Journal of Innovative Technology and Sustainability Education
Homepage : https://journal.i-ros.org/index.php/JITSE
Email : jitse@i-ros.org

e-ISSN 3109-2454
Vol. 2, No.1, April 2026

Profile of High School Students Problem Solving skills and the Implementation of PBL Model Assisted by Digital Books on Dynamic Fluid Material

Elvia Reza Lutfiani[1], Nofri Hidayatin[1], Nurul Muawiyah[1], Siska Agustin Sha Harena[1], Dhea Wanda Irani[1], Binar Kurnia Prahani[1], Imam Sya'roni[2]

[1]State University of Surabaya, Surabaya, Indonesian
[2]National Taiwan University of Science and Technology, Taipei, Taiwan

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DOI : https://doi.org/10.63230/jitse.2.1.118

Sections Info

Article history:
Submitted: December 9, 2025
Final Revised: March 10, 2026
Accepted: March 10, 2026
Published: April 13, 2026

Keywords:
Digital Books;
Dynamic Fluids;
High School Physics;
Problem Based Learning;
Problem Solving Skills.

ABSTRACT

***Objective**: This study aims to analyze the problem-solving skills profile of high school students on fluid dynamics material as a basis for developing and applying a digital book-assisted Problem-Based Learning (PBL) model. **Method**: This preliminary study used a qualitative descriptive approach and was conducted at SMAN 1 Driyorejo, involving 102 grade XII students in the 2025/2026 academic year. Data were collected through problem-solving skill essay tests, student response questionnaires, and teacher interviews. **Results**: The results showed that students' problem-solving skills were still in the low category, with 91 students in the low category, 11 students in the medium category, and no students in the high category. Analysis of the indicators showed that the Visualize the Problem aspect received the lowest score, while the Physics Description indicator had the highest average score. In addition, the results of the questionnaires and interviews showed that physics learning was still dominated by lecture methods and the use of conventional media. **Novelty**: This study provides an empirical basis for the development of innovative learning through the application of Android-based digital books integrated with the PBL model to improve students' problem-solving skills in fluid dynamics material.*

INTRODUCTION

The 21st century is marked by rapid advances in science and technology, necessitating improvements in the quality of human resources through education (Mardhiyah, 2021). Education plays a crucial role in preparing a generation capable of facing the demands of modern development. Education is an activity undertaken consciously, planned, and responsibly to develop one's abilities (Bahri, 2021). Educational success is inseparable from the learning process at school. School education is a key pillar in achieving these goals because schools act as formal institutions that provide structured learning processes. Therefore, along with families and communities, schools are among the leading providers of education among all educational institutions (Makiyah et al., 2021). The primary goal of education is to shape a generation capable of adapting to technological developments, and this process relies on strengthening learning.

Learning is essentially an active interactive process between students, teachers, and learning resources in a well-planned learning environment. The learning process can shape students' perspectives, as it is heavily influenced by interactions with the learning environment, leading to adaptation to the changes they encounter (Widiyanto et al., 2020). One field of science that plays a crucial role in shaping students' logical and analytical perspectives is physics, as the process of learning its concepts is heavily influenced by students' interactions with the learning environment, thus encouraging adaptation to the various changes they face. Physics not only studies natural phenomena but also serves as the basis for the development of various modern technological innovations (Sidik & Kartika, 2020). However, in reality, physics learning in schools still faces various obstacles, such as low student interest in learning, the dominance of lecture based instruction, and a lack of opportunities for students to actively participate in problem solving. Teachers still tend to use lectures as the primary method, leaving students passive and unmotivated. This makes learning monotonous, boring, and out of context with students' real lives (Susanti et al., 2024).

One way to overcome these problems is to train the ability to understand physics concepts by solving contextual problems related to everyday life. Contextual problems encourage students to think systematically, understand problem situations, and relate them to relevant physics concepts. In this case, problem-solving skills are key to meaningful physics learning. Heller, Keith, & Anderson (1992) introduced five steps in problem-solving strategies, namely (1) Visualize the Problem, where students understand the problem situation by writing down what is known and asked, and making illustrative sketches; (2) Physics Description, where students simplify the situation by drawing diagrams and determining relevant physics quantities; (3) Plan a Solution, where students develop a solution plan by looking for relationships between concepts or deriving equations; (4) Execute the Plan, where students carry out calculations systematically until the final result is obtained; and (5) Check and Evaluate, where students re-check the truth, accuracy, and logic of the results obtained. By implementing these steps, students are not only able to solve problems but also understand the underlying scientific thinking process. Therefore, a learning model is needed that is able to guide students through this kind of thinking process, one of which is Problem Based Learning (PBL).

The Problem Based Learning (PBL) model is a learning approach that emphasizes providing real-world problems for students to study and solve. Through Problem Based Learning (PBL), students are encouraged to construct their own knowledge through activities such as discovering, researching, and developing solutions to contextual problems (Yuliani, 2021). In its application, Problem Based Learning (PBL) provides students with opportunities to work collaboratively in groups, discuss ideas, and develop problem-solving skills (Suharni & Rahmatsyah, 2020). According to Astutik & Jauhariyah (2021), this model is effective in improving problem solving skills in physics learning. The Problem Based Learning (PBL) model enables students to think actively, search for and process data, and interpret problems, rather than simply listening, taking notes, and memorizing lessons (Rahmatia et al., 2024). These studies have shown that implementing Problem Based Learning (PBL) improves student learning outcomes and problem-solving skills. These skills are key ingredients for future educational success and support the goals of the Sustainable Development Goals (SDGs) program (Dumitru, 2021). The SDGs underscore the importance of access to quality education (SDG 4), which can be achieved through flexible, inclusive digital learning (Puspitasari, 2025). The application of technology in the curriculum enables more interactive teaching and problem-based learning (Handayani et al., 2023).

To enhance the effectiveness of quality education in the digital era, problem-based learning (PBL) can be combined with educational technology, such as interactive digital textbooks. Through PBL-based digital textbooks, students not only read the material but also interact with simulations, prompt questions, and problem-based assignments relevant to real life. Research by Siregar et al. (2021) agrees that the use of digital textbooks can help students solve problems, making it highly relevant when combined with the Problem Based Learning (PBL) model. This approach allows for more independent, collaborative, and exploratory learning. Furthermore, teachers can use digital textbooks to facilitate learning without being limited by space or time. The development of a Problem-Based Learning model assisted by digital textbooks is expected to improve students' physics problem-solving skills, particularly in fluid dynamics. Many students struggle to understand the relationships among pressure, velocity, and flow rate because the material is still theoretical. By implementing PBL assisted by interactive digital textbooks, students are expected to understand the concept of fluid dynamics through simulations, virtual experiments, and more concrete problem-based activities. Based on the problems described above, this study aims to analyze the profile of high school students' problem-solving abilities as a consideration in implementing the Problem Based Learning (PBL) model using digital books on Dynamic Fluid Physics.

RESEARCH METHOD

This research is preliminary, with a qualitative descriptive analysis, as it does not test a hypothesis. The researcher conducted preliminary research to better understand the actual situation in the school and to provide more in-depth information about the existing problems (Shorey et al., 2020). The results of this study are used to inform improvements in learning innovations, models, and media in schools that influence the problem-solving skills of senior high school students. This research was conducted in 3 classes comprising 102 grade XII students at SMAN 1 Driyorejo, Gresik Regency, in October 2025. Consisting of 68 female students and 34 male students, this research was conducted in the odd semester of the 2025/2026 academic year. The data collection for this research was carried out in several stages, namely (1) a test questionnaire consisting of five essay test questions on problem-solving skills on the Dynamic Fluid material, (2) a student response questionnaire survey, and (3) a teacher interview sheet, all of which had been validated by 3 validators who were experts in their respective fields.

The data analysis technique used was responses from a printed essay test in hard copy and a survey questionnaire of student responses, using a Likert scale of 1-4 via *Google Forms*. The researchers also conducted interviews with physics teachers. The researchers explain the steps of the research method used in the attached diagram as shown below:

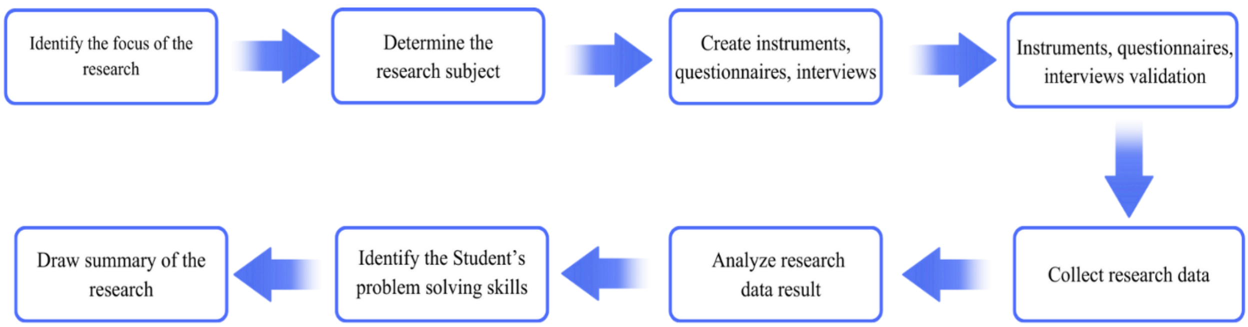

Figure 1. Research flow

This study aims to determine the profile of students' problem-solving skills when assisted by digital books, especially in fluid dynamics material, and to provide a basis for the next development stage. The test instrument consists of 5 essay questions, each of which has 5 main indicators of problem-solving skills, namely (1) Visualize the Problem, (2) Physics Description, (3) Plan a Solution, (4) Execute the Plan, and (5) Check and

Evaluate. The selection of essay questions is used to elicit more in-depth answers than simply choosing from multiple-choice options (Maryani et al., 2021). Next, students are given 15 response questionnaires on Physics learning in schools. Then, the level of problem-solving skills is calculated through the students' answers. For each essay question, the maximum points are 20, with details for the value for each question indicator if the response is logical, complete and systematic, the points obtained are 4; if the answer only has two components (logical and complete or logical and systematic), then the points obtained are 3; if the answer only has one component, then the points obtained are only 2; If the student's answer is wrong and accompanied by a reason, the point obtained is 1; and if the student's answer is not filled in (blank), then the point obtained is 0. So, the maximum value obtained is 100. Then, to determine the value of each student, the following formula (1).

$$Final\ score = \frac{total\ score\ obtained}{maximum\ score}\ x\ 100 \quad (1)$$

RESULTS AND DISCUSSION

Fluid dynamics problem solving skills test

The ability to solve physics problems requires a high level of reasoning, and each student has a different approach. In this study, 5 questions were submitted to test the ability to solve physics problems on dynamic fluid material. With each question item having a total score of 20. The test answer sheet is equipped with problem-solving ability indicators, according to the problem-solving indicators of Heller, Keith, & Anderson (1992), namely *(1) Visualize the problem, (2) Physics description, (3) Plan a solution, (4) Execute the plan, (5) Check and evaluate.* At this stage, students must work on the provided questions according to the given instructions. After conducting the research, the results of the physics problem-solving abilities of students at SMAN 1 Driyorejo were presented in the following graphic.

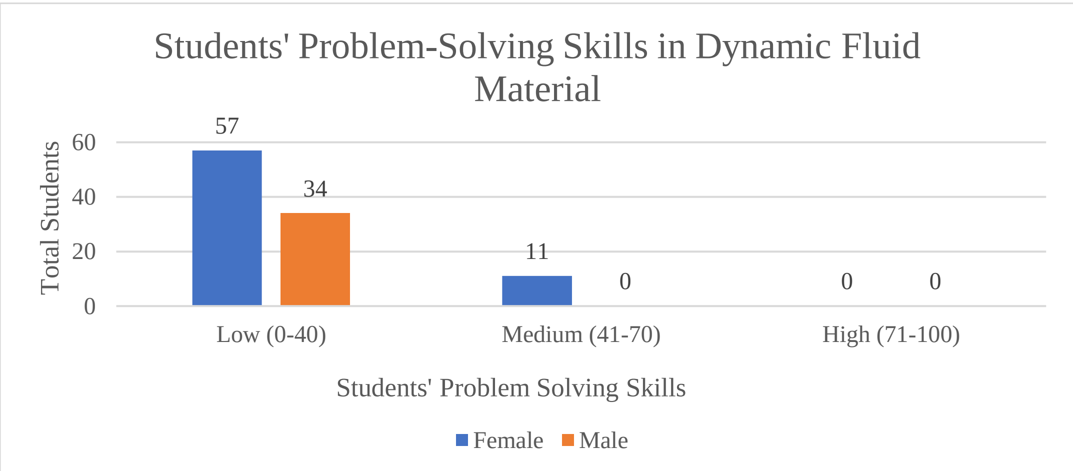

Figure 2. Level of problem-solving skills of women and men

Figure 2. Explains that the level of problem-solving skills of students is still low, regardless of whether they are male or female students. Between the two, there is a very significant difference in scores. This difference is found in the level of problem-solving skills, which can be low, medium, or high. The results were obtained through a problem-

solving skills test, with 57 female students in the low category and 34 males. This means that all male students were in the low score category. Then, in the medium problem-solving skills category, there were 11 female students and 0 male students. And no students achieved the high score category. This shows that students' problem-solving skills remain low.

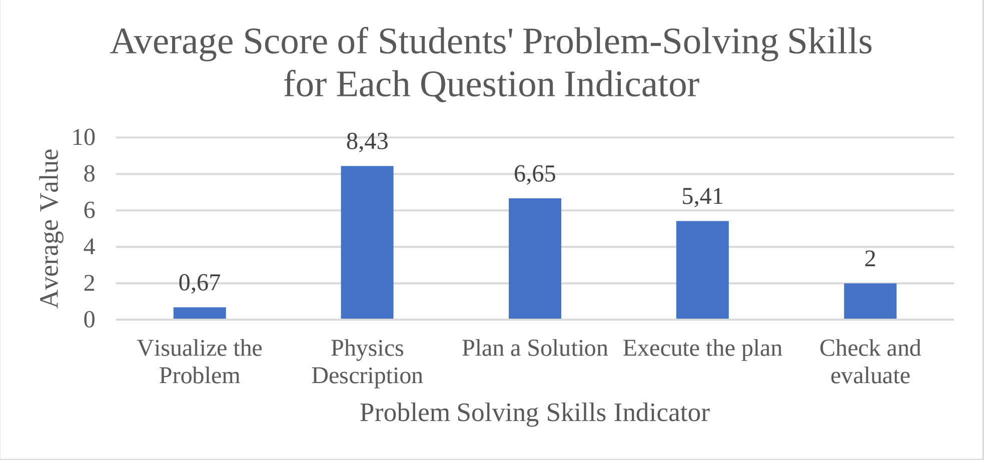

Figure 3. Average value of problem-solving skills for each question indicator

Figure 3. Shows the results of the research through a problem-solving skills test, resulting in an average score for each indicator obtained by students. The *Physics Description Indicator* has a high average score. This indicates that students can understand the known and unknown variables presented in the problem, as indicated by the physics symbols. The second-highest indicator is *Plan a solution*, followed by *Execute the plan indicator*, then *Check and evaluate.* The problem-solving skill indicator with the lowest average score is *Visualize the problem*. This finding is supported by research conducted by Alawiyah (2022), which found that students' ability to interpret information is very low, with 48.80% of students experiencing difficulty interpreting data or images due to a lack of practice and habituation in daily learning activities. The results of the study indicate that students' problem-solving skills remain relatively low, with most students experiencing difficulty understanding concepts, especially in describing physics situations, as well as in planning and evaluating solutions.

The following is an example of a student's completion of the problem-solving skills test for each indicator: Visualize the problem, Physics description, Plan a solution, Execute the plan, and Check and evaluate.

1. Visualize the problem

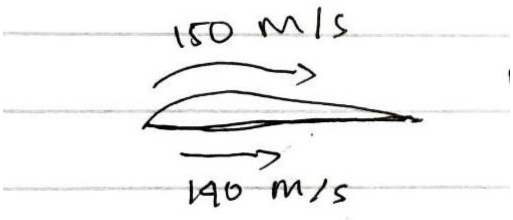

Figure 4. Student answers to the visualize the problem indicator

Figure 4. Students are asked to analyze the factors that prevent an airplane from flying based on the quantities listed in the problem. In the visualization stage of this problem, students can simply visualize it and describe the airspeed above and below the wing. Without describing and explaining the direction of other quantities in the problem case, such as the lift force of the airplane, the gravity of the airplane, and the cross-sectional area of the airplane wing. In fact, many students do not visualize this problem at all.

2. Physics description

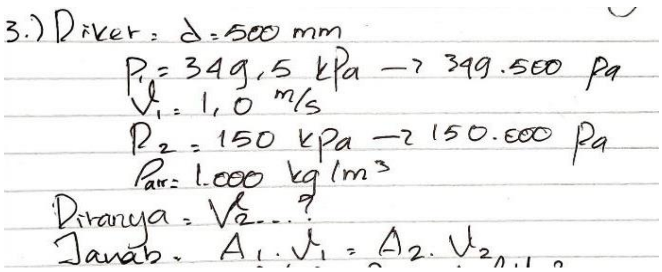

Figure 5. Student answers to the physics description indicator

Figure 5. Students are asked to analyze the velocity at the leak point and the effect of narrowing due to pipe corrosion using the principles of fluid dynamics, the principle of continuity, and Bernoulli's law. Information is presented in terms of pressure, velocity, pipe diameter, and narrowing of the pipe before and at the leak point. From the students' answers, it was found that the skills of describing problems in physics concepts were only related to the information presented, even when information such as pipe narrowing before the leak and at the leak point was not included in the step. It was observed that students had not described the phenomenon, including the magnitude of the cross-sectional area before and after narrowing due to corrosion.

3. Plan a Solution

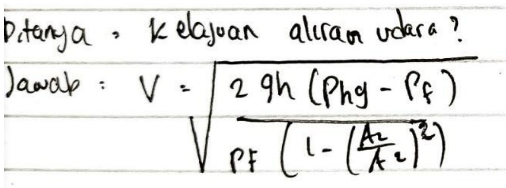

Figure 6. Student answers to the plan a solution indicator

Figure 6. Students are asked to measure the speed of airflow in the Savannah area using a pitot tube. In the problem, the event is given that the U-tube is connected to the tube arm and filled with an alcohol liquid of a given density. Also, other known quantities include air density and height differences. At the planning stage, it becomes clear that students are incorrect in determining the correct formula for the problem. Where the problem is not related to the existence of a cross-sectional area. From these answers, it can be concluded that some students still do not understand the sub-concept of the Pitot Tube, which is an application of Bernoulli's Law. Therefore, if students understand Bernoulli's Law, they will use its basic principles to measure fluid flow rate.

4. Execute the plan

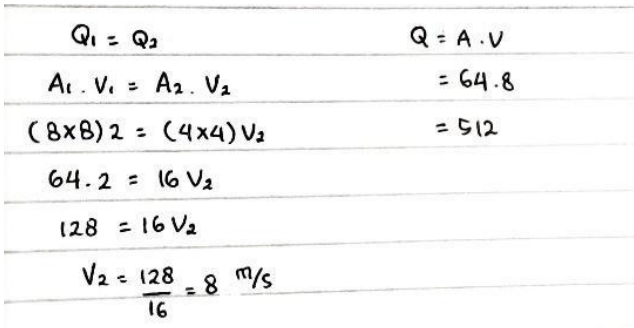

Figure 7. Student answers to the execute the plan indicator

Figure 7. In the question, students are asked to analyze the river discharge at the narrowing section and the river flow rate at the narrowing and shallowing sections during rain using the principle of fluid dynamics and the principle of continuity. From the results of the students' answers, it can be analyzed that students have been able to determine the formula that must be used to solve the problem, but students have not been able to explain the steps for solving the problem in question correctly, which affects the final results of the students' answers.

5. Check and evaluate

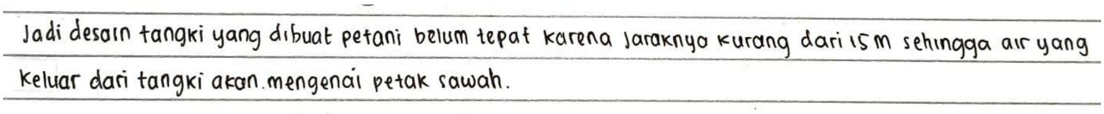

Figure 8. Student answers to the check and evaluate indicator

Figure 8. Students are asked to evaluate the solution to the problem in the question, which illustrates the installation of a water tank by farmers used to irrigate rice fields. Students are asked to prove the distance reached by the water fall using Torricelli's Theorem. It is known that distance B, which is the distance from the water tank fountain to the rice field, is 15 meters. From the students' answers, it can be seen that, when evaluating the solution from the experiment, they are still not quite right. The correct answer should be: it is proven that the distance reached by the water from the water reservoir (distance A) is 8 meters; the farmer's water tank design successfully avoids hitting the rice field directly, so it does not damage the plants.

Results of student responses to physics learning

In the next step, students were asked to fill in their responses to the physics lessons they had learned at school after taking an essay test on problem-solving skills in fluid dynamics. Students chose one of four response scales: 1 (Strongly Disagree, STS), 2 (Disagree, TS), 3 (Agree, S), and 4 (Strongly Agree, SS).

Table 2. Responses to physics learning and problem-solving skills

No	Statement	Answers (102 Students)			
		STS	ST	S	SS
1	I understand the situation and information given in the physics problem before starting to solve it.	10.8% (11)	21.6% (22)	49% (50)	18.6% (19)
2	I can describe a physical situation (e.g., through a diagram, sketch, or symbol) before calculating.	5.9% (6)	35.3% (36)	40.2% (41)	18.6% (19)
3	I can plan steps to solve physics problems logically and systematically.	6.9% (7)	31.4% (32)	47.1% (48)	14.7% (15)
4	I did the calculations carefully and double-checked my work.	3.9% (4)	15.7% (16)	59.8% (61)	20.6% (21)
5	I evaluate whether my answer makes sense based on relevant physics concepts.	5.9% (6)	12.7% (13)	59.8% (61)	21.6% (22)
6	I feel that physics is a fun and challenging subject.	13.7% (14)	25.5% (26)	42.2% (43)	18.6% (19)
7	I feel that fluid dynamics material is important material to understand.	4.9% (5)	12.7% (13)	55.9% (57)	26.5% (27)
8	I find fluid dynamics material difficult to understand.	5.9% (6)	26.5% (27)	50% (51)	17.6% (18)
9	My teacher often carries out learning activities oriented towards problems in everyday life.	1% (1)	14.7% (15)	55.9% (57)	28.4% (29)
10	I try to find solutions to every physics problem given by the teacher.	1% (1)	7.8% (8)	64.7% (66)	26.5% (27)
11	I am more enthusiastic about learning when working in groups to solve physics problems.	5.9% (6)	10.8% (11)	49% (50)	34.3% (35)
12	Problem solving skills are important to teach in learning.	1% (1)	3.9% (4)	52% (53)	43.1% (44)
13	The learning media used by the teacher varied and helped me understand physics concepts.	2.9% (3)	7.8% (8)	54.9% (56)	34.3% (35)
14	I often use technology such as digital books (E-Books) to support my physics learning.	3.9% (4)	17.6% (18)	58.8% (60)	19.6% (20)
15	I feel more motivated to learn physics when using interactive digital media (Interactive E-Book).	5.9% (6)	24.5% (25)	47.1% (48)	22.5% (23)

Table 2. Based on the results of the student response questionnaire regarding Physics learning, it is clear that physics learning has not yet fully developed optimal problem-solving skills. Some students are unable to fully understand physics problem situations and describe them visually, such as in diagrams or sketches, as evidenced by the 41.2%

of respondents who still have difficulty at this stage. Furthermore, approximately one-third of students are unable to plan logical, systematic steps for solving problems. This indicates that the learning process is still oriented towards theory and memorization of formulas, and has not yet developed problem-solving and analytical skills.

Furthermore, the questionnaire results showed that students' motivation and interest in learning physics varied. Some students stated that they did not find physics enjoyable and challenging, indicating a persistent negative perception of the subject. While 67.6% of students considered fluid dynamics important to understand, half also admitted to having difficulty grasping the concepts. This situation illustrates a gap between the material's importance and students' level of understanding, which may be due to a learning approach that remains theoretical and lacks context. Although teachers sometimes relate learning to everyday life problems, technology-based learning media such as *e-books* or interactive digital books have not been utilized optimally. These results demonstrate the need for more engaging, interactive, and problem-based learning innovations to motivate students and train them to solve physics problems systematically. This suggests that the use of interactive e-books in physics learning has proven effective in improving students' conceptual understanding and strengthening their character and motivation to learn (Septikasari, 2021).

Interview results with physics teachers

In addition to student perspectives, researchers conducted interviews with physics teachers about learning outcomes and the learning models used at their schools. The 12 questions from the interviews with physics teachers are summarized in Table 3.

Table 3. Results of interviews with physics teachers regarding the implementation of physics learning.

No	Question	Teacher's Answer
1	What strategies and methods do you apply in the learning process?	Lectures, Discussions, Games (Quizizz)
2	Are there any shortcomings in the learning methods used in teaching physics concepts to students?	Students are lacking in critical, creative and problem-solving thinking.
3	What are the attitudes, motivations, and interests of students towards learning physics using the methods you provide?	It depends on the students' circumstances in each class, as they differ. Some classes have a strong interest in physics, while others have little interest in physics.
4	Do students ask the teacher if there is something they still don't understand?	Ask
5	Have you ever used problem-based learning that is oriented towards everyday life?	Ever with the help of simulation videos on YouTube
6	In your opinion, how important are physics problem-solving skills for students?	It is very important to train students' reasoning regarding physics.
7	Have you ever measured students' skills in finding solutions to problems related to physics?	Frequently use Quizziz
8	For practice questions, what types of questions do you generally give?	Types of questions are graded C1 – C4

No	Question	Teacher's Answer
9	Are the types of questions you give students related to everyday life phenomena?	Yes
10	Are there any obstacles or barriers that students face when solving physics problems?	Weak in calculation skills and some students are still confused with physics concepts
11	How do you help students understand physics problems? before they try to solve it?	Provide basic physics material, provide example questions, then direct students to do assignments
12	Have you ever taught using a problem-based learning model with the aid of a digital book (e-book)?	Never, teach using textbooks

Table 3. shows that the learning strategies used are still dominated by lectures, discussions, and educational games like Quizizz. Teachers also stated that motivation to learn physics is highly dependent on the conditions of each class, with some students showing high interest while others show low interest. This situation demonstrates the need for more interactive, context-based learning models so that all students can be actively involved in the learning process.

Furthermore, interview results also showed that teachers had tried simple problem-based learning using YouTube videos, but had never used the *Problem Based Learning* (PBL) model systematically, especially with the help of digital media such as e-books. Teachers considered physics problem-solving skills very important for training students' scientific reasoning, but their practice was still limited to questions at the cognitive levels C1-C4 and to textbook-based instruction. The main obstacles faced by students were weak numeracy skills and a lack of understanding of basic physics concepts.

Previous research

In this study, to determine the effectiveness of developing a PBL model assisted by digital books in improving high school physics problem-solving abilities, several previous studies were analyzed in national and international articles published between 2020 and 2025. The following is a summary table of the latest research results.

Table 4. Analysis of previous research

Source	Research purposes	Method	Research result
Qotrunnada & Prahani., 2022	Analysis of students' problem-solving ability profiles High school as a consideration in implementing the digital book-based PBL model on Fluid Dynamics material	Preliminary survey, Qualitative descriptive analysis techniques	To improve problem solving skills High school physics problems require innovation supported by digital books in the material of Fluid Dynamics
Ajri et al., 2025	Identifying profiles problem-solving skills on wave material mechanics after following learning through Problem-Based	R&D with 4D models	The implementation of the PBL model assisted by *liveworksheets* has an impact

Source	Research purposes	Method	Research result
	Learning (PBL) assisted by liveworksheets		positive towards problem solving skills.
Kinasih et al., 2023	Analysis of high school students' abilities in solving physics problems as a consideration for implementing the PBL learning model assisted by Android-based 3D digital modules	Descriptive qualitative analysis techniques	Students' ability to solve physics problems is still low so innovative learning models and media are needed, such as application of PBL models and media in the form of 3D digital modules.
Arzak et al., 2023	Analysis of PSS profile of high school students' physics and its application AR book-assisted PBL model as a consideration in the use of media and models learning to support the improvement of PSS of high school students	Descriptive qualitative approach	Students' interest in learning physics with the help of books AR (Augmented Reality) has enhanced their PSS.
Prahani et al., 2022	Analysis of validity, effectiveness, and student response to the learning instruments used	Quantitative quasi experiment	Online PBL assisted by 3D digital books can improve students' CTS on magnetic field material.
Suharni and Rahmatsyah., 2020	Knowing the influence of the Problem Based Learning (PBL) model on Physics problem solving ability (KPM) on the main topic of fluid dynamics	Quasi experiment with design two group pretest-posttest research.	There is a significant influence on students' problem solving abilities on dynamic fluid material.
Yunina, Y. 2022	Knowing the influence of implementing the Problem Based Learning model Based Learning (PBL) on the learning motivation of class XI IPA 1 students at SMAN 1 Cikarang West	Classroom action (CAR)	Shows that the problem based learning (PBL) learning model has The influence of learning motivation on the subject of physics, fluid dynamics material, on students
Widiawati et al., 2022	Produce products in the form of valid Problem Based Learning model-based learning tools, practical and effective to improve problem solving	R&D with 4D models	Learning tools PBL-based learning is very valid, reliable, practical and quite effective in improving students' abilities. solving students' physics problems on

Source	Research purposes	Method	Research result
	skills student physics on fluid dynamics material		dynamic fluid material so that fit for use
Fadila et al., 2025	Developing valid and practical problem-based learning e-modules using Heyzine Flipbook to improve students' understanding of the concept of static fluids	R&D with 4D models	PBL-based e-Modules as alternative learning media which is effective in promoting interactive learning and improving the quality of physics education.
Aulia et al., 2022	Testing the influence of problem-based learning models on students' physics problem-solving abilities on the subject of work and energy	Quasi-experimental with nonequivalent control group design research design.	There is an influence problem-based learning model on students' physics problem-solving abilities in the material effort and energy
Diansah & Asyhari., 2020	Knowing the effectiveness of model-based electronic modules independent learning (SDL) in helping Al-Azhar 3 Bandar Lampung Senior High School students understand fluid dynamics concept	Simple experiment with a static group comparison design.	This physics electronics module has been proven to be able to answer the needs Students will have learning resources that make it easier for students to understand the concept of fluid dynamics.
Firmansyah et al., 2022	Knowing the influence of the Problem Based Learning (PBL) model Learning towards Physics problem-solving abilities of students at SMA Negeri 11 Muaro Jambi	Quantitative with quasi-experimental design approach	The PBL learning model influences problem-solving abilities Physics problems of students at SMA Negeri 11 Muaro Jambi were 88%
Jewaru et al., 2021	Comparing students' problem-solving abilities who use the PBL-GI model against students who use the PBL model	Quantitative with quasi-experiment type, Pretest-Posttest Control Group Design.	PBL learning model combined with Group Investigation have higher problem solving abilities than PBL classes
Resa et al., 2024	Development of Integrated Fluid Dynamics E-Learning Materials Using the PBL Model to Improve Concept Mastery and	Research and Development with the Hannafin & Peck development model.	Integrated PBL model fluid dynamics e-teaching materials effectively improve students' mastery of concepts and creative thinking skills

Source	Research purposes	Method	Research result
	Thinking Skills Student Creativity		
Siregar et al., 2022	Analyzing the influence of using the Problem Based Learning model on students' Physics problem-solving abilities	Meta-analysis	There is an influence of the Problem Based Learning model on improving students' Physics problem-solving abilities.

Table 4. shows that several articles indicate that Problem-Based Learning (PBL) improves students' physics problem-solving abilities (Siregar et al., 2022). Furthermore, according to Widiawati et al. (2022), PBL-based learning tools are effective in improving students' physics problem-solving abilities in fluid dynamics.

Discussion

Students' problem-solving skills in physics learning

The results of the student response questionnaire indicate that the physics learning process has not yet fully developed students' problem-solving skills. This is evident from several indicators that indicate that some students still experience difficulties in the initial stages of the problem-solving process. For example, 41.2% of students stated that they were unable to fully understand the situation and information contained in a physics problem before starting to solve it. Furthermore, approximately one-third of students also reported having difficulty planning logical and systematic steps to solve the problem. These findings indicate that students still experience difficulties in key stages of problem-solving, such as understanding the problem, representing the problem visually, and planning a solution strategy. Yet, in physics learning, these skills are a crucial component of scientific thinking skills. Students are not only required to memorize formulas but also to analyze physics situations and relate them to relevant concepts.

The results of this study also indicate that the learning process tends to be oriented towards direct presentation of material and the use of formulas, thus not fully developing students' analytical thinking and problem-solving skills. This condition aligns with research stating that students' physics problem-solving abilities are still relatively low, necessitating innovative learning models to improve them (Kinasih et al., 2023). Furthermore, problem-solving ability is a crucial skill in 21st-century learning that must be developed through active and meaningful learning processes (Makiyah et al., 2021).

Student motivation and perceptions of physics learning

The questionnaire results also showed that students' motivations and perceptions of physics learning varied. Some students stated that physics is an interesting and challenging subject, but others held negative perceptions of the subject. This indicates that student interest in physics learning is not evenly distributed. A total of 67.6% of students stated that fluid dynamics is important to understand. However, approximately half of the students also admitted that they experienced difficulties in understanding the concepts within the material. This situation indicates a gap between the importance of the material being studied and the students' level of understanding of it.

These difficulties may be caused by a learning approach that is still theoretical and does not adequately connect physics concepts to everyday phenomena. Physics learning should provide contextual learning experiences so students can understand how physics concepts are applied in real life. Monotonous learning methods can also decrease student motivation if not accompanied by engaging and interactive learning activities (Susanti et al., 2024). Other research also shows that implementing the Problem-Based Learning model can increase student motivation because students are actively involved in the learning process and are faced with real-life problems (Yunina, 2022).

The role of learning media and technology in physics learning

Research results also indicate that the use of technology-based learning media in physics learning is still suboptimal. Although some students stated that a variety of learning media can help them understand physics concepts better, the use of technology such as digital textbooks or e-books remains relatively limited. The use of digital learning media, however, has great potential to help students understand abstract physics concepts. Digital media can present material in the form of visualizations, animations, and simulations, which can facilitate students' understanding of physics phenomena. Furthermore, the use of educational technology can support a more effective and relevant learning process (Handayani et al., 2023).

Interactive digital textbooks can also support a more active learning process because they not only present material in text form but also provide practice questions, simulations, and interactive activities that can train students' problem-solving skills. Previous research has shown that the use of interactive e-books in physics learning can improve students' conceptual understanding and learning characteristics (Septikasari et al., 2021).

Teacher perspectives on physics learning implementation

Interviews with physics teachers provide additional insight into the implementation of physics learning in schools. Teachers stated that the learning strategies currently used are still dominated by lectures, discussions, and the use of educational games like Quizizz. While these methods can help create a more interactive learning environment, they are not yet fully capable of developing students' critical thinking, creativity, and problem-solving skills. Teachers also stated that students' motivation levels for learning physics vary across classes, necessitating a more varied and engaging learning approach.

Furthermore, teachers stated that although they have implemented simple problem-based learning using simulation videos from YouTube, they have not yet implemented the Problem-Based Learning model systematically. This indicates that the learning implemented does not fully facilitate the development of students' higher-order thinking skills. This is despite the fact that the Problem-Based Learning model has been proven to improve students' problem-solving and critical thinking skills in physics learning (Firmansyah et al., 2022).

The need for learning innovation through the pbl model assisted by digital textbooks

Based on the results of this study, it can be concluded that innovation is needed in physics learning to improve students' problem-solving skills and increase their learning motivation. One approach that can be used is the implementation of the Problem-Based Learning (PBL) model combined with the use of digital textbooks as a learning medium.

The PBL model allows students to learn by solving real-life problems, thereby developing critical, analytical, and creative thinking skills. The integration of technology, such as digital textbooks, can also make the learning process more interactive and engaging for students.

Previous research has shown that the implementation of the Problem-Based Learning model has a positive impact on students' physics problem-solving abilities (Siregar et al., 2022). Furthermore, the development of PBL-based teaching materials, such as e-modules or digital textbooks, has also been shown to improve conceptual understanding and the quality of physics learning (Fadila et al., 2025). Thus, the implementation of the PBL model assisted by digital textbooks is expected to create a more active, contextual, and interactive learning process, thereby improving students' problem-solving abilities in physics learning.

CONCLUSION

Fundamental Findings: The results of this study indicate that the physics problem-solving skills of students at Driyorejo 1 State Senior High School in fluid dynamics are still relatively low. This is evident from the analysis, which shows that most students fall into the low ability category. The indicator with the lowest average score is the "visualize the problem" stage, indicating that students still have difficulty representing physics problems in diagrams or sketches before performing calculations. Furthermore, based on gender mapping, the average problem-solving skills of male students are lower than those of female students. Student questionnaires and teacher interviews also indicate that the learning process is still dominated by lecture methods and the use of conventional teaching materials. **Implication**: These findings demonstrate the need for innovation in physics learning to improve students' problem-solving skills and support the achievement of SDG 4, which focuses on quality education. One possible approach is to implement the Problem-Based Learning (PBL) model, supported by Android-based digital textbooks, in fluid dynamics, to make learning more interactive, contextual, and student-centered. **Limitation**: This study has limitations because it only analyzed students' problem-solving ability profiles as a basis for developing a learning model without directly implementing the e-book-assisted PBL model. **Future Research**: Further research can test the application of the e-book-assisted PBL model in physics learning and expand the study to different materials or educational levels to obtain a more comprehensive picture of improving the quality of physics learning.

ACKNOWLEDGEMENTS

The author would like to thank the supervising lecturer, who has supported and facilitated this research so that it could be carried out as expected, as well as all parties involved, including parents, family, teachers, students of SMAN 1 Driyorejo Sidoarjo, and all friends.

AUTHOR CONTRIBUTIONS

Elvia Reza Lutfiani contributed to the development of the research methodology, data collection, literature search, data analysis, and drafting the manuscript. **Nofri Hidayatin** was responsible for developing the conceptual framework, research design, and validating the research instruments. **Nurul Muawiyah** contributed to data analysis and interpretation of the research results. **Siska Agustin Sha Harena** contributed to the literature search and drafting and refining the manuscript. **Dhea Wanda Irani** contributed to data management and research documentation. **Binar Kurnia Prahani** served as research supervisor and conducting methodological review. **Imam Sya'roni** contributed to the critical revision, and providing guidance to maintain the academic quality of the research. All authors have read and approved the final version of this manuscript.

CONFLICT OF INTEREST STATEMENT

The authors state that they have no conflicts of interest, financial or otherwise, that could have affected the outcomes of this research.

STATEMENT ON THE USE OF AI OR DIGITAL TOOLS IN WRITING

The author states that several digital tools, including artificial intelligence-based technology, were used as supporting tools in the research and writing process for this article. ChatGPT (OpenAI) was used to help refine the language, improve the writing structure, and summarize several literature sources. In addition, Microsoft Excel was used for processing and organizing research data and supporting data visualization. All results produced through the use of these tools have been reviewed, verified, and revised by the author to ensure academic accuracy, originality, and compliance with research ethics standards. The author is solely responsible for the content, analysis, and conclusions in this article.

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***Elvia Reza Lutfiani (Corresponding Author)**
Physics Education, Universitas Negeri Surabaya
Krajan Hamlet, Paringan Village , Jenangan District, Ponorogo Regency
Email: elviareza.22020@mhs.unesa.ac.id

Nurul Muawiyan
Physics Education, Universitas Negeri Surabaya
Banjarsari Asri Complex, Cerme, Gresik
Email: nurul.22097@mhs.unesa.ac.id

Nofri Hidayatin
Physics Education, Universitas Negeri Surabaya
Gang Mbah Citro III, RT 10 RW 03, Wadungasih, Buduran, Sidoarjo
Email: nofrihidayatin.22016@mhs.unesa.ac.id

Siska Agustin Sha Hareni
Physics Education, Universitas Negeri Surabaya
Lawangan, Lawanganagung, Sugio, Lamongan
Email: siska.22072@mhs.unesa.ac.id

Dhea Wanda Irani
Physics Education, Universitas Negeri Surabaya
Gaplek Hamlet, RT 03 RW 01, Pasirian District, Lumajang Regency
Email: dhea.22057@mhs.unesa.ac.id

Binar Kurnia Prahani
Postgraduate Physics Education, Universitas Negeri Surabaya
Ketintang, Gayungan District, Surabaya, East Java 60231
Email: binarprahani@unesa.ac.id

Imam Sya'roni
Graduate of Automation and Control, College of Engineering, National Taiwan University of Science and Technology
No. 43號, Section 4, Keelung Rd, Da'an District, Taipei City, 106
Email: sya39roniimam@gmail.com