., 2021; Samadun & Dwikoranto, 2022). The PBL model can also help students who have difficulty with physics become more interested in the topic. Applications of PBL supported with interactive learning media such as e-modules can significantly improve students' critical thinking skills (Eriyanti & Rosiningtias, 2023; Sujanem & Putu Suwindra, 2023; Suharno et al., 2022). Students can communicate two-way with interactive learning media (Eriyanti & Rosiningtias, 2023). Students will find it simpler to learn in class with android-based educational tools. When students utilize smartphones, they may access learning resources that are more interactive and not bound by location and time (Zulfiani et al., 2021). There are differences in students' critical thinking skills who use the PBL e-module and textbooks widely used in schools. Students' critical thinking skills are greatly influenced by e-module (Aufa et al., 2021). The application of android digital module combined with the PBL model could help students in developing several critical thinking skills (Liana & Nursuhud, 2020). The integration of the digital android module is one of the effective learning innovations that adds positive enthusiasm and energy to students about physics lessons over traditional learning.

### Conclusion

Based on data obtained from research conducted at the Greek 1st State High School, it can be concluded that many students have low critical thinking skills. Of the 174 students, 199 had low critical thinking skills, 44 had medium critical thinking skills, and 10 had high critical thinking skills. The evaluation indicator has the lowest mean value, and the interpretation indicator has the highest average value. Female students have higher critical thinking abilities compared to male students. The study also conducted a survey of physics learning in schools, and the responses obtained showed that there is a need for training to improve students' skills to think critically, especially on linear motion material. The study also found that teachers tend to use conventional teaching methods, and the role of teachers still dominates. Students are interested in studying physics using android digital modules.

The researchers wanted to use the android digital module for physics learning by implementing an innovative learning model that could improve students critical thinking skills. The alternative is to apply the PBL model with android modules to physics learning.

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