



## Analysis of the Difficulties of High School Students in Improving Problem Solving Ability in Physics Learning

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### ABSTRACT

Problem solving skills are very important in the learning process and in everyday life. This study was conducted with the aim of analyzing what factors cause high school students to have difficulty in improving problem solving skills in physics learning. The method used is a Literature Study with qualitative analysis and reviewed 40 journals or articles in the period 2018-2022, journals obtained through Publish or Perish on the Scopus and Google Scholar databases which are certainly from trusted journals. The results obtained in this study are that the models and learning media used must be relevant because they are important factors that must be considered first in improving the problem solving abilities of high school students. In addition, students are only able to write what is known and asked, without knowing how to solve and students also still have difficulty in distinguishing the equations of physics formulas that will be used in solving problems. Efforts to improve problem solving are to use relevant learning models, such as those used by researchers from the literature study that we have done, namely PBL, PjBL, Inquiry and Discovery Learning. And STEM-based learning has also been shown to be effective in several studies to improve the problem-solving abilities of high school students in physics. And students also need a lot of practice in solving problem solving problems.

### INTRODUCTION

Development rapid access and resources require innovation in the world of education in the learning process. Students must be trained to have appropriate skills with the passage of time (Eka et al., 2022). Learning is a need that must be met by every human being, by learning we will gain knowledge and be able to compete in this 21st century, Life in the 21st century requires many different skills that must be mastered by someone so that it is expected to help students master these skills to become successful individuals in his life (Hidayati & Sinaga, 2019). In this modern era, competition in the world of work is extraordinary, which requires us to learn and add and upgrade our knowledge. Meaningful learning is described in various terms as a type of learning to gain new knowledge or understand new information and concepts based on what students already know and personal experience that will be done (Eshchanov & Matyakubov, 2020).

Besides that education is very important, therefore we need education. Education is a humanization process that allows humans to manifest itself in life, and a good education not only prepares students for their profession and status, but also solves the problems they face in their daily life (Dewi & Primayana, 2019; Sunarti, 2022). In addition, education is a way of forming human abilities to maximize reason and logic in answering problems that arise in fighting for a good future (Hafidzah et al., 2021). Education is also something that cannot be separated from human life. Education can be used as a benchmark for the progress of the nation. Developed countries are

countries that have quality human resources both in terms of spirit, intellect and skills (Hasibuan et al., 2018). To implement this, reforms and evaluations must be carried out to realize a better education. As was done in this study, namely finding out what difficulties students experienced in improving problem-solving skills, especially in the field of physics which we will discuss later, by knowing what difficulties experienced by our students we can create new innovations to make education in Indonesia possible. Indonesia is getting better.

In the learning process, the teacher or an educator has a very important role in teaching students to understand a lesson and solve problems that exist during the learning process. Educators must manage the learning process effectively, Because so much information can be collected, the development of information technology can be used to facilitate learning in solving problems. With a little innovation, changing the way we learn can happen in the midst of technological advances (Rozal et al., 2021). Learning today is different from previous generations, because the process of growth and development is closely related to the digital technology environment (Puspitaningrum et al., 2021; Putra et al., 2021). In this study, we will discuss physics, a subject that is often considered difficult by students. Physics is one of the subjects that according to most students is a difficult subject to learn because the lessons are full of formulas and are abstract. In addition, physics is also one of the school subjects that plays an important role in shaping students' minds to become quality human beings. One of the goals of physics lessons is to equip students with an understanding of physics, as well as how the different physical quantities are related (Weber & Wilhelm, 2020). And the function of physics subjects is to develop experience, understand concepts, apply concepts to solve problems in everyday life, and develop science and technology, especially for high school students (E. Kurniawan & Sofyan, 2020). Physics is the heart of the development of information and communication technology that has fundamentally changed human life. Based on a global and historical perspective, physics offers a more dynamic way to help people solve complex life problems (Prahani, Deta, et al., 2021). One component that is difficult for students to improve in learning physics is problem solving ability.

Problem solving is considered an important 21st century skill that combines cognitive processes and metacognition. In the era of information technology, the ability of students to think and solve problems is very important for students to have world-class knowledge to build a country (Suciati et al., 2020). The ability to solve problems is one of the basic skills that everyone needs to meet the increasingly complex demands of life (Gunawan et al., 2020; Nurmaliah et al., 2021). Problem solving skills are very important to be trained on students because through these skills students learn to be more independent and can train higher order thinking (Dwita et al., 2021). Students use problem solving skills to analyze relevant information, the relationship to the problem, and the problem that needs to be taken to solve the problem (Septriwanto et al., 2021). With the above explanation about physics which is a difficult subject, so that in improving problem solving students also experience difficulties. Problem solving is an important and central part of learning physics. In addition, problem solving is an individual or group effort to find answers based on people's knowledge, understanding, and ability to meet the demands of unexpected circumstances (Sustainable, 2021). If students have good problem solving skills, then the problems that arise will be solved appropriately. In the face of global competition, problem solving

skills are needed and various efforts are needed to improve students' problem solving abilities (Sarwi et al., 2021). But the fact is that there are still many students who have difficulty in improving their problem solving skills (Gavali & Banu, 2020). The indicators used by students in improving their problem-solving skills are very diverse, one of the indicators that is often used is the indicator from Polya, which consists of) Understanding the problem. 2) Create a strategy or solution plan. 3) Solve the problem according to the plan you made and 4) Review the answers. There are also those who use the ACCES indicator (Assen the problem, Create a drawing, conceptualize the strategy, Execute the solution, Scrutinize your result), and many more indicators are used to improve problem solving according to experts.

From the discussion and problems that have been presented above, the purpose of this study is to analyze the difficulties of high school students in improving problem solving skills in physics lessons in Indonesia, this is expected to be an evaluation, both for students and teachers so that students' difficulties in improving their solving abilities problem can be solved immediately.

## RESEARCH METHOD

This study uses a literature study method that aims to describe the difficulties of high school students in improving problem solving skills in physics lessons in Indonesia. In the study of literature, the researcher must follow established rules such as, Systematically identify theories, find literature, and analyze documents containing information about the research topic. (Imran & Ahda, 2022). This research was conducted based on previous researchers and the journals to be reviewed are journals whose research is carried out in Indonesia. Researchers will review 40 journals relevant to the research title, using Publish or Perish on the Scopus and Google Scholar databases. The articles or journals used are articles published in the last year, 2018 – 2022. The following are the steps used in conducting this research.

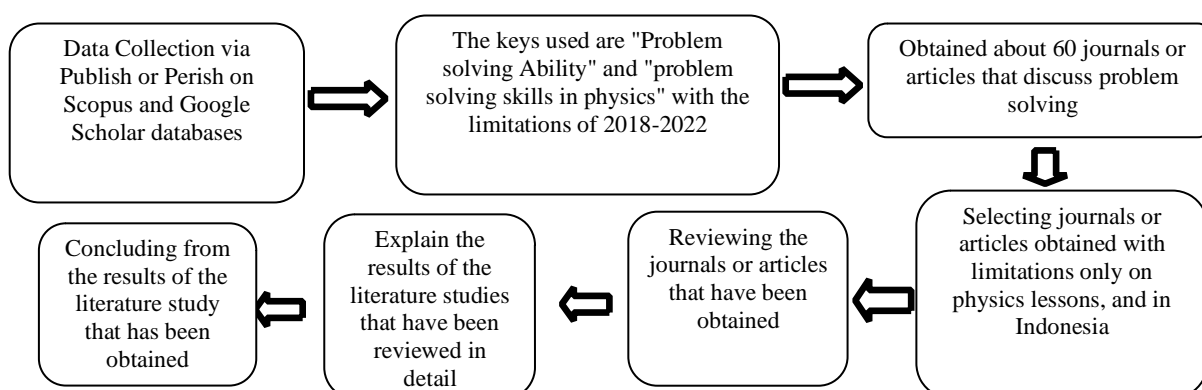


Image 1, Flowchart research on the profile of students' difficulties in improving problem solving

## RESULTS AND DISCUSSION

From the results of the Literature study that has been carried out, there are 40 journals with a range of 2018-2022 that discuss students' problem-solving abilities in Physics lessons. The following is a summary of the literature study contained in the appendix in Table 1.

### **Definition of improving students' problem solving skills**

Problem solving skills are cognitive activities in the learning process, namely problem solving skills related to aspects of thinking and reasoning skills (Cindikia et al., 2020). The importance of problem solving skills in learning physics in secondary education is based on the characteristics of the nature of complex physics concepts (Herayanti et al., 2020). In problem solving abilities students are not only expected to understand concepts but concepts that have been understood can be used to solve physics problems. In addition, problem solving learning exposes students to the real world or simulation problems, works together in groups to develop problem solving skills or problem solving, and then expects students to become individuals who have good problem solving skills (Dwikoranto, 2022). Learning that begins with presenting student presentations Can learn independently, problem solving skills are also very important to be used during experiments especially in physics learning there are many experiments or experiments that will be carried out (Dwita et al., 2021). Poor understanding of concepts requires learning because students' problem solving skills are low This allows you to build knowledge and make learning more meaningful (Top & Confident, 2021).

### **Troubleshooting Ability Indicator**

In the 40 journals that have been carried out, there are 3 indicators used in the 40 studies that we have reviewed, the first indicator according to Polya (1973), there are four steps that can be taken to solve the problem. That is, (1) understand the problem. (2) Problem solving plan. (3) Execute a troubleshooting plan. (4) Verification of the integrity of problem solving, Two indicators of problem solving using ACCES, namely Assen the problem, Create a drawing, Conceptualize the strategy, Execute the solution, Scrutinize Your Result, the last indicator is the problem solving indicator John Dewey (1933) by Carson (2007), he suggested five, which include Recognizing the problem, Diagnosing or defining the problem, Collect several solutions, Estimate the solution, and Expected test. Of the 3 indicators that have been mentioned, the indicator that is widely used is the problem solving indicator from Polya.

### **Students' difficulties in improving problem solving skills**

In this study, we will enter into the main discussion. Namely analyzing the difficulties and factors causing the difficulties experienced by students in improving problem solving in physics learning, especially in high school. The cause of students having low problem solving abilities is low self-efficacy, if students have high efficacy then their problem solving abilities will be better (Susanti et al., 2021). And in improving problem solving students experience some difficulties, students are only able to write known and asked, without knowing how to solve and Students also still have difficulty in distinguishing the equations of the formula that will be used in solving problems (Annisa et al., 2020). Sometimes students can only work on some indicators of problem solving and there are also students who have difficulty in determining the problems that must be solved from a problem (Widiasih et al., 2018). Students also lack practice to work on problem solving problems related to physics (Uminingtyas et al., 2019). Another factor that causes difficulties in improving problem solving from several journals that have been studied is the learning model and the media used are less relevant and the learning delivered is also too monotonous. In research (Habibullah &



Hartono, 2019) Students' difficulties in physics As a result, 14.77% of students have difficulty in factual knowledge, 17.05% have difficulty in conceptual knowledge, 45.46% have difficulty in procedural knowledge, and 53.41% have difficulty in metacognitive knowledge.

Of the 40 journals that have been reviewed, many students still do not understand the basic concepts of physics, students' mathematical abilities are weak, do not ask questions when they do not understand the material and many more. Other factors that can cause difficulties for students in learning physics include lack of time, carelessness, anxiety, giving up easily, and not being thorough in answering questions, always wanting to finish without rechecking the answers (Fitriani & Arnawa, 2020). Other factors are that they do not understand the lessons taught, as well as the thoughts of students who always think that physics is difficult and lack of practice in working on questions (Yanto, 2019). From several studies, it was also stated that school facilities that do not provide physics laboratories are also a factor in students' difficulties in solving problems. On research (Sutriani & Mansyur, 2021) Interviews were conducted with students regarding the difficulties and the factors caused so that students' problem solving abilities did not develop or even decrease. Some of these factors Have a weak memory, Do not match the troubleshooting indicators, Lack of student motivation, then Fear, doubt, neglect, Lack of students' ability to express, Students have low ability to understand concepts, and The strategy used is not right.

### **Overcoming difficulties improve problem solving skills**

To overcome the difficulty of improving problem solving abilities, as well as the factors that make it difficult for high school students to improve their problem solving skills in physics learning. Physics is known as a very difficult subject and has many formulas and various concepts (Jua et al., 2018). Teachers must prepare learning models and learning media that are fun and supportive to improve student problem solving in physics lessons (Ari Masitoh et al., 2021). From the journals that have been reviewed, the relevant learning models to improve problem solving are PBL, PjBl, Discovery and Inquiry. learning media using e-learning, simulation videos, teaching aids. And also STEM-based learning which has been proven in several studies to be effective in improving student problem solving. Students must often carry out laboratory activities, work on questions, discuss groups to practice problem solving skills in Physics. As well as to overcome the factors that cause high school students difficulty improving problem solving are, Be more careful in re-examining the answers to the problems, Listening when the teacher explains, Repeat learning at home, Increase motivation and enthusiasm to learn physics, and Sharpen memory (Habibullah & Hartono, 2019).

### **CONCLUSIONS**

This study aims to analyze the difficulties of high school students in improving problem solving skills in physics lessons in Indonesia, the limitation of this research is the journals used are journals whose research was carried out in high schools in Indonesia and the time span is the last 5 years, namely 2018-2022. Based on the results of literature studies that have been carried out regarding the problem solving difficulties of high school students in physics learning, it can be seen that students' difficulties are mostly caused by irrelevant learning models and media. As well as students only being able to write known and asked, without knowing how to solve and

students also still have difficulty in distinguishing the equations of the formula that will be used in solving problems. This is because students have not mastered the indicators of problem solving and the concepts of the physics material being asked. There are many factors that make it difficult for high school students to improve problem solving, one of which is a lack of practice in working on problems regarding problem solving. Efforts were made to overcome the difficulties of improving problem solving by using relevant learning models such as PBL, PjBl, inquiry and discovery. And learning media that can support improving problem solving. And we must often practice problem-solving ability questions. In further research, it is hoped that researchers can determine models and learning media that can support in improving problem solving for high school students, especially in improving problem solving.

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## ATTACHMENT

**Table 1.** Literature review of the difficulties of high school students in improving problem solving in physics learning

Author (Year)	Characteristics Sample	Design Study	Finding
(Melawati et al., 2022)	The number of samples taken were 62 students from 2 class XI at SMAN 1 Woyla in the 2021/2022 academic year	<ul style="list-style-type: none"> <li>Quantitative Approach</li> <li>Quasi Experimental Research Design</li> </ul>	Difficulty in Improving problem solving skills is dependent on the learning model used.
(Annisa et al., 2020)	This research was piloted on 30 students of class XI IPA SMA Negeri 2 Jenggawah	<ul style="list-style-type: none"> <li>Using the design nieveen model of development</li> <li>Using Pre-test and Post-test</li> </ul>	In improving problem solving students experience some difficulties, students are only able to write known and asked, without knowing how to solve. Students also still have difficulty in distinguishing the equations of the formula that will be used in solving problems.
(Uminingtyas et al., 2019)	The research subjects were 13 physics teachers from 7 high schools in Surakarta	<ul style="list-style-type: none"> <li>concurrent triangulation strategy and descriptive analysis method</li> </ul>	The cause of the lack of students' problem-solving skills is lack of practice
(Meisaroh et al., 2020)	This research was conducted on 30 students of class XII IPA 5 at SMAN 1 Driyorejo	<ul style="list-style-type: none"> <li>Preliminary research method</li> <li>In the form of written tests, student questionnaires, teacher questionnaires</li> </ul>	In this study, the difficulty experienced by students was that there was no laboratory for students to conduct experiments directly, so it was difficult for students to improve their problem solving skills.
(Ari Masitoh et al., 2021)	This research is in the form of bibliometric analysis. There were 52 articles analyzed which were taken from 24 journals over a period of 20 years, namely 2001-2020.	<ul style="list-style-type: none"> <li>Bibliometric Analysis</li> </ul>	The difficulty in improving physics problem solving is because the learning model used is less relevant, and the development of instruments and media also affects in improving this problem solving
(Darmaji et al., 2019)	This research was taken from 144 students who took the subject of Basic physics at the University of Jambi	<ul style="list-style-type: none"> <li>This research is, development research, implementation phase, and evaluation.</li> </ul>	The difficulty is that the media used in physics learning is irrelevant, therefore the development of e-modules is carried out which is one way to overcome students' difficulties in improving



			students' problem-solving abilities in physics.
(Apriyani et al., 2019)	The research sample was 27 students of class X in one of the Vocational High Schools in West Bandung Regency	<ul style="list-style-type: none"> <li>• Pre-Experiment research method</li> <li>• Design One Group pretest-Posttest</li> </ul>	In this study, it was found that before the STEM-based PBL and PjBL models were applied, students were still weak in visualizing a problem or problem in learning because it was less relevant to the learning model used.
(Rokhmat et al., 2019)	The number of samples used were 33 students from one high school in Mataram	<ul style="list-style-type: none"> <li>• The research design used is a mixed method embedded experimental design</li> </ul>	The difficulty experienced by students is the lack of physics experiments carried out so that students find it difficult to imagine the material being taught and it also makes it difficult for students to improve their problem solving skills.
(Fitriani & Arnawa, 2020)	The samples used were students in class SMAN 14 Padang, 33 students, SMAN 15 15 students in the 2018/2019 school year	<ul style="list-style-type: none"> <li>• Descriptive research with a qualitative approach</li> </ul>	When the questions are presented, many students have not been able to solve problems with mathematical problem solving indicators, and students are also still dependent on sample questions, where the sample questions are not always the same as the questions that will be given by the teacher.
(Habibullah & Hartono, 2019)	The research subjects were 22 students who were selected by random sampling technique from one of the high schools in Indragiri Hilir	<ul style="list-style-type: none"> <li>• Qualitative Descriptive Research</li> </ul>	Factors that can cause difficulties for students in learning physics include lack of time, carelessness, anxiety, giving up easily, and not being thorough in answering questions, always wanting to finish without checking the answers again.
(Hidaayatullah et al., 2020)	The sample of this research is the students of class X SMAN Negeri Surabaya. There are 3 groups consisting of one experimental group (X-MIA 4) and two replicate groups (X MIA-5 and X MIA-6)	<ul style="list-style-type: none"> <li>• Pre-experimental quantitative approach</li> <li>• One group pre-test post-test design</li> </ul>	In this study, the difficulty of students in improving problem solving was the lack of practice in identifying and evaluating any existing problems. After the PBL model was applied, the students' problem solving abilities increased.
(Jua et al., 2018)	The research sample is social studies students	<ul style="list-style-type: none"> <li>• Descriptive research</li> <li>• Collecting data by</li> </ul>	The concept of student learning is not listening when

	in class X at SMAN Connect Macan, Sragen, who are cross-interested in taking physics lessons	making observations, taking tests, interviews, etc.	the teacher explains, not studying before doing class lessons, last week's material that is not repeated, does not understand the basic concepts of physics, students' mathematical abilities are weak, and do not ask questions when they do not understand the material. from these factors students also have difficulty in improving problem solving skills.
(Mustakim et al., 2020)	Tadulako universitas university physics education student	<ul style="list-style-type: none"> <li>Qualitative research methods, or Naturalistic research</li> </ul>	Causal reasoning has an important role in students in solving problems, the low level of causal reasoning in students is one of the difficulties to improve problem solving abilities.
(Prahani, Susiawati, et al., 2021)	The number of samples used was 84 students of SMA Negeri 1 Driyorejo.	<ul style="list-style-type: none"> <li>Research Design (DRD) descriptive method</li> </ul>	The problem solving ability of students based on the ACCES indicator is still relatively low. Problem solving skills have been taught by the teacher, it's just that students lack practice and need interactive learning models and media to improve problem solving.
(Retno et al., 2019)	The population in the study consisted of class X students of SMK Negeri 5 Surakarta for the 2018/2019 academic year which consisted of 7 majors and 22 classes.	<ul style="list-style-type: none"> <li>The type of research is quasi-experimental</li> </ul>	This difficulty occurs because the learning model is not appropriate and students' abilities and ways of learning are different.
(Sartika & Humairah, 2018)	Physics students who have taken Modern Physics	<ul style="list-style-type: none"> <li>Qualitative Descriptive</li> </ul>	From this research, the main factor is that it is difficult for students to understand the problem and determine the equation that will be used in solving the existing problem.
(Taqwa et al., 2019)	The research sample used was 118 physics education students at UNY	<ul style="list-style-type: none"> <li>This study uses pretest and posttest</li> </ul>	Students are not able to describe problems in physics, few students are aware of the importance of evaluating answers in the problem solving process. And students find it difficult to use what

			formula to use.
(Wati et al., 2020)	The research subjects were 33 students of class X in one of the senior high schools in Banjarmasin	<ul style="list-style-type: none"> <li>Using one group pretest and posttest design</li> </ul>	Students are only able to solve simple problems and when complex problems are presented students have difficulty
(Widiasih et al., 2018)	The research subjects were 50 students of class XI in one high school in the city of Tangerang	<ul style="list-style-type: none"> <li>Using Case Study method</li> </ul>	The ability of students to solve problems has difficulty determining the equations that will be used in solving problems, it requires a lot of practice questions and learning material from various learning media in order to better understand
(Yanto, 2019)	The research sample is in the form of interviews with teachers and several students in one high school in Indonesia	<ul style="list-style-type: none"> <li>This type of research is development research. audit model Revees (2006), Mc Kenney (2001), Nieveen, et al. (2006) and Plomp (2013).</li> </ul>	The difficulty of students in improving problem solving is that students pay less attention to the teacher when the teacher is explaining, and are embarrassed to ask the teacher when the lessons they are taught do not understand, and the thinking of students who always think that physics is difficult and lack of practice in working on questions.
(Yulindar et al., 2018)	The population of the study was students of class X MIA from SMAN 7 Pontianak, 4 classes with a total of 132 students.	<ul style="list-style-type: none"> <li>Experimental Method</li> <li>Quasi Experimental Research Design</li> </ul>	The value of students' problem-solving abilities is low, caused by not being careful in working on questions and not evaluating or rechecking answers, as well as lack of time in working on problem-solving questions.
(Yuberti et al., 2019)	The research population was all students of class XI IPA SMA Islam Kebumen, Tanggamus district	<ul style="list-style-type: none"> <li>Mixed Method</li> <li>The research strategy is sequential explanator</li> </ul>	Students with poor problem solving skills usually have difficulty understanding the material, studying, obtaining important information in test questions, and finding the right solution. , the answer is sloppy
(Yuliati et al., 2018)	The number of samples taken were all students of class X SMAN 1 Gondanglegi namely 52 students, of	<ul style="list-style-type: none"> <li>Using quasi-experiments</li> <li>Pretest post test design</li> </ul>	The difficulty experienced by students in improving problem solving is that students cannot organize and use their knowledge and

	which 26 students were in the experimental group and 26 students in the control group.		known concepts to solve existing problems, besides that the right learning model is also very influential.
(Nehru et al., 2020)	The number of samples taken were 34 prospective high school teachers from Jambi University	<ul style="list-style-type: none"> <li>• Mixed-Method Research</li> <li>• Explanatory model design</li> </ul>	the category of students in the problem solving process is still classified as beginners. This is because most students run the problem solving process based on the variables that were set initially, not using concepts.
(Susanti et al., 2021)	The population of this research is all students of class X IPA SMA Al-Azhar 3 Bandar Lampung	<ul style="list-style-type: none"> <li>• Using Quasi-Experiment research</li> </ul>	From this research, the cause of students having low problem solving abilities is low self-efficacy
(Rezeki et al., 2021)	The number of samples used was taken randomly with 15 students from MA Hikmatusy yarief	<ul style="list-style-type: none"> <li>• One group pre test post test research design</li> </ul>	Effective causal learning tools are used in problem solving, so learning media also have an important role in improving the problem solving abilities of high school students.
(Araiku et al., 2019)	The number of research samples is 27 students from MA Surya Buana Malang	<ul style="list-style-type: none"> <li>• Preliminary research</li> <li>• With Qualitative Descriptive</li> </ul>	The difficulty of students in physics is their underdeveloped mindset due to lack of learning and practice solving a problem.
(Suryani et al., 2021)	The number of samples used were 77 class XI students in one of the high schools in Bandar Lampung, the 2019/2020 school year.	<ul style="list-style-type: none"> <li>• Using One group pretest pist test design</li> </ul>	The difficulty of students is not repeating learning at home, so they often forget the material that has been conveyed by the teacher, so that problem solving abilities decrease.
(Sutriani & Mansyur, 2021)	The research sample used was 19 students of class XI IPA MAN Cendikia people, Palu City	<ul style="list-style-type: none"> <li>• Qualitative Research</li> <li>• Qualitative Descriptive Approach</li> </ul>	So the difficulty in improving problem solving in this study is that students' memory is weak, does not match the problem solving indicators, lacks motivation, is less thorough, often hesitates and is negligent, has low understanding of concepts and the strategies used are not appropriate.
(Wulantri et al., 2020)	The number of research samples was 66 students of class XII from SMAN 7	<ul style="list-style-type: none"> <li>• Quasi-experimental research</li> <li>• Design Pre test post test, control Group</li> </ul>	The thing that hinders students in improving student problem solving is lack of confidence in working on



	Bandar Lampung	Design	problem solving problems.
(Yuberti et al., 2020)	The population in this study were all students of class XI MIA Madrasah Aliyah Kebumen, Tanggamus Regency.	<ul style="list-style-type: none"> <li>• Using Mixed method</li> <li>• Strategy Sequential Explinator</li> </ul>	Metacognition has an important role in students' skills in solving problems, if students have difficulty solving problems, students' metacognition is low.
(Fiteriani et al., 2021)	The sample used is the experimental class XI IPA 3 and the control class XI IPA 2 in a high school in Lampung	<ul style="list-style-type: none"> <li>• The research used is a quasi-experimental</li> </ul>	The difficulties experienced by students because the models and media used do not facilitate the improvement of student problem solving.
(Mufida et al., 2021)	Determination of research topics using cluster sampling technique. The sample size is 246 XSMA class students who receive work and energy materials.	<ul style="list-style-type: none"> <li>• Pre-experiment method</li> <li>• with a one-shot case study design</li> </ul>	The difficulty of students is to understand the meaning of the problem, so they are still confused to determine the formula to be used
(W. Kurniawan et al., 2019)	The number of samples used is 108 students who have taken basic physics courses	<ul style="list-style-type: none"> <li>• Qualitative approach</li> <li>• Comparative research design</li> </ul>	Science process skills can overcome students' difficulties in problem solving abilities.
(Anggraini et al., 2022)	The subjects of this study were 39 students of grade 10 and 11 of the electrical engineering expertise program at SMK Muhammadiyah 3 Gresik for the 2021/2022 academic year which consisted of 2 classes.	<ul style="list-style-type: none"> <li>• Quantitative Descriptive Research</li> </ul>	The difficulty of students in understanding the material well, becomes an obstacle in students' problem solving abilities, besides that students tend to be less thorough and hasty in solving problems without being checked again.
(Dwikoranto, 2022)	30 students majoring in physics in Statistics class	<ul style="list-style-type: none"> <li>• One group pretest post test Design</li> </ul>	Students are less active in discussing when doing group work to solve a problem or problem
(Simanjuntak et al., 2021)	The sample used in this study were 21 classes in 2 high schools in Medan, with a total of 740 Class X students.	<ul style="list-style-type: none"> <li>• Pseudo Experiment Design</li> <li>• With pretest and posttest</li> </ul>	PBL model with computer simulation to improve student problem solving, effective to use.
(Astuti et al., 2021)	The sample used is in the form of journals or articles on problem solving using STEM	<ul style="list-style-type: none"> <li>• Literature Study Method</li> </ul>	In this study, initially students were only able to make an initial plan, without knowing how to solve the problem, after using STEM-

			based learning it increased.
(Alatas & Yakin, 2021)	The research sample was 70 students of class X from one high school in Tangerang with purposive sampling technique	<ul style="list-style-type: none"> <li>• Quasi-experimental method</li> <li>• Nonequivalent control group design</li> </ul>	In this study, students' problem-solving abilities improved in each indicator after using STEM-based learning.
(Cindikia et al., 2020)	The number of samples is 30 students from SMAN 1 Driyorejo, Gresik.	<ul style="list-style-type: none"> <li>• Method is descriptive</li> <li>• Not to the Hypothesis</li> </ul>	The difficulty of students is that they do not understand the scientific steps in improving physics problem solving.
(Herayanti et al., 2020)	Testing 17 valid instruments	<ul style="list-style-type: none"> <li>• Research development and education</li> <li>• The development model is 4-D</li> </ul>	Problem solving students can develop when conducting group discussions and thinking about solving problems that occur. Physics problem solving skills can be trained by carrying out investigative activities using the scientific method.