



A STUDY OF PROBLEM SOLVING IN PHYSICS LEARNING: A SYSTEMATIC REVIEW

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Abstract :

This research is the first to conduct a systematic review of problem-solving learning in physics learning. The research aims to synthesize the existing literature on the learning models and experimental methods that can improve high school students' physics problem-solving abilities. The method used in this research is qualitative research using a systematic literature review method. Data collection techniques by reviewing books, journals, literature, notes, and various reports related to the problem you want to solve. Data samples were taken by tracing several scientific articles resulting from previous researchers' research on developmental, experimental, and descriptive research. The data analysis technique used is matrix synthesis. Based on the research that has been conducted, it was found that almost all articles apply learning models and use experimental methods to improve high school students' physics problem-solving abilities. The research contributes to the literature on physics education and problem-solving by providing a comprehensive and systematic overview of the existing literature on problem-solving learning in physics learning. The novelty of this research is that it introduces a new framework of problem-solving learning in physics learning. The research also provides empirical evidence of the effectiveness and feasibility of problem-solving learning in physics learning. Future research may conduct empirical studies to test the effectiveness and feasibility of problem-solving learning in physics learning.

Keywords: Physics Learning, Problem Solving, Systematic Review

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INTRODUCTION

Learning is an effort that is carried out systematically by an educator in realizing learning activities so that they run effectively and efficiently where learning activities start from planning, implementing, and evaluating (Darmaji et al., 2020; Iqbal et al., 2022). One of the lessons that need to be learned is learning physics. Physics learning is learning that addresses symptoms and natural phenomena through a series of processes known as scientific processes (Rizaldi et al., 2021; Astalini et al., 2023; Wisnuputri et al., 2023). Through learning physics, several abilities can be trained to become better such as critical, logical, analytical, systematic, honest, and disciplined thinking in solving a problem of physics concepts related to everyday life (Darmaji et al., 2019; Gems & Bhakti,

2020; Budiarti et al., 2022; Anjelina et al., 2023). Therefore, students need the ability to learn physics, because students can grow interest and are able to build new knowledge by solving a problem.

Problem-solving skills are a form of higher-order thinking skills that students need to have. Problem-solving is when students learn to solve problems and respond to stimuli that describe problem situations that occur, using various rules they have mastered (Afifah et al., 2019; Putri et al., 2019; Mari'a & Ismono, 2021). In physics, solving physics problems is related to physics concepts, and factors that influence solving physics problems are the knowledge possessed by the person solving the problem and the character of the problem (Sujarwanto, 2019; Ernawati et al., 2022; Tanti et al., 2022). In solving problems there are four stages, namely understanding the problem, planning problem-solving, planning the problem, and looking back at the results obtained (Ramadayanty et al., 2021; Aulia et al., 2022; Cuomo et al., 2022; Astalini et al., 2022).

The gap research of this study is that there is a lack of literature on problem-solving learning in physics learning with a systematic review. Most previous studies have focused on the individual aspects of problem-solving learning, such as the problem-solving process, the problem-solving strategies, the problem-solving skills, and the problem-solving outcomes. However, there is a need to explore the holistic and comprehensive picture of problem-solving learning in physics learning, such as the theoretical framework, the learning models, the experimental methods, the assessment tools, and the best practices. The problem-solving learning in physics learning is important for developing students' conceptual understanding, critical thinking, creativity, and scientific literacy.

There are several previous studies regarding problem-solving in physics. Among them is research conducted by (Putri et al., 2023) the research method used is research and development, focusing on determining the effectiveness of the modules being developed. Furthermore, research by (Fitriadi et al., 2022; Saputri, 2021) research is in the form of development using a quantitative approach, the focus of the research is developing and knowing the effect of applying CTL-based physics e-books on students' problem-solving abilities. Research by (Bahaudin et al., 2019) focuses on determining the feasibility of modules developed to improve problem-solving abilities. Research by (Retno et al., 2019; Hardiyanti et al., 2018; Doblou, 2023) uses quasi-experimental research, and the focus of the research is to determine the effect on physics problem-solving abilities through project-based learning. Then, research by (Purwaningsih et al., 2020; Komariah, 2020;) uses a quasi-experimental research method and focuses on the effect of STEM-PjBL learning and discovery to improve students' problem-solving skills.

The novelty of this research is that the research method used is a literature study related to problem-solving in physics learning. Whereas previous research has not conducted literature studies related to problem-solving in physics learning, and only uses development methods, quasi-experiments, and module validation to improve problem-solving skills. Therefore, the researcher carried out the process of reviewing articles by discussing an overview of the problem-solving abilities of high school students in learning physics.

RESEARCH METHOD

This type of research is qualitative research using a systematic literature review method. This method can be used to identify, explore, and classify several research results on a topic (Maulana et al., 2023; Ningsih, 2022). The data collection technique used is a literature study. A literature study is a data collection technique by examining books, journals, literature, notes, and various reports related to the problem to be solved (Adlini et al., 2022; Kamid et al., 2022; Lailani et al., 2023).

Data samples were taken by searching several scientific articles from the results of previous researchers' research on development, experimental, and descriptive research, based on literature studies which were then reviewed and conclusions drawn according to the research topic being studied. The process of reviewing articles in this study discusses the analysis of the problem-solving abilities of high school students in learning physics. The data collection instruments used included reviews of scientific articles sourced from the last 25 references from Google Scholar which focused on the topic under study.

The data analysis technique used is the synthesis matrix. The synthesis matrix is a table or diagram that allows researchers to group and classify different arguments from several articles and combine them in order to be able to conclude the whole article in general (Parinata & Puspaningtyas,

2022; Kamid et al., 2022; Putri et al., 2018). In this study, the researcher made a table consisting of the author's column (year), sample, research design, and findings. So that the research procedure starts with choosing the method used, then determining the instrument used, determining the sampling technique and research sample, and conducting data analysis to draw conclusions.

The analysis technique is carried out using a synthesis matrix. The synthesis matrix is a table/diagram that allows researchers to group and classify different arguments from several articles and combine different elements to get an impression/conclusion of the whole article in general (Murniati, et al., 2018; Aldila & Mundarti, 2023). In this study, the researcher made a table consisting of the name of the journal, author (year), title, and findings.

Data selection is carried out through identification, screening, eligibility, and inclusion. The study discovery process followed PRISMA rules, as presented in Figure 1.

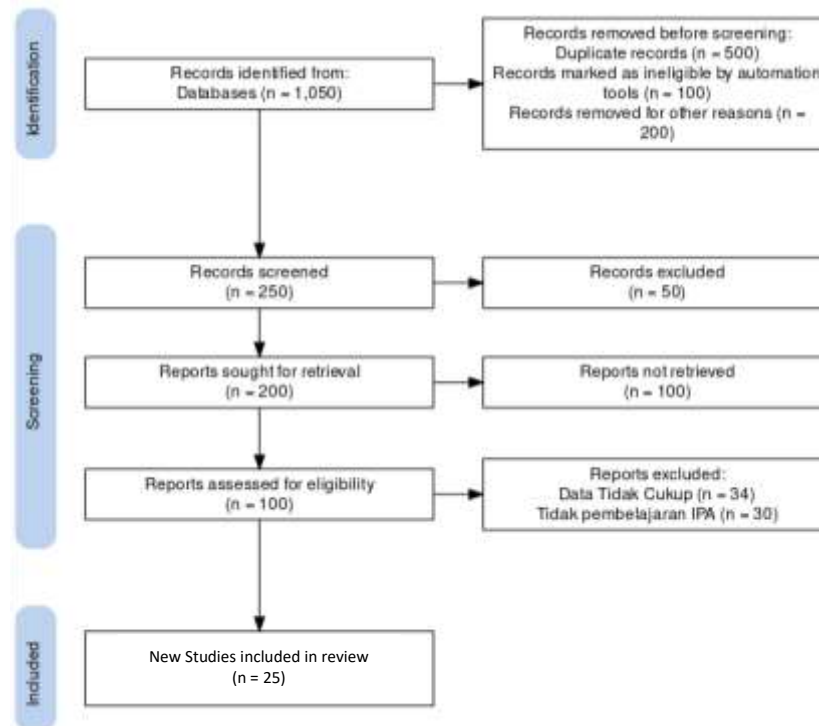


Figure 1. Literature Review Flowchart

RESULTS AND DISCUSSION

The literature review process was carried out on selected scientific articles based on the topics studied related to the analysis of high school students' problem-solving abilities in physics learning. The number of articles reviewed was 25 articles. Following are the results of a review of articles about this research in Table 1.

Table 1. Table of review results

Author (Year)	Title	Research Design	Findings
Sofyan Daryana (2022)	Improving Physics Learning Outcomes Using a Problem Solving Approach	The research design used was classroom action research (PTK)	The results showed that there was an increase in physics learning outcomes after using the problem-solving approach.

Author (Year)	Title	Research Design	Findings
Lusiani, Andi Hendrawan, Sendra Dimastara, Supriyanto (2022)	Analysis of Problem Solving Abilities in the Application of Applied Maritime Physics Sub-Material Vector in Students at SMA Negeri 1 Sukorejo	The method used is observation and literature review	Overall, the average student's ability to use problem-solving steps is 99.12, which means more than 70% and this can be categorized as very capable or very good.
Maritua Simatupang (2019)	Application of Learning Models	The research design used is classroom action research	The application of the Problem-Solving learning model can improve student learning outcomes in Physics learning material on Symptoms of Global Warming in class XI SMA Negeri 1 Pahae Julu in the 2018/2019 academic year.
Novita Iriyanti Ningrum, Raden Wakhid Akhdinirwanto, Siska Desy Fatmaryanti, Eko Setyadi Kurniawan (2023)	Problem Solving To Improve	The research design refers to the ADDIE development model	Scratch-assisted physics learning media is declared valid, practical, and effective so that it is feasible to use to improve problem-solving skills learners.
Mei Saleh (2022)	Physics Learning Outcomes	The type of research used is classroom action research	The use of Problem-Solving type problem-based learning models in Physics in class XII IPA SMA Negeri 1 Buntulia, Pohuwato Regency can increase the number of students who meet the minimum learning mastery standard (KKM).
Tri Isti Hartini, Martin (2020)	Development of Scratch-Assisted Physics Learning Media for	The method used in this research is the experimental method	There is an influence of the systematic problem-solving learning model on student physics learning outcomes in direct current material.
Tika Supriati (2022)	Improving Problem Solving Abilities	Students' Solving	The research method used is a quasi-experimental design with Nonequivalent
			There is a significant influence of information technology-based creative problem-solving models on high school

Author (Year)	Title	Research Design	Findings
		Control Group Design	students' physics learning outcomes.
Susilawati, Fiki Rahmana, Kosim, Lalu Mulyadi (2022)	Improving Student Learning Outcomes in Physics Subjects Using the Problem Solving Learning Model for Class XII Science Students at SMA Negeri 1 Buntulia 2019/2020 Academic Year	The type of research used is development with a 4D model	Problem-based physics learning tools with the help of videos, practically improve students' problem-solving abilities.
Mahilda Wiwit Handayani, Eko Swistoro, Eko Risdianto (2018)	The Influence of Using the Systematic Problem Solving Learning Model on Learning Outcomes in Basic Physics 2 Direct Current Electricity Material for Physics Education Students	The research design used is a quasi-experimental design and pre-experimental designs	There is an effect of using the Physics Problem-Solving learning model on the ability to solve physics problems on the concept of momentum and impulse.
Irma Tri Diana Wilujeng, Suliyanah (2022)	The Influence of Information Technology-Based Creative Problem Solving Models on High School Students' Physics Learning Outcomes	The research design used was pre-experimental designs	Learning physics with the PBL model is quite effective in improving students' problem-solving abilities.
Indra Avico, Andik Purwanto, Desy Hanisa Putri (2019)	Practicality of Problem-Based Physics Learning	The type of research used is experimental research with a posttest-only control design and one group pretest posttest design	The use of Cooperative Problem-Solving learning on students' problem-solving abilities at SMAN 1 Kepahiang has a strong effect by calculating the effect size of 5,779
Yenni Novita Lestari, Eko Swistoro, Andik Purwanto (2019)	Tools with Video Assistance to Improve Problem-	The type of research used is experimental research with quasi-experimental design and pre-experimental design	There is a significant effect of learning using the physics problem-solving model on cognitive learning outcomes and critical thinking skills
Safri Daryanti, Indra Sakti, Dedy Hamdani (2019)	Solving Ability of Students	This type of research is Quasi-Experiment Research type nonequivalent control group design and one group pretest-posttest design	There is an influence of HOTS-oriented Problem-Solving model learning on physics learning outcomes and improving students' problem-solving abilities.
Cahaya Sukma	The Influence of the	The research model	The CPS learning model

Author (Year)	Title	Research Design	Findings
Putri, Feriansyah Sesunan, Ismu Wahyudi (2019)	Physics Solving Model on Students' Concept Mastery and Problem Solving Abilities	used was a quasi-experimental with pretest-posttest control group design with non-equivalent	has an effect on improving students' creative thinking skills in solving physics problems in classes that have low and high average creative abilities in the medium category
Uli Martina Benedicta Purba, Apriani Sijabat, Sudirman T.P Lumbangaol (2022)	Class X MIPA SMAN 4 Bengkulu City	The type of research used is quantitative research, with a quasi-experimental method with a nonequivalent control group design	There is an influence of the Problem-Solving learning model on students' cognitive physics learning outcomes at SMA Negeri 5 Pematang Sintang.
Mega Angellena, Eko Swistoro, Desy Hanisa Putri (2020)	The Implementation of Problem Based Learning Model: An Effort in Upgrading Students' Problem-Solving Skills	The research design used was the nonequivalent control group design and one group pretest posttest design	There is no significant effect of learning using the Physics Problem Solving model on student achievement in class X SMAN 4 Kaur and there is a significant effect on the critical thinking skills of class X SMAN 4 Kaur.
Titik Nurhayati (2021)	The Influence of Cooperative Problem Solving Learning on Students' Physics Problem Solving Ability at SMAN 1 Kepahiang	This study uses a qualitative descriptive approach with a survey method	From the results of the analysis of answers, students of class X SMA Muhammadiyah 1 Demak are already good at solving problems but the wording is still not quite right.
Ulfie Kusuma, Woro Setyarsih (2021)	The Effect of Learning Using the Physics Problem Solving Model on Students' Cognitive Learning Outcomes and Critical Thinking Abilities	This research uses a qualitative approach with a bibliometric method	From the results of the analysis, it was shown that the development of problem-solving instruments was carried out based on the demands of the 21st century, in addition to knowing the extent to which educators were successful in implementing learning innovations that were applied to the teaching and learning process.
Sa'diah, Damar Septian, Gita Erlangga Kurniawan	The Influence of Problem Solving Model Learning Oriented to Higher Order Thinking	This research is research and Development	Problem-solving-based learning module media is quite influential in use in the learning process to

Author (Year)	Title	Research Design	Findings
(2019)	Skills on Physics Learning Outcomes and Problem Solving Abilities	(R&D) which refers to the Four-D (4D) model.	raise the High Order Thinking Skills.
Chairatul Umamah, Maisyatul Azkiyah, Herman Jufri Andi, Suprianto (2021)	The Effect of Applying the Creative Problem Solving Learning Model to Improve Creative Thinking Abilities in Solving Physics Problems in High School Students	The research design used was a non-equivalent control group design	Increasing high school physics learning achievement using the Problem-Solving Laboratory learning model is in the high category.
Mulya Rahmawati, Sutrio, Muh Makhrus (2020)	The Influence of the Problem Solving Learning Model on Students' Cognitive Physics Learning Outcomes at SMA Negeri 5 Pematang Siantar	The type of research used is research and development with a 4D model	The developed learning tools are suitable for use in terms of content and construction in improving students' physics problem-solving abilities.
Dede Nurul (2022)	The Effect of Learning Using the Physics Problem Solving Model (PSF) on Learning Achievement and Critical Thinking Ability	The research method used is descriptive qualitative research, with reference to problem solving strategies	The results of the research show that the difficulties faced by students in solving physics problems include: 1) Lack of ability to relate physics concepts in solving physics problems. 2) Less systematic and less attention to the steps of problem-solving, only focused on the final result. 3) Weak understanding of the principles and rules of physics.
Oka Melawati, Evendi, A. Halim, Yusrizal, Elisa (2022)	Analysis of Problem Solving Ability in Physics Concepts in Momentum Impulse Material in Muhammadiyah 1 Demak High School Students	The type of research used is quasi research, with a nonequivalent control group design	There is an effect of using worksheets on increasing problem-solving skills.
Aristiawan (2022)	Literature Review on Capability Instrument Development	The type of research used is survey research	The majority of students have the ability to solve physics problems in the moderate category.
Rizka Ramdhani, Ahmad Harjono, dan	Problem Solving in Physics Material	This type of research is Research and Development (R&D) with a 4D	This learning tool is feasible to be applied in learning and teaching activities to improve

Author (Year)	Title	Research Design	Findings
Wahyudi (2022)		model	students' physics problem-solving abilities.

From Table 1, it is known that in previous research, the focus was on increasing students' problem-solving skills in learning physics by applying problem-solving learning models and developing learning tools and learning media that could improve achievement and physics learning outcomes for high school students. In this study, an analysis of 25 articles was carried out based on the research design and findings, focusing on analyzing the problem-solving abilities of high school students in learning physics.

Based on the analysis of the findings of 25 articles related to problem-solving abilities in physics learning at the high school level, it is known that 15 articles apply learning models to improve problem-solving abilities and students' physics learning outcomes, including 14 articles applying the problem-based learning model and 1 article applying the CPS model. In addition, there is 1 article that uses worksheets and 5 articles developing learning tools and learning media to improve students' problem-solving abilities. The other 3 articles analyzed students' problem-solving abilities in physics learning, where the findings revealed that most students already had good problem-solving skills. One of the 25 articles also revealed some difficulties for students in solving problems in physics: 1) Students were less able to relate physics concepts, 2) Students were less systematic, paid less attention to problem-solving steps, and only focused on results. course, 3) Students have a weak understanding of the principles and rules of physics.

Based on the analysis of the research design of 25 articles related to problem-solving abilities in physics learning at the high school level, it is known that 5 articles use the type of development research, including using the ADDIE model and the 4D model. In addition, there are 3 articles with the kind of classroom action research, 1 article using the type of survey research, 13 articles using the experimental method, 1 article using the method of observation and literature review, and 2 articles to the kind of qualitative research.

The analysis of the 25 articles shows that student's problem-solving abilities can be increased by developing learning tools such as research conducted by (Rahmawati et al., 2020; Sakahuni & Ramadhanti, 2021; Wirayuda et al., 2022), who developed reasoning and problem-solving model learning tools in improving students' physics problem-solving abilities. In addition, research by (Nisyah et al., 2019; Afrianty & Yolviansyah, 2021; Putri & Simbolon, 2022) developed an inquiry model learning tool combined with an advanced organizer to improve students' physics problem-solving abilities. Besides that, applying learning models can also improve students' problem-solving abilities, such as research conducted by (Firmansyah et al., 2022) applying problem-based learning models, with the results of his research showing that this learning model can affect students' physics problem-solving abilities. In addition, learning media also helps improve students' problem-solving abilities, such as research conducted by (Mega & Makiyah, 2021), with the results of his research showing that Problem-Based learning modules can help improve students' problem-solving abilities.

The update in this study was to conduct a literature review for 25 articles by analyzing the research design and findings from previous studies. The focus of this research was the analysis of problem-solving skills in physics learning for high school students. Whereas previous research only developed learning tools and learning media, applied learning models to improve problem-solving abilities and did not conduct a literature review of previous research. The study also synthesizes previous studies' findings and recommendations and identifies the literature's strengths, weaknesses, and gaps. The study contributes to the literature on physics education and problem-solving by providing a comprehensive and systematic overview of problem-solving learning in physics learning. The limitation of this study is that it only relies on secondary data from previous studies, and it does not measure the actual impact of problem-solving learning on students' physics problem-solving abilities. Therefore, the researcher hopes that further research can be carried out on background analysis, samples, and others and can be carried out on research subjects of elementary, junior high, and tertiary students. Future research may conduct empirical studies to test the effectiveness and feasibility of the problem.

CONCLUSION

Based on the research that has been done, it can be concluded that almost all of the articles apply learning models and use experimental methods to improve high school students' physics problem-solving abilities. The research contributes to the physics education and problem-solving literature by providing a comprehensive and systematic overview of the existing literature on problem-solving learning in physics learning. The novelty of this research is that it introduces a new framework of problem-solving learning in physics learning. The research also provides empirical evidence of the effectiveness and feasibility of problem-solving learning in physics learning. Future research may conduct empirical studies to test the effectiveness and feasibility of problem-solving learning in physics learning.

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