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Profile of PBL Model Assisted by Digital Books to Improve Problem Solving Ability of High School Students on Dynamic Fluids

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Abstract: This research was conducted with the aim of analyzing the problem-solving ability profile of high school students as a consideration in applying the Problem Based Learning (PBL) model based on digital books on Dynamic Fluids. The survey method used is a preliminary survey method. Data collection techniques for written exams, questionnaires, and interviews with teachers and students. This research was conducted in Gresik district with a total of 143 high school students from 5 classes in class XI, there were 78 boys and 67 girls. This study was conducted in the even semester of 2020/2021. Written test data were analyzed descriptively qualitatively. From the results of research based on problem-solving abilities that were tested on 143 students in the low category with a range of 0-40 as many as 133 students consisting of 76 men and 58 women. Medium category with a range of 41 – 70 as many as 9 students consisting of 0 boys and 9 students. While the High category with a range of 71 - 100 as many as 1 student, namely 1 female. Applying PBL techniques will improve students' problem-solving skills. Therefore, it can be concluded that in order to improve students' problem-solving skills, they need updates in learning, such as the application of an attractively packaged PBL learning model that is adapted to the current learning era.

Keywords: PBL; Digital Books; Dynamic fluids; Problem solving skills

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Introduction

Education is a change in human behavior and thinking through formal levels provided by the government. (Pratiwi et al., 2019). Education is an important element in supporting national development through the formation of superior human resources (Hartini Ti and Martin, 2020). The success of an education cannot be separated from the learning process in schools. Therefore, together with families and communities, schools are one of the leading education providers in all educational organizations (Makiyah et al., 2021).

Learning is one way to add insight to new knowledge. In addition, learning is a new realm that occurs when students interact with their environment. (Wahyuningsih et al., 2021). The learning process can be carried out when there is a process of interaction between teachers and students. In the learning process in class, teachers often use the lecture method which makes students feel bored and sleepy. The use of the lecture method is less effective, especially in physics subjects that require more practice and practicum in order to understand the material being taught.

People in the Industrial Revolution Era 4.0 which led to Society 5.0 (society 5.0) are required to have higher order thinking skills (HOTS) (Saputra, 2019). Improve problem solving ability one part of HOTS (High Order Thinking Skills). According to Yuliantaningrum and Sunarti (2020) problem solving (problem solving) is the last part in higher-order thinking by linking critical and creative thinking to get the right end result. PBL requires students to solve problems by digging up as much information as possible and needs HOTS thinking (Sunaryoa et al., 2020). According to (Sofan Amri, et al 2020), there are several benefits that students get in improving problem solving

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skills, including: 1) students are trained to explore, reason logically, and think comprehensively, 2) students can develop communication skills and form values – social values through group work, 3) Helping students with low achievement to understand concepts and proficient in learning.

There are 5 indicators for solving student problems, namely ACCES (A, namely Assen the problem. C, namely Create the drawing. C, namely Conceptualizing the strategy. E, namely Execute the solution. S, namely Scrutinize your result). In Indicator A students are expected to be able to identify the principles of the problem contained in the problem, therefore students can solve problems using predetermined principles. For indicator C, students are expected to be able to explain the phenomenon of the question in the form of images, this is done to find out how well students understand the questions. In the next indicator, namely C, Students are expected to be able to formulate steps in a systematic way to facilitate the problem-solving process. In Indicator E, students are expected to be able to work on questions using the steps specified in the previous indicator. And in the last indicator, namely S, students can explain the reasons for the answers that have been written in the sure and not sure categories and the reasons that support the statement.

One of the learning models that can be used so that students understand more about physics material is PBL. The PBL model is a learning model that shows students about real problems that occur in the environment around us, so that students not only have material knowledge but can practice it themselves (Yuliani, 2021). In line with Yuliani, et al. PBL is giving problems related to students' daily lives, then students in groups look for alternative solutions to these problems. According to Suharni & Rahmatsyah (2020) the PBL model has an influence on students' problem abilities. PBL model is a learning approach that raises contextual questions and deepens understanding of the subject (Aisyah et al., 2021). Students learn how to construct problems, organize and research problems, collect and analyze data, sort facts, build problem discussions, individually or collectively to solve problems (Nora et al., 2020).

Technology is growing rapidly, so the learning media used must be in accordance with the times (Alwan, 2018). The use and development of technology-based learning media must be carried out by teachers in the learning process so that they are relevant to the times (Handayani et al., 2021). Books as one of the main learning media used by teachers and students. Books as learning media should facilitate and attract students' interest in mastering learning material (Yuyun et al ., 2021). Teaching materials that were originally in the form of print can be changed to digital form, such as one of them is an electronic book which is often called an e-book. Ebooks are books using digital technology (GE's daughter & Festiyed, 2019). The choice of digital books is because technological advances have also penetrated the world of education. Problem solving-based digital books are one type of teaching material Used to assist teachers in conducting learning activities in the classroom and laboratory (Carlina et al., 2021). The advantages of digital books themselves are that they can be used anywhere, very easy to use, efficient, practical. We can make digital books with the PBL learning model with the hope that students can understand the Dynamic Fluids material that we will convey in digital books, and this digital book learning media is expected to improve problem solving abilities of high school students. From the problems that have been presented above, this research aims to analyze the problem-solving ability profile of high school students as a consideration in the application of the PBL model with digital books on Dynamic Fluids.

Method

This research is essentially a descriptive preliminary study because it does not test the hypothesis. This study uses a qualitative descriptive approach, namely an approach that tries to understand the individual meaning of the subject being studied (Deno et al., 2020). The basis for selecting qualitative data is giving high, medium, and low categories to research respondents (Hijriani & Hatibe, 2021). The results of the research that have been obtained, will later be considered in the application of learning models and media that can improve students' ability to solve problems in high school physics problems.

In testing students' problem solving skills, 5 questions are presented and each question uses the ACCES method, namely (A is a Assen the problem, C is a Create a drawing, C is a Conceptualize the strategy, E is a Execute the solution, S is a -Scritinize your result) (Rachmawati et al., 2021). In addition, we also collected data in the form of a questionnaire containing 11 statements which aimed to determine student responses after working on problem-solving ability questions and to find out learning models and media that students often used during the learning process. The questionnaire used has been tested for validity and reliability.

In addition, there were interviews with students and teachers The aim is to obtain detailed information about the teaching and learning process in the classroom, and what learning media have been used, as well as the models used during the learning process. And students' interest in using digital books as learning media. This research was conducted in one of the public high schools in Gresik district with a total of 143 students from 5 classes in class XI, there were 78 boys and 67 girls. This research was conducted in the even semester of the 2020/2021 semester. Data analysis techniques utilize the results of problem solving ability tests, questionnaires, and interviews with physics subject teachers. The data analysis method used in

this study is a qualitatively descriptive method for explaining a particular situation based on existing facts. The following are the steps used in the research in Figure 1.

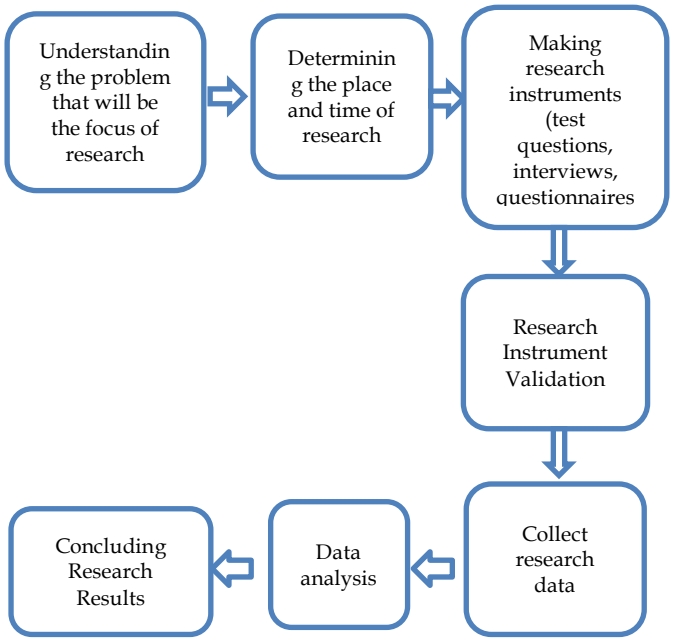

Figure 1. Research Method

Result and Discussion

Physics problem solving ability test

Problem solving skills in physics require a fairly high level of reasoning. Every student has a different way of solving problems. In this study, 5 questions were presented to test the ability to solve physics problems on dynamic fluid materials. The test answer sheet is equipped with a problem-solving ability indicator, namely ACCES. And students must work on the questions that have been provided based on the instructions that have been listed. After doing the research, the results of the ability to solve physics problems are obtained **Figure 2.**

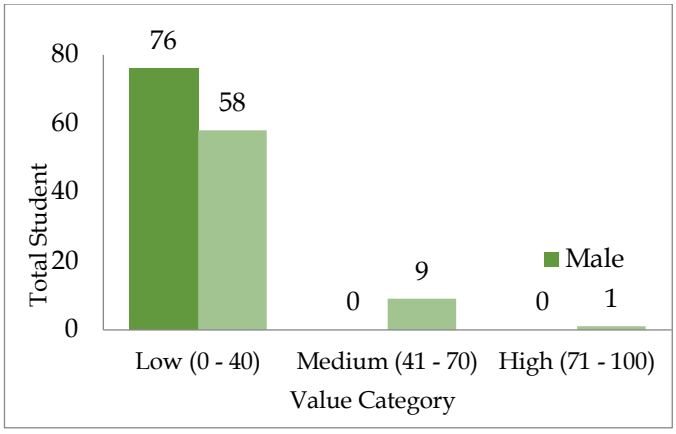

Figure 2. The relationship between the number of students and ACCES Category Class

Figure 2 shows the results of students who are divided into several categories, namely Low (0-40), Medium (41-70), and High (71-100). These results were obtained from scoring on 5 questions based on the ACCES problem-solving ability indicator. One question has a total score of 20 with each indicator worth 4, so the maximum score on the 5 questions is 100. In the graph it can be observed that there are 133 students in the high category, 9 students in the medium category, and 1 student in the high category.

From Figure 2, we can see that on average students are not able to and many have difficulty in solving problems based on problem solving indicators. Of the 5 questions that have been presented, students cannot answer the questions using the ACCES problem solving indicator. This is because students are still not used to solving questions using the ACCES indicator. In addition, the 5 questions presented used HOTS (High Order Thinking Skills) questions which made it more difficult for students to work on the questions presented. The following is presented which indicators are better understood by students and what indicators are not understood by students. It can be observed in Figure 3.

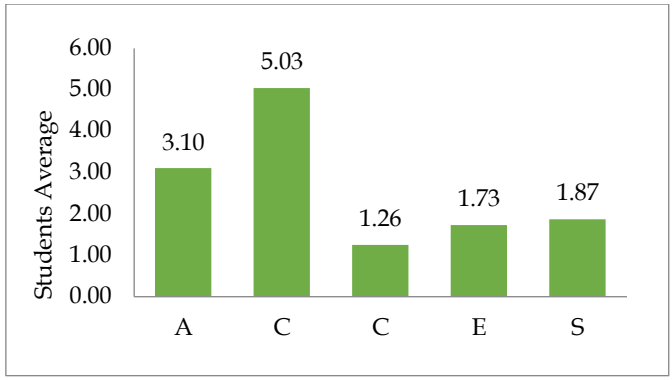

Figure 3 , Average student score for each indicator of problem-solving skills

From Figure 3, the average of 143 students, the highest indicator is the indicator C-(Create a Drawing), while the indicator with the lowest average value of 143 students is the indicator C- (Conceptualize the strategy), which explains that students have not been able to determine the formula and the steps that must be taken in solving the problem. Indicator C which aims to conceptualize the strategy becomes the lowest value, meaning that students have not been able to find the principles of the problem that will be used to solve the problem (Zamil, MRR, et al. 2021).

These results were obtained from the analysis of students' responses to the ACCES problem solving indicators which include:

1. A- Assen The Problem (Identify the problem principles needed to solve the problem). In this first indicator, students identify what problem principles should be used to solve problems and this indicator

also aims to determine students' ability to identify problem principles.

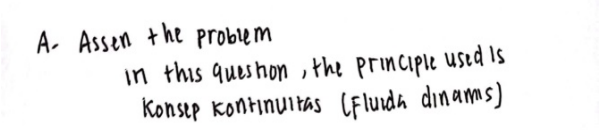

Figure **4** , Example of student answers on Indicator A (Assen the problem)

From the picture above, students are able to identify the principles contained in the questions, but the answers written by students are still wrong, due to lack of thoroughness and understanding of the questions.

2. *C- (*Create the Drawing*)* (Translate words in the form of pictures or pictures that provide troubleshooting instructions). In this second indicator, students are required to be able to translate the sentence into a question into an image form accompanied by a description of the question. The following is an example in **Figure 5**.

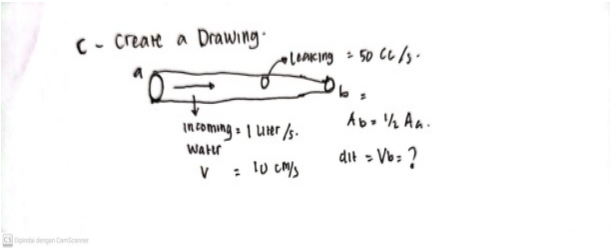

Figure 5 . Example of student answers on indicator C (Create A drawing)

From Figure 5, it is known that students have been able to translate the sentences in the questions in the form of pictures and information that has been written on the pictures.

3. *C - (* Conceptualize the strategy*)* (Please explain the steps used in solving the problem) In this indicator students must describe the steps so that the problem can be solved . The following is an example of an answer in **Figure 6.**

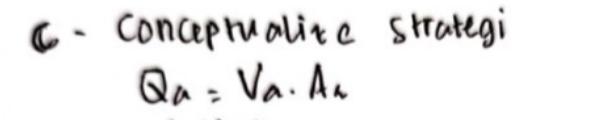

Figure 6. Example of student answers on indicator C (Conceptualize the strategy)

From Figure 6, it can be analyzed that students have been able to determine the formula that must be used, but the student was unable to explain the steps to solve the problem in question.

4. *E-(Execute the solution)* (Apply the formula to solve the problem). In the fourth indicator, students are expected to be able to solve problems with known models, asked and answered and using the formulas that have been determined in the previous indicator. The following is an example of an answer in Figure 7.

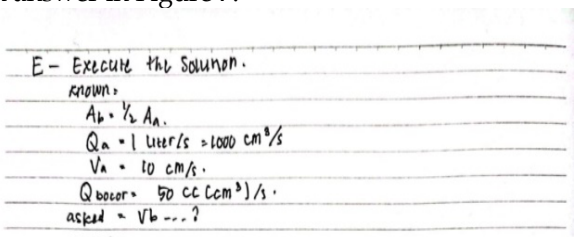

Figure 7. Example of student answers on indicator E (Execute the solution)

In Figure 7 students have not been able to apply the formula to answer questions, and in this indicator most students only write what they already know.

5. S (scrutinize the result) (Are you sure about the answer?) The last indicator needs to show the level of confidence for the answer described in the previous indicator in the problem-solving process for four reasons. I have question. The following is an example of a response in **Figure 8**.

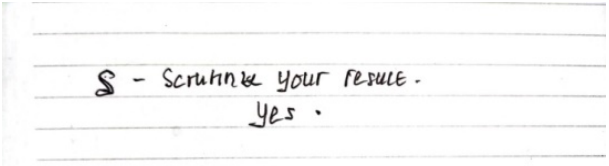

Figure 8 . Example of student answers on the S indicator (Scrutinize your result)

Based on students' answers, students believe in the answers described in the previous indicator, but it is not clear why students believe in this answer.

The conclusion that can be drawn from the results of student responses to each indicator, that students still have difficulty in working on problems with problem solving indicators.

Student Response Questionnaire Results

To find out the responses of 143 students in working on problems based on students' problem-solving abilities , a questionnaire was given that contained 11 statements about experiences in learning physics, responses about working on problems with problem-solving indicators and The process of teaching and learning in the classroom. Students can choose from 1 (Strongly Disagree), 2 (Disagree), 3 (Agree), 4 (Strongly Agree).

The results of the questionnaire that have been filled out by students, it appears that (1) physics is a difficult subject to understand, (2) Dynamic Fluids material is easy to understand by students but there are some students who say it is very difficult, (3) Lecture method applied by the teacher in class ineffective for understanding physics subjects, (4) students prefer

offline learning, (5) online physics learning makes students' grades better than offline, (6) the lecture method cannot help students understand physics, (7) Students will find it easier to understand physics learning more actively, accompanied by simulations and media, (8) physics problem solving skills can help students better understand and be able to work on physics problems, (9) There are obstacles in working on problems to practice problem solving skills, (10) The use of digital books is very helpful for students in the physics learning process, (11) Interested in using digital books as a medium of learning physics lessons.

Table 1. Results of student questionnaire

Statement	Percentage (%)			
	1	2	3	4
Physics is a difficult subject to understand	0.70 (1)	8.50 (12)	71.10 (101)	19.70 (28)
Dynamic Fluids material is very easy for students to understand	4.90 (7)	5.92 (84)	31.70 (45)	4.20 (6)
The lecture method applied by the teacher in the classroom has been effective for understanding physics subjects	2.80 (4)	51.40 (73)	35.20 (50)	10.60 (15)
I prefer learning online than offline	17.60 (25)	40.80 (58)	31.70 (45)	9.90 (14)
Learning physics online makes my grades better than offline	10.60 (15)	12.70 (18)	61.30 (87)	15.50 (22)
The lecture method can help students understand in studying physics	1.40 (2)	46.50 (66)	41.50 (59)	10.60 (15)
I make it easier to understand physics learning with simulation and media more positively	0.70 (1)	7.70 (11)	47.20 (67)	44.40 (63)
Physics problem solving skills help students better understand and solve physics problems	0.70 (1)	8.50 (12)	80.30 (114)	10.60 (15)
There are obstacles in working on problems to practice problem-solving skills	0 (0)	14.10 (20)	74.60 (106)	11.30 (16)
The use of digital books is very helpful for students in the physics learning process	1.40 (2)	14.10 (20)	70.40 (100)	14.10 (20)
Interested in using digital books as a medium for learning physics	0.70 (1)	9.20 (13)	31.00 (44)	59.20 (84)

Teacher Interview

In addition to student response questionnaires, interviews with teachers were also carried out. Based on the results of interviews that have been carried out, the teacher stated that there were obstacles experienced by students related to understanding physics material, namely lack of interest in reading (literacy), low ability to understand questions, lazy to try, as soon as they saw the formula, they immediately gave up. In the process of teaching and learning in the classroom there are several obstacles that teachers often experience, namely the content of curriculum material for physics is too much while time is very limited. And in solving problems based on problem solving abilities students have been taught and it is very important according to the statement from the physics teacher because it is important because it trains students to think critically in solving problems. however, there are some obstacles that are often experienced, namely literacy and numeracy are still weak so that the ability to understand problems is still lacking, and the teacher also stated that he had implemented the PBL learning process d . class but the results are not optimal. For learning media, they have used digital books, but when school was online. The teacher stated that there were several advantages and disadvantages of digital books. The advantages include students easily getting information on subject matter for free without . H should buy books, easy to access, many varieties (various publishers and many titles) while the weaknesses include the cellphone battery must remain full, need packages for online ones, wrong targets (if you already have cellphones, students are more likely to open others, YouTube, tiktok instead of reading books using cellphones).

Related research

In this study, to determine the effectiveness of developing PBL models assisted by digital books in improving high school physics problem solving skills, analyze several previous studies on national and international articles in the results of the scope of 2018 to 2022. The following is a summary of the table of the latest research result.

Table 2. Review Study of the last five years

Author (Year)	Research purposes	Research design	Research result
Parno., et al (2020)	The goal is to determine the effectiveness of the experiential learning (EL) model system. Create learning materials for fluid mechanics and use formative assessment (FA) to uncover student difficulties.	– The research used mixed search with integrated test design	Shows that the El Model, STEM can build mastery on dynamic fluid materials with a higher effectiveness of the Nouli subtopic than continuity. Before this model was applied, students experienced difficulties in all dynamic fluid materials
Wahyuningsih ET., (2021)	Aims to determine whether there is a significant relationship between student interest in learning and learning outcomes through project-based learning (PjBL) models.	– The research used is quasi-experimental – One group – Pretest and Posttest	The result of this research is the learning model applied by the teacher is very important to the students' interest in learning.
Nora, A & Yusrizal (2020)	The purpose of this study was to determine the effectiveness of learning models across five categories: classes, teaching materials, knowledge aspects, critical thinking skills aspects, and problem-solving skills aspects.	– Use a quantitative approach – using posttest and pretest	From the results of this study, the five categories have a very large effect on the learning model.
Sunaryo., et al (2020)	This study aims to analyze students' higher order thinking skills and problem solving using E-modules.	– The method used is Research and development (R & D). – Using Literature Study.	Among the results of research and have been confirmed by a number of experts, which show that E-modules are feasible to be used as new learning media and can improve students' higher order thinking skills and problem solving abilities.
Diansa & Asyhari (2020)	This study aims to determine the effectiveness of learning modules based on the Self-Directed Learning (SDL) model to help students at SMA Negeri 3 Al Azhar Bandar Lampung understand dynamic fluid materials.	– The research method used is a poor experimental design model. – By Sample Selection using purposive sampling technique	The conclusion of this research is the module effective because it helps students of SMA Al Azhar 3 Bandar Lampung to understand the concept of fluid mechanics effectively by using an electronic physics module based on an independent learning model according to the target.
Handayani, MF et al., (2021)	To analyze student learning independence using the PBL model in physics learning	– This survey method is quasi-experimental – The design of this research is pretest – posttest design.	The results of this study stated that the independence of students using the PBL model was greatly increased.
Pratiwi & Y ulkifli (2019)	The purpose of this study was to confirm the improvement of skill proficiency supported by LKS. based on the discovery learning model	– The study used is a quasi-experimental study – The survey design used was a control design only after testing.	In this study, there is an impact in the use of LKPD based on the discovery learning model on skill competence. This can be seen from the increase in skill competence after being given treatment
Noviantika, R et al., (2019)	The aim is to use a book on Pocket physics to determine the effectiveness of a problem-based learning model.	– The design used is in the form of pretest and posttest – Using tests and interviews.	There is an influence on students towards the problem-based learning model assisted by pocket physics.
Rahmana et al., (2021)	To produce a video-based device so that students' problem-solving skills increase in the elasticity material.	– This research uses research and development – The research design used is a 4D model	The video-based physics learning device developed is effective in improving students' problem solving on the elasticity material.
Ayumniyya, et al (2021)	To describe the capacity profile of high school in solving problems on Newton's law material	– This type of research is descriptive quantitative – Presented test questions, and questionnaires.	Data from the research, it was found that the problem solving ability of students was still quite adequate.

Author (Year)	Research purposes	Research design	Research result
Khusaeri, A et al (2022)	Using the PBL model to increase student activity and learning outcomes with dynamic fluid materials.	– This classroom action research uses four phases: planning, action, observation, and reflection.	There is an increase in students who achieve completeness from cycle I to the next cycle. So that the PBL model is able to increase student activity and learning outcomes in dynamic fluid material.
Aldi et al., (2022)	aims to test the feasibility of STEM learning tools assisted by learning videos to increase students' understanding of dynamic fluid material.	– The research used is (R&D) – Research design 4 models, namely Define, Design, Develop, Desseminate.	From the feasibility test of video-assisted STEM devices and the results are suitable for increasing students' understanding of dynamic fluid concepts
Anita et al., (2021)	Develop STEM-based learning materials (digital books) about problem solving	– Using the R&D research method – Using the ADDIE model	From the results of the study, that STEM-based digital books on students' problem solving abilities are learning media that have categories suitable for students to use.
Putri GE., et al (2019)	To describe the characteristics of students who are e-book users and the results of the analysis will be a reference in developing high school physics e-books based on the Discovery Learning learning model.	– Descriptive method – The instrument used is a student questionnaire.	This study obtained the results, that the development of e-books based on Discovery learning needs to be improved as an aspect of learning styles during the design process.
Suharni & Rahmatsyah (2021)	of problem-based learning model (PBL) on solving physics problems in dynamic fluid subjects .	– The research design is Two Group pretest and posttest.	The results showed that the post-test scores in the experimental class were higher than the post-test scores in the control class.
Hartini et al., (2020)	To find out whether there is an effect of the systematic problem solving learning model on the learning outcomes of Basic Physics 2 .	– The method used is the experiment – Research design one group pretest – posttest design	There is an influence on the problem-solving model on basic physics material 2.

From Table 2, there are several articles which state that there is a very good influence, when teachers apply the PBL learning model to students to improve student problem solving (Suharni & Rahmatsyah, 2021). In addition, according to Hartini, et al. 2020. That the effect of learning models in improving systematic problem solving on student learning outcomes in physics subjects.

Conclusion

Based on the research conducted, it can be concluded that the students' ability in solving physics problems is in the low category, it can be seen from the results of research on 143 students, students who got low scores were 133 students, moderate scores were 9 students, and only 1 student got high scores. This is because students are not used to solving problems using the problem-solving ability indicator, namely ACCES. Another factor that causes students' low problem solving abilities is that the questions given are included in the High Order Thinking skill (HOTS) category which makes it difficult for students to solve the problem. of existing problems and to improve high school physics problem solving skills, new innovations are needed, such as the learning model and learning media used by students, which are expected to be packaged as attractively as possible and in accordance with the times so that students are interested in learning. With this, it is hoped that the PBL model is supported by digital books this can enhance high school problem-solving problems, especially in dynamic fluids.

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