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Binar Kurnia Prahani <binarprahani@unesa.ac.id>

[JPPIPA] Submission Acknowledgement

1 message

Drs. Aris Doyan, M.Si., Ph.D <jppipa@unram.ac.id> Tue, Mar 1, 2022 at 9:56 PM
To: "Dr. Binar Kurnia Prahani" <binarprahani@unesa.ac.id>

Dr. Binar Kurnia Prahani:

Thank you for submitting the manuscript, "Profile of Students' Physics Critical Thinking Skills and Application of Problem Based Learning Models Assisted by Digital Books in Physics Learning in High School" to Jurnal Penelitian Pendidikan IPA. With the online journal management system that we are using, you will be able to track its progress through the editorial process by logging in to the journal web site:

Manuscript URL: https://jppipa.unram.ac.id/index.php/jppipa/authorDashboard/submission/1444
Username: binar

If you have any questions, please contact me. Thank you for considering this journal as a venue for your work.

Drs. Aris Doyan, M.Si., Ph.D

We have reached a decision regarding your submission to Jurnal Penelitian Pendidikan IPA, "Profile of Students' Physics Cri
of Problem Based Learning Models Assisted by Digital Books in Physics Learning in High School".

Our decision is: Revisions Required

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Binar Kurnia Prahani <binarprahani@unesa.ac.id>

[JPPIPA] Editor Decision

1 message

Editor JPPIPA <jppipa@unram.ac.id> Tue, Mar 22, 2022 at 11:14 AM
To: Shalsa Billa Ardhana Neswary <shalsa.19032@mhs.unesa.ac.id>, "Dr. Binar Kurnia Prahani" <binarprahani@unesa.ac.id>

Shalsa Billa Ardhana Neswary, Dr. Binar Kurnia Prahani:

We have reached a decision regarding your submission to Jurnal Penelitian Pendidikan IPA, "Profile of Students' Physics Critical Thinking Skills and Application of Problem Based Learning Models Assisted by Digital Books in Physics Learning in High School".

Our decision is to: Accept Submission

C-B-Reviewer 1 Revised.docx
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Profile of Students' Physics Critical Thinking Skills and Application of Problem Based Learning Models Assisted by Digital Books in Physics Learning in High School

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Abstract: This research aims to analyze the profile of students' critical thinking skills and the application of Problem Based Learning (PBL) models based on digital books on physics learning in high school. This research method is a preliminary study with data collection techniques in the form of written tests whose data results will be analyzed descriptively qualitatively. The study was conducted on 176 students consisting of 77 male students and 99 female students. in 5 classes X MIPA at one of the State High Schools in Sidoarjo Regency. It was concluded that: 1) The lowest criteria for critical thinking skills of students were found in the analysis indicator with an average score of 0.989 in female students and 0.636 in male students. 2) Students' critical thinking skills belong to the low category, the score range of 0-45 as many as 99 female students and 77 male students and no students who belong to the medium and high categories. In this study, the application of digital book-assisted PBL is expected to improve students' critical thinking skills. So, it was concluded that if the critical thinking skills that students have are low, then it is necessary to improve students' critical thinking skills, namely with the implementation of digital book-assisted PBL models.

Keywords: PBL, Critical Thinking Skills, Digital Books

Citation: Neswary, SBA, & Prahani, BK (2022). Profile of Students' Physics Critical Thinking Skills and Application of Problem Based Learning Models Assisted by Digital Books in Physics Learning in High School. *Journal of Science and Science Education (JoSSEd)*, *8*(2), 1-4. doi: https://doi.org/10.29303/jppipa.v1i1.264

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Introduction

According to Jannah, (2020) education is a learning process that is done consciously to develop students' potential, not only in cognitive abilities but also in the ability to self-control demonstrated through attitudes. Many factors are supportive in the education process, one of which is school. The learning process and the components contained in it such as teachers, students, learning objectives, lesson models can determine a success of the Education process (Fitri, 2020). The main goal in the implementation of a learning process in school, which can be one of the references for learners can achieve basic competencies in accordance with the plan that has been made before (Sari et al., 2021).

Physics is an important basis for the development of science and technology (Dewi et al., 2021). In the process of physics learners there is usually a root cause

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in the form of students less interested in the material delivered by the teacher (Lutfiana et al., 2021). Students feel that physics is too difficult. This is because at the time of learning, the learning model used by teachers in teaching tends to be the same so it seems boring. Students assume that physics contains only mathematical calculations identical to formulas (Elizabeth & Sigahitong, 2018). According to Badriyah et al, (2021), the process of learning physics emphasizes understanding more than remembering. Therefore, students' critical thinking skills are required as the key to successful understanding of physical concepts.

Thinking is intended that learners can use the knowledge as well as the skills they develop as they learn in new contexts, which means it has not been thought of by learners before but has been taught by teachers (Irwan et al., 2021). Critical thinking enables a person to determine the purpose, relationship, or relationship between things, and consider the decisions to be taken to determine truth and education (Nurussaniah & Ramandha, 2017; Rosmasari & Supardi, 2021). Critical thinking skills have 6 indicators, namely: Analysis, interpretation, inference, explanation, evaluation and self-regulation. However, on indicators of self-planation and self-regulation it is difficult to measure using tests, so this study only uses 4 indicators (Facione, 2011; Hasannah & Suprapto, 2021). Learning models that can teach and develop critical thinking, one of which is PBL (Safitri et al., 2021).

PBL is a learning model that technically provides problems directly or in real life that are used as analyzing materials to find solutions to these problems (Ardeniyansah & Rosnawati, 2018). Problems used in PBL models are problems that are authentic or that arise in the environment (Hidaayatullaah & Dwikoranto, 2019). According to Mangngella, (2021) the PBL model is a learning model that is central to students and which is currently being widely developed. According to Fatma, (2018), the PBL model can be varied by teachers and clarify the flow that will make learners become more understanding and teaching and learning activities in the classroom will be more fun so that learners do not get bored. The application of the PBL model can make students more non-passive and can improve student learning outcomes (Ningrum et al., 2021). Research results (Rahmadani, 2019), The use of PBL can evoke the activeness, motivation, and creativity of students in learning.

Physics learning needs to be packaged using media and must use learning models that can attract students' attention so that the learning runs more fun so that students will not feel bored. (Sulthon et al., 2020). At this time, the development of information and communication (ICT) has had an effect on the world of Education including in the learning process. Digital books are publications in the form of text and images packaged in digital form, in English digital books called e-books (Andina, 2011; Alwan, 2018). E-book as a medium of learning is also very easy to carry everywhere without having to bother when carrying it (Angriani et al., 2020). With this e-book can be a solution so that the learning process is more fun in the classroom. E-books can help to effectively and streamline learning time (Shobrina et al., 2020).

Based on the above problems, researchers conducted research aimed at analyzing the profile of students' critical thinking skills and the application of PBL models based on digital books on physics learning in high school.

Method

The study uses preliminary studies with descriptive research designs and does not test hypotheses, but used a descriptive research design. The results of this study will be used as a consideration for the improvement of learning models and learning media that improve students' critical thinking skills in high school.

The study was conducted on 176 students in 5 X classes at one of the high schools in Sidoarjo Regency consisting of 77 male students and 99 female students. The research instruments used in this study are written tests, student response questionnaires, and physics teacher interviews. Written tests are used to find out the results of students' learning in the cognitive realm (Amir et al., 2020). Students' essay test questions amount to 8 questions to estimate critical thinking skills (Dita et al., 2021) about straight motion material equipped with indicators of critical thinking skills. Student questionnaire sheets are used for data collection (Syamsu, 2020) shared through google form with 10 statements. The teacher interview contains 7 questions that can explain the conditions related to the physics learning process in school. Interview conducted to explore information about the situation of physics learning (Napaswati, 2020). The information sought is whether it has been applied PBL models to improve students' critical thinking skills and teachers opinions regarding PBL models based on digital books.

The data analysis technique used in this study is a qualitative descriptive technique (Tiswarni, 2019) to describe how the situation is compatible with the facts that exist. **Figure 1.** demonstrate the method flow procedures used regarding the profile of students' critical thinking skills and the application of digital book-assisted PBL models in physics learning in high school.

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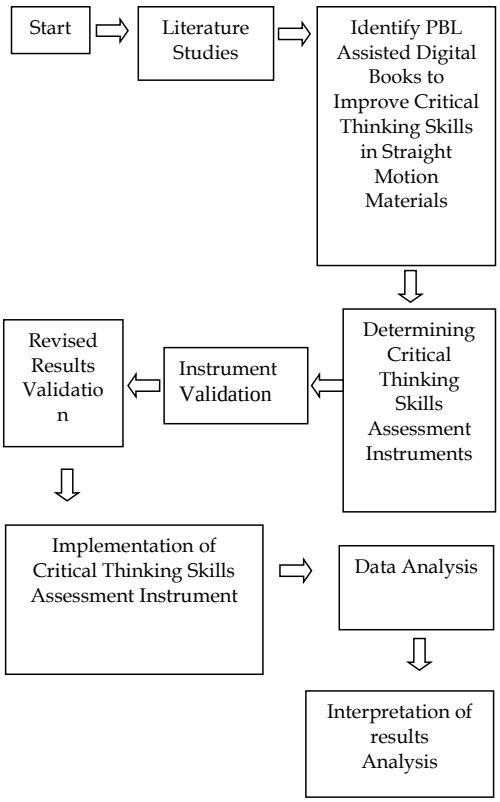


Figure 1. Research Methods

Result and Discussion

This research was conducted to find out how the level of critical thinking skills of students is done by testing using a written test tool consisting of 8 essay test questions that correspond to 4 indicators of critical thinking ability, among others: Interpretation, analysis, inference, and evaluation. That way students are expected to be able to interpret, analyze questions, make conclusions, and evaluate according to the question instrument. Based on the research that has been carried out, it is obtained the results of students' thinking skills in straight motion material by using the PBL model using Facione indicators such as in **Figure 2.**

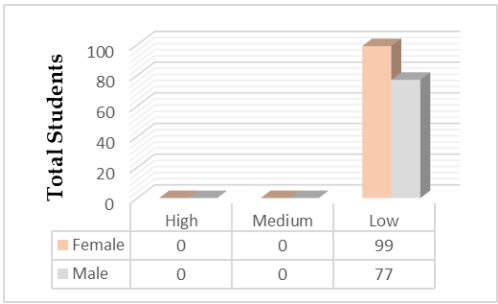


Figure 2. Critical Thinking Skills Category

Figure 2, it was obtained from 176 students with low categories, 99 of whom were women and the remaining 77 were men. No student scores in medium and high categories.

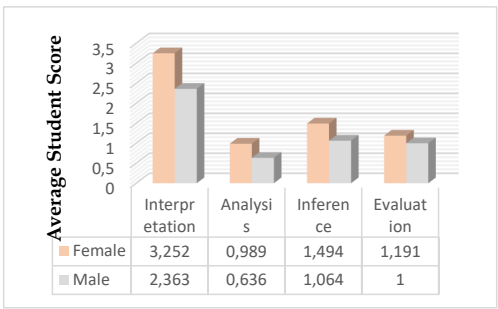
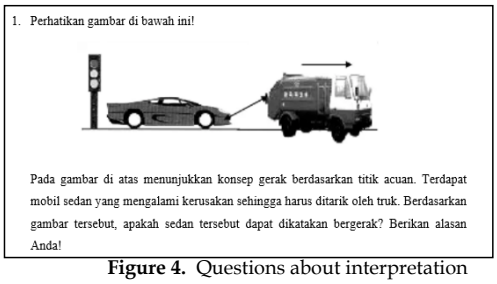


Figure 3. Students' average results based on critical thinking indicators

Figure 3, average critical thinking skills by gender showed a significant difference. It can also be known, if the highest average indicator of critical thinking is an interpretation indicator that shows students can understand, explain, and give reasons in the problem. The second highest average is inference and then followed by evaluation. While the average of the lowest critical thinking indicators is an analysis so that it can be known if students have not been able to analyze the steps of using the formula correctly to answer questions.

The examples of questions and answers of students to the critical thinking skills essay test of each indicator, namely achievement, inference, analysis and evaluation are as follows:

1. **Interpretation**


1. Perhatikan gambar di bawah ini!

Pada gambar di atas menunjukkan konsep gerak berdasarkan titik acuan. Terdapat mobil sedan yang mengalami kerusakan sehingga harus ditarik oleh truk. Berdasarkan gambar tersebut, apakah sedan tersebut dapat dikatakan bergerak? Berikan alasan Anda!

Figure 4. Questions about interpretation indicators

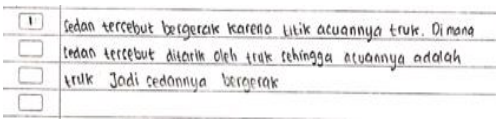

1 Sedan tersebut bergerak karena titik acuannya truk. Di mana sedan tersebut ditarik oleh truk sehingga acuannya adalah truk Jadi sedannya bergerak

Figure 5. Student answers on interpretation indicators

Figure 5, students are asked to understand, explain, and give reasons about motion. However, the student's answer has not been correct in understanding about motion. The correct answer should be that the sedan car will be said to move if the reference point is the traffic light, while the sedan car will be silent if the reference point is a truck. This is because when the car is towed by the truck, the sedan will change position to the traffic lights and not change positions against the truck.

2. Analysis

5. Jaemin dan Jeno adalah dua sahabat baik. Mereka adalah mahasiswa berasal dari dua daerah yang berbeda dan sedang menyelesaikan studi di sebuah kampus ternama di Surabaya. Suatu hari Jaemin dan Jeno berniat untuk pulang kampung. Jika kampung halaman Jaemin membutuhkan waktu 4 jam sampai bagi sebuah bus yang bergerak dengan kecepatan konstan 60 km/jam. Berapa jam Jeno akan sampai di kampung halaman jika ia harus melanjutkan perjalanan sejauh 120 km lagi.

Figure 6. Questions about analytical indicators

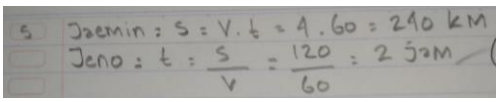

5 Jaemin : $S = V.t = 4.60 = 240$ km
Jeno : $t = \frac{S}{V} = \frac{120}{60} = 2$ jam

Figure 7. Student answers on analytical indicators

Figure 7, students are asked to analyze Jeno's time to arrive at his hometown. From the student's answer, it can be seen that the answer only meets one element, namely the distance of Jaemin's hometown, while for the travel time Jeno is wrong. The correct answer is that after knowing the distance of Jaemin's hometown, it needs to be summed up with the remaining distance of Jeno's hometown. Jeno's hometown mileage is 240 Km + 120 Km = 360 Km. So, the time it takes Jeno to get to his hometown is:

$$t = \frac{s}{v} \ldots\ldots (1)$$

$$t = \frac{120}{60} \ldots\ldots (2)$$

$$t = 6\,hour$$

So, the time it takes Jeno to get to his hometown is 2 hours.

3. Inference

2. Di jalan Ponti, terdapat dua mobil yang bergerak pada suatu lintasan yang lurus. Mobil merah bergerak secara GLB sedangkan mobil hitam bergerak secara GLBB. Menurut Anda, bagaimanakah perubahan kecepatan yang dialami gerak mobil? Serta mobil manakah yang akan tiba terlebih dahulu di tempat tujuan? Ambil kesimpulan berdasarkan kejadian tersebut!

Figure 8. Questions about the inference indicator

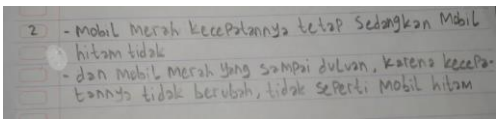

2 - Mobil merah kecepatannya tetap sedangkan mobil hitam tidak
- dan mobil merah yang sampai duluan, karena kecepatannya tidak berubah, tidak seperti mobil hitam

Figure 9. Student answers on inference indicators

Figure 9, students are asked to understand and conclude related GLB and GLBB. From the answer, students assume if the red car will arrive first compared to the black car, the student also does not conclude the answer. The correct answer is a black car, because the red car moves GLB so it has a fixed speed while the black car moves in GLBB so that the speed will change. If the speed of the black car changes even greater, then the black car will run ahead of the red car and will arrive first. The conclusion is that the GLB will have a constant speed, while the GLBB speed will vary.

4. Evaluation

7. Haechan mengendarai sepeda motornya dengan kecepatan sebesar 54 km/jam. Tiba-tiba Haechan melihat terdapat kubangan di tengah jalan pada jarak 30 m di mukanya. Jika sepeda motor Haechan direm dengan perlambatan maksimum 5 m/s2. Maka peristiwa apa yang akan terjadi?

Figure 10. Questions about evaluation indicators

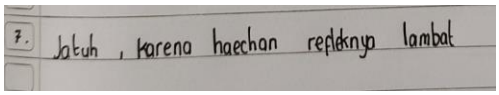


Figure 11. Student answers on evaluation indicators

Figure 11, students were asked to evaluate the distance between Haechan and the puddle if braking with a maximum deceleration of 5 m/s². However, students' answers do not count them, using only logic so that the answer is wrong. The correct answer is that students must count first, as follows:

$$v_t^2 = v_0^2 - 2as$$

$$0 = 15^2 - 2.5.s$$

$$s = 22{,}5\,m$$

Because Haechan's motorcycle has stopped at a distance of 22.5 m, it means that Haechan's motorcycle will not fall in the puddle. Because this event is a slowing event in straight motion changes in order.

Student Response Questionnaire

To find out the response to the critical thinking skills test, a questionnaire containing 10 statements about the student's physics learning experience and teacher delivery during the physics learning process. Students are given the choice of Strongly Disagree (SD), Disagree (D), Agree (A), and Strongly Agree (SA). Here are the results of the student response from the questionnaire that has been shown in **Table 1.**

Table 1. Student questionnaires related to critical thinking skills

No.	Statement	Percentage (%)			
		Strongly Disagree (SD)	Disagree (D)	Agree (A)	Strongly Agree (SA)
1.	Boring physics subjects	12% (21)	51% (89)	31% (55)	6% (11)
2.	Straight motion material is important to learn	1% (1)	13% (22)	52% (92)	35% (61)
3.	Straight motion material is difficult to learn	3% (5)	38% (66)	51% (89)	9% (16)
4.	Straight motion material is easy to understand	5% (9)	45% (79)	44% (78)	6% (10)
5.	I often ask if I don't understand the material delivered by the teacher.	10% (18)	37% (65)	39% (69)	14% (24)
6.	Critical thinking skills are important in physics learning	0% (0)	11% (19)	39% (69)	50% (88)
7.	I've done learning activities to improve critical thinking skills.	3% (6)	26% (45)	48% (84)	23% (41)
8.	I've been trained with critical thinking skills tests.	5% (9)	28% (49)	48% (85)	19% (33)
9.	Critical thinking skills tests are difficult to do.	3% (5)	27% (47)	51% (89)	20% (35)
10.	I am interested in using digital books in physics learning.	8% (14)	27% (48)	41% (73)	23% (41)

Table 1, students disagree if physics subjects are boring. The student's next statement agrees that straight motion material is important to learn. However, students find that straight motion material is difficult to learn. Students often ask if they lack understanding of the material delivered by the teacher.

Students strongly agree that critical thinking skills on physics are important. Students have undertaken activities to improve critical thinking skills and have been trained on critical thinking skills tests. That way, students are interested in using digital books in physics learning. The use of media for a learning model is considered important (Laskaryani et al., 2020). At the student's questionnaire, students feel interested in doing learning by using digital books to improve students' critical thinking skills. Digital books contain straight motion related materials and there are questions that will improve students' thinking skills.

Teacher Interview

Analysis with physics subject teachers consists of 10 questions related to the condition of physics learning in school. Teachers say that critical thinking skills activities are once trained to students by providing basic questions related to current events or phenomena, and students will analyze. Teachers also say that critical

thinking skills are important to improve because physics learning is closely related to everyday life and teachers say that all lessons require critical thinking. The methods that teachers use in physics learning in school are different from matter. There is material that must be practiced and some that are not. Teachers also incorporate lecture methods and also provide a medium for students' understanding. The teacher also provides a video explanation of the material for the physics learning process in school. The school has implemented *Merdeka Belajar*, the obstacle obtained is a reference book as a medium of learning students are still of quite low quality. Must adapt to new time management in the learning process that makes the teacher must manage his time well so that learning remains well implemented.

Teachers say they prefer face-to-face learning to online. This is because students will be more active if learning is done face-to-face, if online students become passive. However, the teacher also said that some students are also still passive at the time of physics learning. Teachers say that students' grades are better if learning is done online rather than face-to-face. Research by Putri, (2021) mentions that students are still passive in responding to learning that at the time responds to learning provided by teachers. At the time of the interview, the teacher also said that never used the PBL model with the help of digital books to improve students' critical thinking skills. This is because teachers never make digital books because they are constrained by time. Therefore, teachers must replace the lecture learning model with the PBL model with digital book assisted.

Table 2. Relevant research in

No.	Author	Research Purposes	Research Result
1.	(Rosmasari & Supardi, 2021)	Improve learners' critical thinking skills by applying PBL learning models to business and energy materials.	PBL learning model on Business and Energy material physics lessons is able to improve learners' critical thinking skills.
2.	(Windari & Yanti, 2021)	Improve the ability to think critically in physics learning using PBL models.	This study uses this type of classroom action research. By incorporating aspects of critical thinking skills, it can improve the critical thinking skills of static fluid principal learners.
3.	(Latifah et al., 2020)	Knowing the feasibility of e-modules, responses, learning outcomes of learners to e-modules results in improving students' critical thinking skills.	This research uses e-modules with kvisoft flipbook maker applications to improve learners' critical thinking skills. Development produces products in the form of e-module teaching materials with kvisoft flipbook applications good enough so that they are worth using in learning.
4.	(Lawut et al., 2019)	Know the feasibility of the PBL-based Physics IPA module on the straight motion subject developed and the effectiveness of the modules developed in improving students' critical thinking skills.	PBL-based Physics IPA module on straight motion subjects developed is worth using from expert research. PBL-based Physics IPA module developed effectively enhances students' critical thinking skills.
5.	(Syafitri et al., 2019)	Producing teaching materials in the form of HOTS-oriented e-modules and knowing the validity level of e-modules.	HOTS-oriented e-modules on heat matter and kinetic gas theory in class XI SMA/MA were declared valid after validity tests by experts. So, e-modules are worth using in the learning process.
6.	(Aripin et al., 2021)	Know the effectiveness of PBL teaching materials to improve effective and efficient problem solving and students' critical thinking skills.	Physics learning tools based *on* PBL models effectively fan efficient to improve problem-solving skills and critical thinking skills learners.
7.	(Sitanggang & Nasution, 2018)	Knowing the ratio of improved students' critical thinking skills in static fluids between classes using	The achievement of the results of knowledge of static fluid material students

No.	Author	Research Purposes	Research Result
		PBL and conventional models in students.	are influenced by how the teacher in carrying out the model PBL.
8.	(Yulianti & Gunawan, 2019)	Knowing the effectiveness of PBL models on understanding concepts and critical thinking of high school learners on temperature and temperature materials heat.	The PBL model can improve students' concept understanding and critical thinking.
9.	(Nurhayati et al., 2019)	Know the effect of applying the PBL model, its critical thinking skills and its interactions on high-level thinking skills on optics.	The application of the PBL model can improve understanding and improve critical thinking skills.
10.	(Karmila et al., 2019)	Knowing the influence of multiple-representation shorting PBL on students' critical thinking skills and process science skills on business materials and energy.	PBL implementation can improve critical thinking skills shown in the results of the gain test analysis by 56%.
11.	(Cahyono & Dwikoranto, 2021)	Describe the application of the PBL model as well as the implications for improving critical thinking skills.	Implementation of the PBL model was able to improve students' critical thinking skills according to the experimental class n-gain score of 0.58 and control class by 0.31.
12.	(Tanti et al., 2020)	Construct, validate, and analyze the effectiveness of PBL-based physics teaching materials to improve students' generic skills.	The use of PBL-based teaching materials can improve students' generic skills especially on critical thinking and problem-solving skills.
13.	(Santuthi et al., 2020)	Describe and explain the role of PBL on students' problem-solving and critical thinking skills.	Students experience an increase in critical thinking using the PBL model.
14.	(Herdianto et al., 2021)	Develop mobile learning-based digital books with the implementation of PBL models to improve problem-solving capabilities.	The use of PBL-based e-books knows validity, is practical, and effective.
15.	(Santyasa et al., 2019)	Analyzing PBL through DI's critical thinking skills is reviewed from social attitudes.	The use of the PBL model is superior to the DI model in achieving students' critical thinking skills in physics learning.

Table 2, proving that the application of the PBL model has a positive response to the understanding of student and student concepts, student learning outcomes, student problem solving, and students' critical thinking skills. Then, the implementation of digital books on the PBL model can be used as one of the effective, efficient, practical, and feasible learning innovations in physics. From previous research conducted by Rohmah, (2021), it is said that there is a good change due to the application of PBL to students' critical thinking skills.

Conclusion

From the results of the study using preliminary research methods that have been implemented, it was concluded that: 1) The lowest criteria for critical thinking skills of students were found in the analysis indicator with an average score of 0.989 in female students and 0.636 in male students. 2) Students' critical thinking skills belong to the low category, the score range of 0-45 as many as 99 female students and 77 male students and no students who belong to the medium and high categories. In this study, the application of digital book-assisted PBL is expected to improve students' critical thinking skills. So, it was concluded that if the critical thinking skills that students have are low, then it is necessary to improve students' critical thinking skills, namely by the application of digital book-assisted PBL models.

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Profile of Students' Physics Critical Thinking Skills and Application of Problem Based Learning Models Assisted by Digital Books in Physics Learning in High School

Commented [AE1]: Dalam judul ada kalimat "berbantuan bu digital",namun dalam pembahasan buku digital yang bagaimana, dan penerapannya seperti apa, tidak dibahas.

Shalsa Billa Ardhana Neswary[1], Binar Kurnia Prahani[2*]

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Abstract: This research aims to analyze the profile of students' critical thinking skills and the application of Problem Based Learning (PBL) models based on digital books on physics learning in high school. This research method is a preliminary study with data collection techniques in the form of written tests whose data results will be analyzed descriptively qualitatively. The study was conducted on 176 students consisting of 77 male students and 99 female students. in 5 classes X MIPA at one of the State High Schools in Sidoarjo Regency. It was concluded that: 1) The lowest criteria for critical thinking skills of students were found in the analysis indicator with an average score of 0.989 in female students and 0.636 in male students. 2) Students' critical thinking skills belong to the low category, the score range of 0-45 as many as 99 female students and 77 male students and no students who belong to the medium and high categories. 3) The implementation of digital book-assisted PBL is expected to improve students' critical thinking skills. So, it was concluded that if the critical thinking skills that students have are low, then it is necessary to improve students' critical thinking skills, namely with the implementation of digital book-assisted PBL models.

Commented [AE2]: Dijelaskan pada poin 1) bahwa indikato KBK yang rendah adalah indikator analisis, mengapa dap menyimpulkan bahwa KBK siswa rendah?, sedangkan indikator lainnya bagaimana?, tolong dijelaskan!

Keywords: PBL, Critical Thinking Skills, Digital Books

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Introduction

According to Jannah, (2020) education is a learning process that is done consciously to develop students' potential, not only in cognitive abilities but also in the ability to self-control demonstrated through attitudes. Many factors are supportive in the education process, one of which is school. The learning process and the components contained in it such as teachers, students, learning objectives, lesson models can determine a success of the Education process (Fitri, 2020). The main goal in the implementation of a learning process in school, which can be one of the references for learners can achieve basic competencies in accordance with the plan that has been made before (Sari et al., 2021).

Physics is an important basis for the development of science and technology (Dewi et al.,

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2021). In the process of physics learners there is usually a root cause in the form of students less interested in the material delivered by the teacher. Students feel that physics is too difficult. This is because at the time of learning, the learning model used by teachers in teaching tends to be the same so it seems boring. Students assume that physics contains only mathematical calculations identical to formulas (Elizabeth & Sigahitong, 2018). According to Badriyah et al, (2021), the process of learning physics emphasizes understanding more than remembering. Therefore, students' critical thinking skills are required as the key to successful understanding of physical concepts.

Thinking is intended that learners can use the knowledge as well as the skills they develop as they learn in new contexts, which means it has not been thought of by learners before but has been taught by teachers (Irwan et al., 2021). Critical thinking enables a person to determine the purpose, relationship, or relationship between things, and consider the decisions to be taken to determine truth and education (Nurussaniah & Ramandha, 2017; Rosmasari & Supardi, 2021). Critical thinking skills have 6 indicators, namely: Analysis, interpretation, inference, explanation, evaluation and self-regulation. However, on indicators of self-planation and self-regulation it is difficult to measure using tests, so this study only uses 4 indicators (Facione, 2011; Hasannah & Suprapto, 2021). Learning models that can teach and develop critical thinking, one of which is PBL (Safitri et al., 2021).

PBL is a learning model that technically provides problems directly or in real life that are used as analyzing materials to find solutions to these problems (Ardeniyansah & Rosnawati, 2018). Problems used in PBL models are problems that are authentic or that arise in the environment (Hidaayatullaah & Dwikoranto, 2019). According to Mangngella, (2021) the PBL model is a learning model that is central to students and which is currently being widely developed. According to Fatma, (2018), the PBL model can be varied by teachers and clarify the flow that will make learners become more understanding and teaching and learning activities in the classroom will be more fun so that learners do not get bored. The application of the PBL model can make students more non-passive and can improve student learning outcomes (Ningrum et al., 2021). Research results (Rahmadani, 2019), The use of PBL can evoke the activeness, motivation, and creativity of students in learning.

Physics learning needs to be packaged using media and must use learning models that can attract students' attention so that the learning runs more fun so that students will not feel bored. (Sulthon et al., 2020). At this time, the development of information and communication (ICT) has had an effect on the world of Education including in the learning process. Digital books are publications in the form of text and images packaged in digital form, in English digital books called e-books (Andina, 2011; Alwan, 2018). E-book as a medium of learning is also very easy to carry everywhere without having to bother when carrying it (Angriani et al., 2020). With this e-book can be a solution so that the learning process is more fun in the classroom. E-books can help to effectively and streamline learning time (Shobrina et al., 2020).

Based on the above problems, researchers conducted research aimed at analyzing the profile of students' critical thinking skills and the application of PBL models based on digital books on physics learning in high school.

Method

The study uses preliminary studies with descriptive research designs and does not test hypotheses. The results of this study will be used as a consideration for the improvement of learning models and learning media that improve students' critical thinking skills in high school.

The study was conducted on 176 students in 5 X classes at one of the high schools in Sidoarjo Regency consisting of 77 male students and 99 female students. The research instruments used in this study are written tests, student response questionnaires, and physics teacher interviews. Written tests are used to find out the results of students' learning in the cognitive realm (Amir et al., 2020). Students' essay test questions amount to 8 questions to estimate critical thinking skills (Dita et al., 2021) about straight motion material equipped with indicators of critical thinking skills. Student questionnaire sheets are used for data collection (Syamsu, 2020) shared through google form with 10 statements. The teacher interview contains 7 questions that can explain the conditions related to the physics learning process in school. Interview conducted to explore information about the situation of physics learning (Napaswati, 2020). The information sought is whether it has been applied PBL models to improve students' critical thinking skills and teachers opinions regarding PBL models based on digital books.

The data analysis technique used in this study is a qualitative descriptive technique (Tiswarni, 2019) to describe how the situation is compatible with the facts that exist. The methods used in this study will be shown in **Figure 1.**

Commented [AE3]: Tuliskan sumbernya!

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Commented [AE5]: Tuliskan nama sekolahnya!

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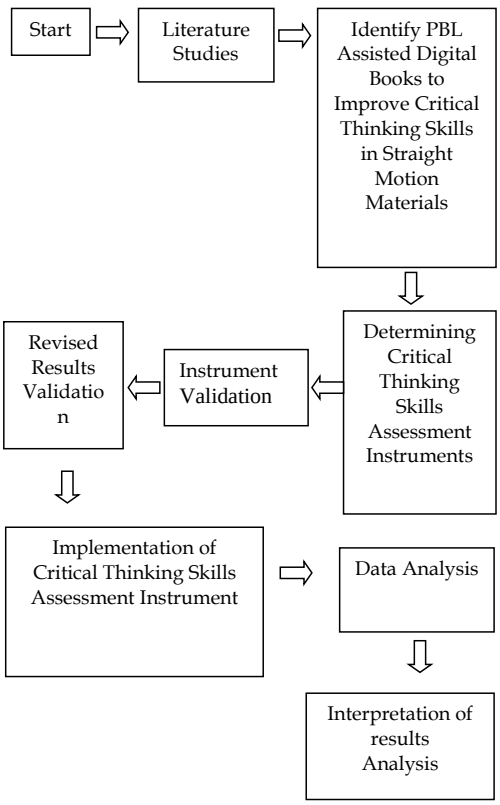


Figure 1. Research Methods

Result and Discussion

This research was conducted to find out how the level of critical thinking skills of students is done by testing using a written test tool consisting of 8 essay test questions that correspond to 4 indicators of critical thinking ability, among others: Interpretation, analysis, inference, and evaluation. That way students are expected to be able to interpret, analyze questions, make conclusions, and evaluate according to the question instrument. Based on the research that has been carried out, it is obtained the results of students' thinking skills in straight motion material by using the PBL model using Facione indicators such as in **Figure 2.**

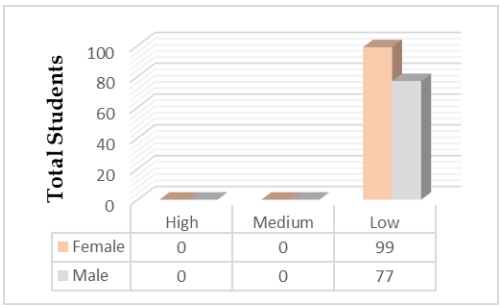


Figure 2. Critical Thinking Skills Category

Figure 2, it was obtained from 176 students with low categories, 99 of whom were women and the remaining 77 were men. No student scores in medium and high categories.

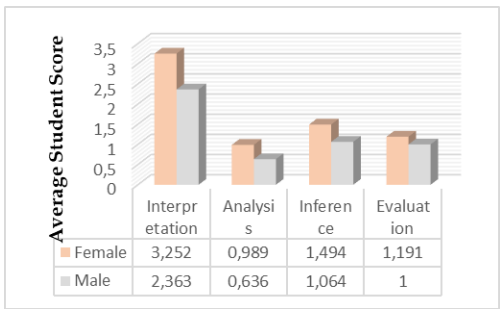
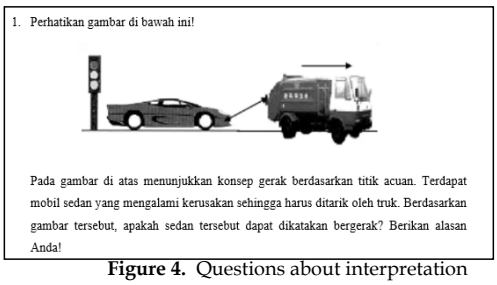


Figure 3. Students' average results based on critical thinking indicators

Figure 3, average critical thinking skills by gender showed a significant difference. It can also be known, if the average indicator of the highest critical thinking is an interpretation indicator that shows students can understand, explain, and give reasons in the problem. While the average of the lowest critical thinking indicator is an analysis so that it can be known if the student has not been able to analyze the steps of using the formula correctly to answer questions.

The examples of questions and answers of students to the critical thinking skills essay test of each indicator, namely achievement, inference, analysis and evaluation are as follows:

1. Interpretation


1. Perhatikan gambar di bawah ini!

Pada gambar di atas menunjukkan konsep gerak berdasarkan titik acuan. Terdapat mobil sedan yang mengalami kerusakan sehingga harus ditarik oleh truk. Berdasarkan gambar tersebut, apakah sedan tersebut dapat dikatakan bergerak? Berikan alasan Anda!

Figure 4. Questions about interpretation indicators

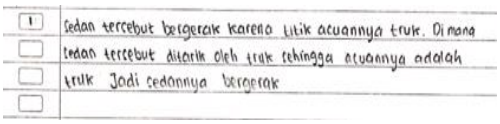


Figure 5. Student answers on interpretation indicators

Figure 5, students are asked to understand, explain, and give reasons about motion. However, the student's answer has not been correct in understanding about motion. The correct answer should be that the sedan car will be said to move if the reference point is the traffic light, while the sedan car will be silent if the reference point is a truck. This is because when the car is towed by the truck, the sedan will change position to the traffic lights and not change positions against the truck.

2. Analysis

5. Jaemin dan Jeno adalah dua sahabat baik. Mereka adalah mahasiswa berasal dari dua daerah yang berbeda dan sedang menyelesaikan studi di sebuah kampus ternama di Surabaya. Suatu hari Jaemin dan Jeno berniat untuk pulang kampung. Jika kampung halaman Jaemin membutuhkan waktu 4 jam sampai bagi sebuah bus yang bergerak dengan kecepatan konstan 60 km/jam. Berapa jam Jeno akan sampai di kampung halaman jika ia harus melanjutkan perjalanan sejauh 120 km lagi.

Figure 6. Questions about analytical indicators

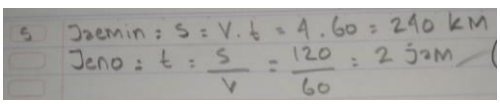


Figure 7. Student answers on analytical indicators

Figure 7, students are asked to analyze Jeno's time to arrive at his hometown. From the student's answer, it can be seen that the answer only meets one element, namely the distance of Jaemin's hometown, while for the travel time Jeno is wrong. The correct answer is that after knowing the distance of Jaemin's hometown, it needs to be summed up with the remaining distance of Jeno's hometown. Jeno's hometown mileage is 240 Km + 120 Km = 360 Km. So, the time it takes Jeno to get to his hometown is:

$$t = \frac{s}{v} \ldots\ldots (1)$$

$$t = \frac{120}{60} \ldots\ldots (2)$$

$$t = 6\,hour$$

So, the time it takes Jeno to get to his hometown is 2 hours.

3. Inference

2. Di jalan Ponti, terdapat dua mobil yang bergerak pada suatu lintasan yang lurus. Mobil merah bergerak secara GLB sedangkan mobil hitam bergerak secara GLBB. Menurut Anda, bagaimanakah perubahan kecepatan yang dialami gerak mobil? Serta mobil manakah yang akan tiba terlebih dahulu di tempat tujuan? Ambil kesimpulan berdasarkan kejadian tersebut!

Figure 8. Questions about the inference indicator

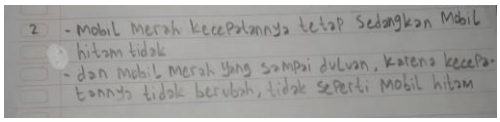


Figure 9. Student answers on inference indicators

Figure 9, students are asked to understand and conclude related GLB and GLBB. From the answer, students assume if the red car will arrive first compared to the black car, the student also does not conclude the answer. The correct answer is a black car, because the red car moves GLB so it has a fixed speed while the black car moves in GLBB so that the speed will change. If the speed of the black car changes even greater, then the black car will run ahead of the red car and will arrive first. The conclusion is that the GLB will have a constant speed, while the GLBB speed will vary.

4. Evaluation

7. Haechan mengendarai sepeda motornya dengan kecepatan sebesar 54 km/jam. Tiba-tiba Haechan melihat terdapat kubangan di tengah jalan pada jarak 30 m di mukanya. Jika sepeda motor Haechan direm dengan perlambatan maksimum 5 m/s2. Maka peristiwa apa yang akan terjadi?

Figure 10. Questions about evaluation indicators

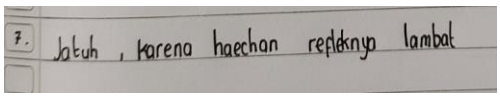


Figure 11. Student answers on evaluation indicators

Figure 11, students were asked to evaluate the distance between Haechan and the puddle if braking with a maximum deceleration of 5 m/s². However, students' answers do not count them, using only logic so that the answer is wrong. The correct answer is that students must count first, as follows:

$$v_t^2 = v_0^2 - 2as$$

$$0 = 15^2 - 2.5.s$$

$$s = 22{,}5\ m$$

Because Haechan's motorcycle has stopped at a distance of 22.5 m, it means that Haechan's motorcycle will not fall in the puddle. Because this event is a slowing event in straight motion changes in order.

Student Response Questionnaire

To find out the response to the critical thinking skills test, a questionnaire containing 10 statements about the student's physics learning experience and teacher delivery during the physics learning process. Students are given the choice of Strongly Disagree (SD), Disagree (D), Agree (A), and Strongly Agree (SA). Here are the results of the student response from the questionnaire that has been shown in **Table 1.**

Table 1. Student questionnaires related to critical thinking skills

No.	Statement	Percentage (%)			
		Strongly Disagree (SD)	Disagree (D)	Agree (A)	Strongly Agree (SA)
1.	Boring physics subjects	12% (21)	51% (89)	31% (55)	6% (11)
2.	Straight motion material is important to learn	1% (1)	13% (22)	52% (92)	35% (61)
3.	Straight motion material is difficult to learn	3% (5)	38% (66)	51% (89)	9% (16)
4.	Straight motion material is easy to understand	5% (9)	45% (79)	44% (78)	6% (10)
5.	I often ask if I don't understand the material delivered by the teacher.	10% (18)	37% (65)	39% (69)	14% (24)
6.	Critical thinking skills are important in physics learning	0% (0)	11% (19)	39% (69)	50% (88)
7.	I've done learning activities to improve critical thinking skills.	3% (6)	26% (45)	48% (84)	23% (41)
8.	I've been trained with critical thinking skills tests.	5% (9)	28% (49)	48% (85)	19% (33)
9.	Critical thinking skills tests are difficult to do.	3% (5)	27% (47)	51% (89)	20% (35)
10.	I am interested in using digital books in physics learning.	8% (14)	27% (48)	41% (73)	23% (41)

Table 1, students disagree if physics subjects are boring. The student's next statement agrees that straight motion material is important to learn. However, students find that straight motion material is difficult to learn. Students often ask if they lack understanding of the material delivered by the teacher.

Students strongly agree that critical thinking skills on physics are important. Students have undertaken activities to improve critical thinking skills and have been trained on critical thinking skills tests. That way, students are interested in using digital books in physics learning. The use of media for a learning model is considered important (Laskaryani et al., 2020).

Teacher Interview

Analysis with physics subject teachers consists of 10 questions related to the condition of physics

learning in school. Teachers say that critical thinking skills activities are once trained to students by providing basic questions related to current events or phenomena, and students will analyze. Teachers also say that critical thinking skills are important to improve because physics learning is closely related to everyday life and teachers say that all lessons require critical thinking. The methods that teachers use in physics learning in school are different from matter. There is material that must be practiced and some that are not. Teachers also incorporate lecture methods and also provide a medium for students' understanding. The teacher also provides a video explanation of the material for the physics learning process in school. The school has implemented *Merdeka Belajar*, the obstacle obtained is a reference book as a medium of learning students are still of quite low quality. Must adapt to new time management in the learning process that makes the teacher must manage his time well so that learning remains well implemented.

Teachers say they prefer face-to-face learning to online. This is because students will be more active if learning is done face-to-face, if online students become passive. However, the teacher also said that some students are also still passive at the time of physics learning. Teachers say that students' grades are better if learning is done online rather than face-to-face. Research by Putri, (2021) mentions that students are still passive in responding to learning that at the time responds to learning provided by teachers. Teachers never use PBL models with digital book-aided to improve students' critical thinking skills. This is because teachers never make digital books so it is considered ineffective in learning. Therefore, teachers should replace the lecture learning model with the PBL model.

Table 2. Relevant research in

No.	Author	Research Purposes	Research Result
1.	(Rosmasari & Supardi, 2021)	Improve learners' critical thinking skills by applying PBL learning models to business and energy materials.	PBL learning model on Business and Energy material physics lessons is able to improve learners' critical thinking skills.
2.	(Windari & Yanti, 2021)	Improve the ability to think critically in physics learning using PBL models.	This study uses this type of classroom action research. By incorporating aspects of critical thinking skills, it can improve the critical thinking skills of static fluid principal learners.
3.	(Latifah et al., 2020)	Knowing the feasibility of e-modules, responses, learning outcomes of learners to e-modules results in improving students' critical thinking skills.	This research uses e-modules with kvisoft flipbook maker applications to improve learners' critical thinking skills. Development produces products in the form of e-module teaching materials with kvisoft flipbook applications good enough so that they are worth using in learning.
4.	(Lawut et al., 2019)	Know the feasibility of the PBL-based Physics IPA module on the straight motion subject developed and the effectiveness of the modules developed in improving students' critical thinking skills.	PBL-based Physics IPA module on straight motion subjects developed is worth using from expert research. PBL-based Physics IPA module developed effectively enhances students' critical thinking skills.
5.	(Syafitri et al., 2019)	Producing teaching materials in the form of HOTS-oriented e-modules and knowing the validity level of e-modules.	HOTS-oriented e-modules on heat matter and kinetic gas theory in class XI SMA/MA were declared valid after validity tests by experts. So, e-modules are worth using in the learning process.
6.	(Aripin et al., 2021)	Know the effectiveness of PBL teaching materials to improve effective and efficient problem solving and students' critical thinking skills.	Physics learning tools based *on* PBL models effectively fan efficient to improve problem-solving skills and critical thinking skills learners.
7.	(Sitanggang & Nasution,	Knowing the ratio of improved	The achievement of the results of

No.	Author	Research Purposes	Research Result
	2018)	students' critical thinking skills in static fluids between classes using PBL and conventional models in students.	knowledge of static fluid material students are influenced by how the teacher in carrying out the model PBL.
8.	(Yulianti & Gunawan, 2019)	Knowing the effectiveness of PBL models on understanding concepts and critical thinking of high school learners on temperature and temperature materials heat.	The PBL model can improve students' concept understanding and critical thinking.
9.	(Nurhayati et al., 2019)	Know the effect of applying the PBL model, its critical thinking skills and its interactions on high-level thinking skills on optics.	The application of the PBL model can improve understanding and improve critical thinking skills.
10.	(Karmila et al., 2019)	Knowing the influence of multiple-representation shorting PBL on students' critical thinking skills and process science skills on business materials and energy.	PBL implementation can improve critical thinking skills shown in the results of the gain test analysis by 56%.
11.	(Cahyono & Dwikoranto, 2021)	Describe the application of the PBL model as well as the implications for improving critical thinking skills.	Implementation of the PBL model was able to improve students' critical thinking skills according to the experimental class n-gain score of 0.58 and control class by 0.31.
12.	(Tanti et al., 2020)	Construct, validate, and analyze the effectiveness of PBL-based physics teaching materials to improve students' generic skills.	The use of PBL-based teaching materials can improve students' generic skills especially on critical thinking and problem-solving skills.
13.	(Santuthi et al., 2020)	Describe and explain the role of PBL on students' problem-solving and critical thinking skills.	Students experience an increase in critical thinking using the PBL model.
14.	(Herdianto et al., 2021)	Develop mobile learning-based digital books with the implementation of PBL models to improve problem-solving capabilities.	The use of PBL-based e-books knows validity, is practical, and effective.
15.	(Santyasa et al., 2019)	Analyzing PBL through DI's critical thinking skills is reviewed from social attitudes.	The use of the PBL model is superior to the DI model in achieving students' critical thinking skills in physics learning.

Table 2, proving that the application of the PBL model has a positive response to the understanding of student and student concepts, student learning outcomes, student problem solving, and students' critical thinking skills. Then, the implementation of digital books on the PBL model can be used as one of the effective, efficient, practical, and feasible learning innovations in physics. From previous research conducted by Rohmah, (2021), it is said that there is a good change due to the application of PBL to students' critical thinking skills.

Conclusion

From the results of the study using preliminary research methods that have been implemented, it was concluded that: 1) The lowest criteria for critical thinking skills of students were found in the analysis indicator with an average score of 0.989 in female students and 0.636 in male students. 2) Students' critical thinking skills belong to the low category, the score range of 0-45 as many as 99 female students and 77 male students and no students who belong to the medium and high categories. 3) The implementation of digital book-assisted PBL is expected to improve students' critical thinking skills. So, it was concluded that if the critical thinking skills that students have are low, then it is necessary to improve students' critical thinking skills, namely with the implementation of digital book-assisted PBL models.

Commented [AE7]: Tidak dijelaskan penerapan PBL berban buku digital di sekolah yang diteliti ini,namun ada kesimpulan. Dilihat Kembali dalam pembahasannya!

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Profile of Students' Physics Critical Thinking Skills and Application of Problem Based Learning Models Assisted by Digital Books in Physics Learning in High School

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Abstract: This research aims to analyze the profile of students' critical thinking skills and the application of Problem Based Learning (PBL) models based on digital books on physics learning in high school. This research method is a preliminary study with data collection techniques in the form of written tests whose data results will be analyzed descriptively qualitatively. The study was conducted on 176 students consisting of 77 male students and 99 female students. in 5 classes X MIPA at one of the State High Schools in Sidoarjo Regency. It was concluded that: 1) The lowest criteria for critical thinking skills of students were found in the analysis indicator with an average score of 0.989 in female students and 0.636 in male students. 2) Students' critical thinking skills belong to the low category, the score range of 0-45 as many as 99 female students and 77 male students and no students who belong to the medium and high categories. In this study, the application of digital book-assisted PBL is expected to improve students' critical thinking skills. So, it was concluded that if the critical thinking skills that students have are low, then it is necessary to improve students' critical thinking skills, namely with the implementation of digital book-assisted PBL models.

Keywords: PBL; Critical thinking skills; Digital books

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Introduction

According to Jannah, (2020) education is a learning process that is done consciously to develop students' potential, not only in cognitive abilities but also in the ability to self-control demonstrated through attitudes. Many factors are supportive in the education process, one of which is school. The learning process and the components contained in it such as teachers, students, learning objectives, lesson models can determine a success of the Education process (Fitri, 2020). The main goal in the implementation of a learning process in school, which can be one of the references for learners can achieve basic competencies in accordance with the plan that has been made before (Sari et al., 2021).

Physics is an important basis for the development of science and technology (Dewi et al., 2021). In the process of physics learners there is usually a root cause in the form of students less interested in the material delivered by the teacher (Lutfiana et al., 2021). Students feel that physics is too difficult. This is because at the time of learning, the learning model used by teachers in teaching tends to be the same so it seems boring. Students assume that physics contains only mathematical calculations identical to formulas (Elizabeth & Sigahitong, 2018). According to Badriyah et al, (2021), the process of learning physics emphasizes understanding more than remembering. Therefore, students' critical thinking skills are required as the key to successful understanding of physical concepts.

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Thinking is intended that learners can use the knowledge as well as the skills they develop as they learn in new contexts, which means it has not been thought of by learners before but has been taught by teachers (Irwan et al., 2021). Critical thinking enables a person to determine the purpose, relationship, or relationship between things, and consider the decisions to be taken to determine truth and education (Nurussaniah & Ramandha, 2017; Rosmasari & Supardi, 2021). Critical thinking skills have 6 indicators, namely: Analysis, interpretation, inference, explanation, evaluation and self-regulation. However, on indicators of self-planation and self-regulation it is difficult to measure using tests, so this study only uses 4 indicators (Facione, 2011; Hasannah & Suprapto, 2021). Learning models that can teach and develop critical thinking, one of which is PBL (Safitri et al., 2021).

PBL is a learning model that technically provides problems directly or in real life that are used as analyzing materials to find solutions to these problems (Ardeniyansah & Rosnawati, 2018). Problems used in PBL models are problems that are authentic or that arise in the environment (Hidaayatullaah & Dwikoranto, 2019). According to Mangngella, (2021) the PBL model is a learning model that is central to students and which is currently being widely developed. According to Fatma, (2018), the PBL model can be varied by teachers and clarify the flow that will make learners become more understanding and teaching and learning activities in the classroom will be more fun so that learners do not get bored. The application of the PBL model can make students more non-passive and can improve student learning outcomes (Ningrum et al., 2021). Research results (Rahmadani, 2019), The use of PBL can evoke the activeness, motivation, and creativity of students in learning.

Physics learning needs to be packaged using media and must use learning models that can attract students' attention so that the learning runs more fun so that students will not feel bored. (Sulthon et al., 2020). At this time, the development of information and communication (ICT) has had an effect on the world of Education including in the learning process. Digital books are publications in the form of text and images packaged in digital form, in English digital books called e-books (Andina, 2011; Alwan, 2018). E-book as a medium of learning is also very easy to carry everywhere without having to bother when carrying it (Angriani et al., 2020). With this e-book can be a solution so that the learning process is more fun in the classroom. E-books can help to effectively and streamline learning time (Shobrina et al., 2020).

Based on the above problems, researchers conducted research aimed at analyzing the profile of students' critical thinking skills and the application of PBL models based on digital books on physics learning in high school.

Method

The study uses preliminary studies with descriptive research designs and does not test hypotheses, but used a descriptive research design. The results of this study will be used as a consideration for the improvement of learning models and learning media that improve students' critical thinking skills in high school.

The study was conducted on 176 students in 5 X classes at one of the high schools in Sidoarjo Regency consisting of 77 male students and 99 female students. The research instruments used in this study are written tests, student response questionnaires, and physics teacher interviews. Written tests are used to find out the results of students' learning in the cognitive realm (Amir et al., 2020). Students' essay test questions amount to 8 questions to estimate critical thinking skills (Dita et al., 2021) about straight motion material equipped with indicators of critical thinking skills. Student questionnaire sheets are used for data collection (Syamsu, 2020) shared through google form with 10 statements. The teacher interview contains 7 questions that can explain the conditions related to the physics learning process in school. Interview conducted to explore information about the situation of physics learning (Napaswati, 2020). The information sought is whether it has been applied PBL models to improve students' critical thinking skills and teachers opinions regarding PBL models based on digital books.

The data analysis technique used in this study is a qualitative descriptive technique (Tiswarni, 2019) to describe how the situation is compatible with the facts that exist. Figure 1. demonstrate the method flow procedures used regarding the profile of students' critical thinking skills and the application of digital book-assisted PBL models in physics learning in high school.

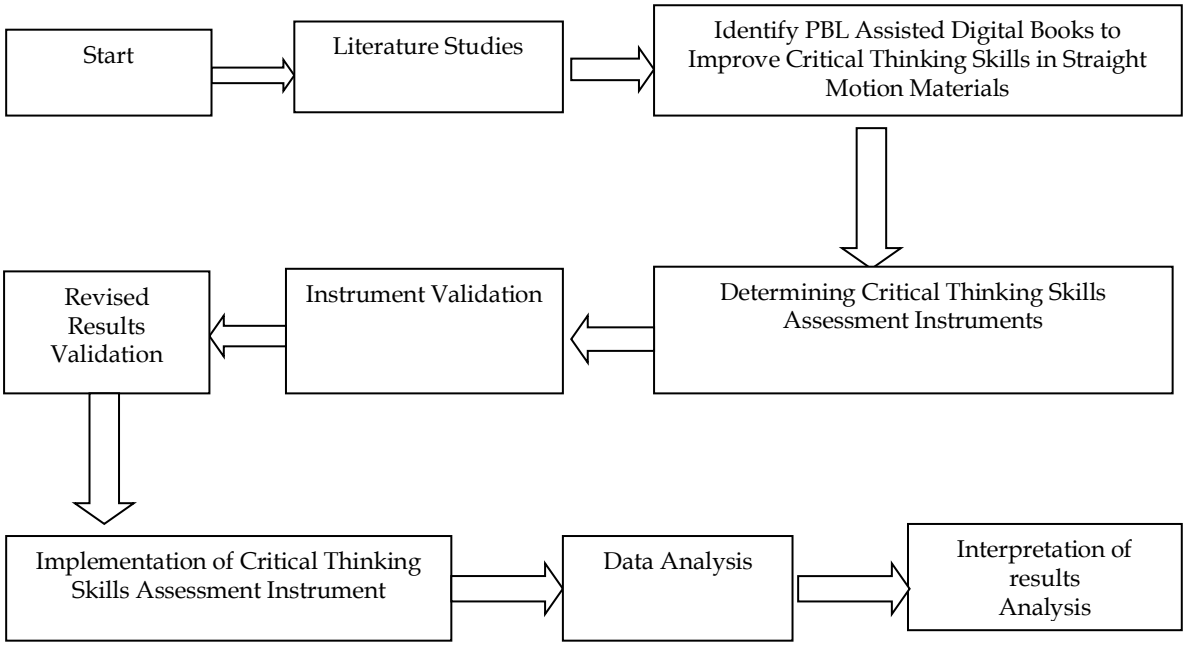

Figure 1. Research Methods.

Result and Discussion

This research was conducted to find out how the level of critical thinking skills of students is done by testing using a written test tool consisting of 8 essay test questions that correspond to 4 indicators of critical thinking ability, among others: Interpretation, analysis, inference, and evaluation. That way students are expected to be able to interpret, analyze questions, make conclusions, and evaluate according to the question instrument. Based on the research that has been carried out, it is obtained the results of students' thinking skills in straight motion material by using the PBL model using Facione indicators such as in Figure 2.

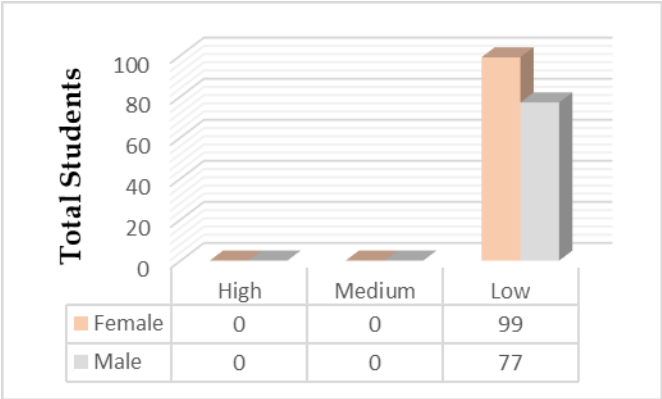

Figure 1. Critical Thinking Skills Category

Figure 2, it was obtained from 176 students with low categories, 99 of whom were women and the remaining 77 were men. No student scores in medium and high categories.

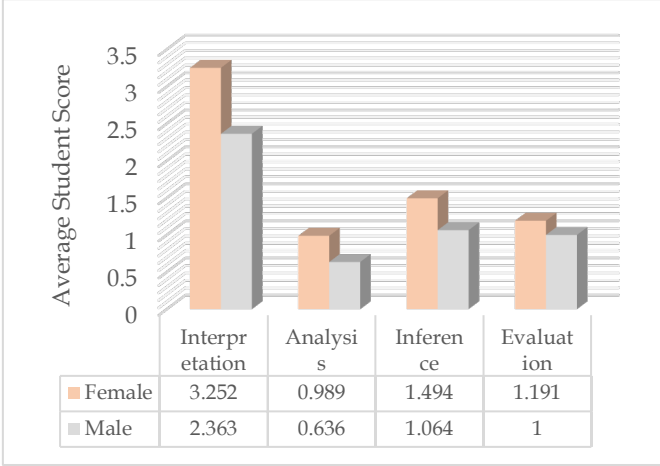

Figure 3. Students' average results based on critical thinking indicators

Figure 3, average critical thinking skills by gender showed a significant difference. It can also be known, if the highest average indicator of critical thinking is an interpretation indicator that shows students can understand, explain, and give reasons in the problem. The second highest average is inference and then followed by evaluation. While the average of the lowest critical thinking indicators is an analysis so that it can be known if students have not been able to analyze the steps of using the formula correctly to answer questions.

The examples of questions and answers of students to the critical thinking skills essay test of each indicator, namely achievement, inference, analysis and evaluation are as follows:

Interpretation

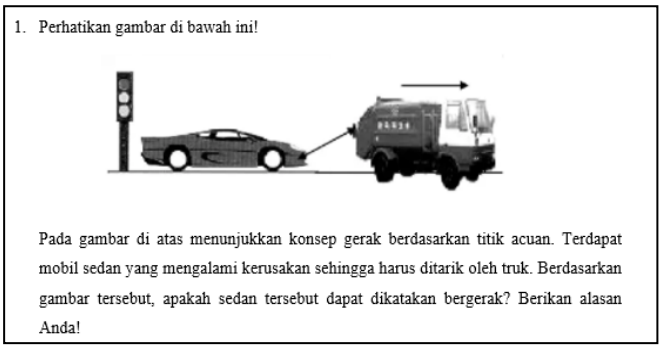

Figure 4. Questions about interpretation indicators

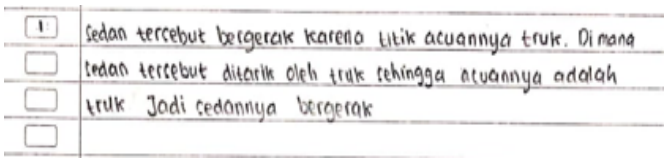

Figure 5. Student answers on interpretation indicators

Figure 5, students are asked to understand, explain, and give reasons about motion. However, the student's answer has not been correct in understanding about motion. The correct answer should be that the sedan car will be said to move if the reference point is the traffic light, while the sedan car will be silent if the reference point is a truck. This is because when the car is towed by the truck, the sedan will change position to the traffic lights and not change positions against the truck.

Analysis

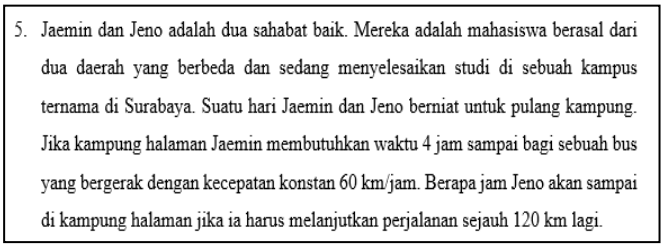

Figure 6. Questions about analytical indicators

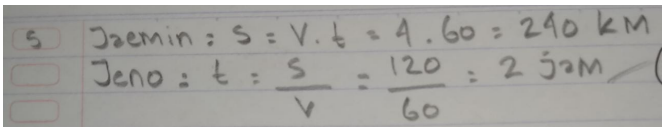

Figure 7. Student answers on analytical indicators

Figure 7, students are asked to analyze Jeno's time to arrive at his hometown. From the student's answer, it can be seen that the answer only meets one element, namely the distance of Jaemin's hometown, while for the travel time Jeno is wrong. The correct answer is that after knowing the distance of Jaemin's hometown, it needs to be summed up with the remaining distance of Jeno's hometown. Jeno's hometown mileage is 240 Km + 120 Km = 360 Km. So, the time it takes Jeno to get to his hometown is:

$$t = \frac{s}{v} \ldots\ldots (1)$$

$$t = \frac{120}{60} \ldots\ldots (2)$$

$$t = 6\,hour$$

So, the time it takes Jeno to get to his hometown is 2 hours.

Inference

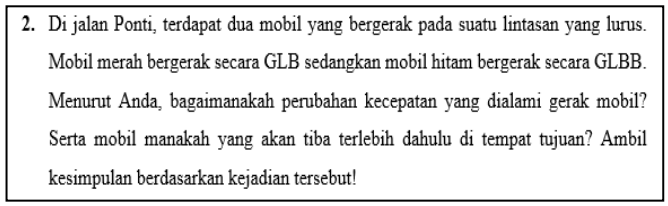

Figure 8. Questions about the inference indicator

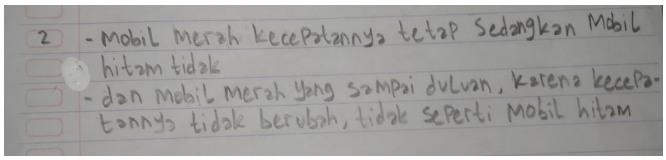

Figure 9. Student answers on inference indicators

Figure 9, students are asked to understand and conclude related GLB and GLBB. From the answer, students assume if the red car will arrive first compared to the black car, the student also does not conclude the answer. The correct answer is a black car, because the red car moves GLB so it has a fixed speed while the black car moves in GLBB so that the speed will change. If the speed of the black car changes even greater, then the black car will run ahead of the red car and will arrive first. The conclusion is that the GLB will have a constant speed, while the GLBB speed will vary.

Evaluation

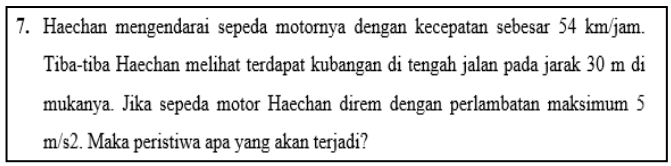

Figure 10. Questions about evaluation indicators

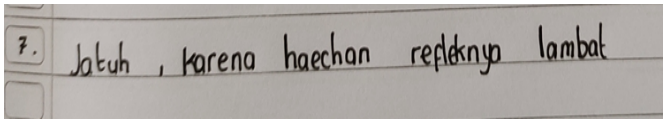

Figure 11. Student answers on evaluation indicators

Figure 11, students were asked to evaluate the distance between Haechan and the puddle if braking with a maximum deceleration of 5 m/s^2. However, students' answers do not count them, using only logic so that the answer is wrong. The correct answer is that students must count first, as follows:

$$v_t^2 = v_0^2 - 2as$$

$$0 = 15^2 - 2.5.s$$

$$s = 22{,}5\,m$$

Because Haechan's motorcycle has stopped at a distance of 22.5 m, it means that Haechan's motorcycle will not fall in the puddle. Because this event is a slowing event in straight motion changes in order.

Student Response Questionnaire

To find out the response to the critical thinking skills test, a questionnaire containing 10 statements about the student's physics learning experience and teacher delivery during the physics learning process. Students are given the choice of Strongly Disagree (SD), Disagree (D), Agree (A), and Strongly Agree (SA). Here are the results of the student response from the questionnaire that has been shown in **Table 1.**

Table 1. Student questionnaires related to critical thinking skills

Statement	Percentage (%)			
	Strongly Disagree (SD)	Disagree (D)	Agree (A)	Strongly Agree (SA)
Boring physics subjects	12% (21)	51% (89)	31% (55)	6% (11)
Straight motion material is important to learn	1% (1)	13% (22)	52% (92)	35% (61)
Straight motion material is difficult to learn	3% (5)	38% (66)	51% (89)	9% (16)
Straight motion material is easy to understand	5% (9)	45% (79)	44% (78)	6% (10)
I often ask if I don't understand the material delivered by the teacher.	10% (18)	37% (65)	39% (69)	14% (24)
Critical thinking skills are important in physics learning	0% (0)	11% (19)	39% (69)	50% (88)
I've done learning activities to improve critical thinking skills.	3% (6)	26% (45)	48% (84)	23% (41)
I've been trained with critical thinking skills tests.	5% (9)	28% (49)	48% (85)	19% (33)
Critical thinking skills tests are difficult to do.	3% (5)	27% (47)	51% (89)	20% (35)
I am interested in using digital books in physics learning.	8% (14)	27% (48)	41% (73)	23% (41)

Table 1, students disagree if physics subjects are boring. The student's next statement agrees that straight motion material is important to learn. However, students find that straight motion material is difficult to learn. Students often ask if they lack understanding of the material delivered by the teacher.

Students strongly agree that critical thinking skills on physics are important. Students have undertaken activities to improve critical thinking skills and have been trained on critical thinking skills tests. That way, students are interested in using digital books in physics learning. The use of media for a learning model is considered important (Laskaryani et al., 2020). At the student's questionnaire, students feel interested in doing learning by using digital books to improve students' critical thinking skills. Digital books contain straight motion related materials and there are questions that will improve students' thinking skills.

Teacher Interview

Analysis with physics subject teachers consists of 10 questions related to the condition of physics learning in school. Teachers say that critical thinking skills activities are once trained to students by providing basic questions related to current events or phenomena, and students will analyze. Teachers also say that critical thinking skills are important to improve because physics learning is closely related to everyday life and teachers say that all lessons require critical thinking. The methods that teachers use in physics learning in school are different from matter. There is material that must be practiced and some that are not. Teachers also incorporate lecture methods and also provide a medium for students' understanding. The teacher also provides a video explanation of the material for the physics learning process in school. The school has implemented *Merdeka Belajar*, the obstacle obtained is a reference book as a medium of learning students are still of quite low quality. Must adapt to new time management in the learning process that makes the teacher must manage his time well so that learning remains well implemented.

Teachers say they prefer face-to-face learning to online. This is because students will be more active if learning is done face-to-face, if online students become passive. However, the teacher also said that some students are also still passive at the time of physics learning. Teachers say that students' grades are better if learning is done online rather than face-to-face. Research by Putri, (2021) mentions that students are still passive in responding to learning that at the time responds to learning provided by teachers. At the time of the interview, the teacher also said that never used the

PBL model with the help of digital books to improve students' critical thinking skills. This is because teachers never make digital books because they are constrained by time. Therefore, teachers must replace the lecture learning model with the PBL model with digital book assisted.

Table 2. Relevant research in

Author	Research Purposes	Research Result
(Rosmasari & Supardi, 2021)	Improve learners' critical thinking skills by applying PBL learning models to business and energy materials.	PBL learning model on Business and Energy material physics lessons is able to improve learners' critical thinking skills.
(Windari & Yanti, 2021)	Improve the ability to think critically in physics learning using PBL models.	This study uses this type of classroom action research. By incorporating aspects of critical thinking skills, it can improve the critical thinking skills of static fluid principal learners.
(Latifah et al., 2020)	Knowing the feasibility of e-modules, responses, learning outcomes of learners to e-modules results in improving students' critical thinking skills.	This research uses e-modules with kvisoft flipbook maker applications to improve learners' critical thinking skills. Development produces products in the form of e-module teaching materials with kvisoft flipbook applications good enough so that they are worth using in learning.
(Lawut et al., 2019)	Know the feasibility of the PBL-based Physics IPA module on the straight motion subject developed and the effectiveness of the modules developed in improving students' critical thinking skills.	PBL-based Physics IPA module on straight motion subjects developed is worth using from expert research. PBL-based Physics IPA module developed effectively enhances students' critical thinking skills.
(Syafitri et al., 2019)	Producing teaching materials in the form of HOTS-oriented e-modules and knowing the validity level of e-modules.	HOTS-oriented e-modules on heat matter and kinetic gas theory in class XI SMA/MA were declared valid after validity tests by experts. So, e-modules are worth using in the learning process.
(Aripin et al., 2021)	Know the effectiveness of PBL teaching materials to improve effective and efficient problem solving and students' critical thinking skills.	Physics learning tools based *on* PBL models effectively fan efficient to improve problem-solving skills and critical thinking skills learners.
(Sitanggang & Nasution, 2018)	Knowing the ratio of improved students' critical thinking skills in static fluids between classes using PBL and conventional models in students.	The achievement of the results of knowledge of static fluid material students are influenced by how the teacher in carrying out the model PBL.
(Yulianti & Gunawan, 2019)	Knowing the effectiveness of PBL models on understanding concepts and critical thinking of high school learners on temperature and temperature materials heat.	The PBL model can improve students' concept understanding and critical thinking.
(Nurhayati et al., 2019)	Know the effect of applying the PBL model, its critical thinking skills and its interactions on high-level thinking skills on optics.	The application of the PBL model can improve understanding and improve critical thinking skills.
(Karmila et al., 2019)	Knowing the influence of multiple-representation shorting PBL on students' critical thinking skills and process science skills on business materials and energy.	PBL implementation can improve critical thinking skills shown in the results of the gain test analysis by 56%.
(Cahyono & Dwikoranto, 2021)	Describe the application of the PBL model as well as the implications for improving critical thinking skills.	Implementation of the PBL model was able to improve students' critical thinking skills according to the experimental class n-gain score of 0.58 and control class by 0.31.
(Tanti et al., 2020)	Construct, validate, and analyze the effectiveness of PBL-based physics teaching materials to improve students' generic skills.	The use of PBL-based teaching materials can improve students' generic skills especially on critical thinking and problem-solving skills.

Author	Research Purposes	Research Result
(Santuthi et al., 2020)	Describe and explain the role of PBL on students' problem-solving and critical thinking skills.	Students experience an increase in critical thinking using the PBL model.
(Herdianto et al., 2021)	Develop mobile learning-based digital books with the implementation of PBL models to improve problem-solving capabilities.	The use of PBL-based e-books knows validity, is practical, and effective.
(Santyasa et al., 2019)	Analyzing PBL through DI's critical thinking skills is reviewed from social attitudes.	The use of the PBL model is superior to the DI model in achieving students' critical thinking skills in physics learning.

Table 2, proving that the application of the PBL model has a positive response to the understanding of student and student concepts, student learning outcomes, student problem solving, and students' critical thinking skills. Then, the implementation of digital books on the PBL model can be used as one of the effective, efficient, practical, and feasible learning innovations in physics. From previous research conducted by Rohmah, (2021), it is said that there is a good change due to the application of PBL to students' critical thinking skills.

Conclusion

From the results of the study using preliminary research methods that have been implemented, it was concluded that: 1) The lowest criteria for critical thinking skills of students were found in the analysis indicator with an average score of 0.989 in female students and 0.636 in male students. 2) Students' critical thinking skills belong to the low category, the score range of 0-45 as many as 99 female students and 77 male students and no students who belong to the medium and high categories. In this study, the application of digital book-assisted PBL is expected to improve students' critical thinking skills. So, it was concluded that if the critical thinking skills that students have are low, then it is necessary to improve students' critical thinking skills, namely by the application of digital book-assisted PBL models.

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