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The Impact of Physics Modules Based on Problem Based Learning on The Problem-Solving Abilities of Students in the Material of Optical Instruments

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Abstract: The purpose of this study is to ascertain how students' problem-solving skills are affected by the use of a problem-based learning physics module. A nonequivalent control group design and a quasi-experimental research methodology are used. Test instruments in the form of descriptive questions and non-test instruments in the form of a questionnaire on student replies make up the instruments utilized. Students in grade XI at SMA Darul Falah for the academic year 2022–2023 make up the study population. Purposive sampling was used to choose the research sample, resulting in the experimental group consisting of 21 students from class XI MIPA 2 and the control group consisting of 21 students from class XI MIPA 1. For the experimental group, a customized problem-based learning module in physics was employed. The Problem-Solving Ability instrument consists of descriptive questions that have been tested for validity, reliability, difficulty level, and item discrimination. The experimental group's average post-test score was 83.66, compared to 60.09 for the control group. Both groups' data were uniformly distributed and homogeneous. The hypothesis test results indicated that the calculated t-value was greater than the critical t-value, specifically 6.33, which is higher than 2.02 for the post-test data. Therefore, the alternative hypothesis (H_a) is accepted, and the null hypothesis (H_0) is rejected, indicating an influence of using the physics module based on problem-based learning on students' problem-solving abilities in the topic of optical instruments. Based on the analysis of the questionnaire responses, students' responses improved after the implementation of the physics module based on problem-based learning, with an implementation percentage of 72%. In conclusion, there is an influence of using the physics module based on problem-based learning on students' problem-solving abilities in the topic of optical instruments.

Keywords: Optical Instruments; Physics Modules; Problem Based Learning; Problem-Solving Skills.

Introduction

Because it produces qualified people and advances the Indonesian nation, education is an essential component. As a result, the Indonesian government works continuously to raise the standard of education there (Harefa and Gumay, 2020). Talking about education invariably brings up the central task of learning. How well tactics, learning models, or methodologies are executed has a big impact on how effective learning is. Educators are essential to the teaching and learning process and play a critical part in it (Meilasari et al., 2020). Accordingly, in order to avoid falling behind and to thrive in an environment that is continuously changing and competitive, the younger generation—especially learners—must be able to gather, choose, and manage information (Fatmawati and Murtafiah, 2018). Many innovations are required to raise the standard of education in order to generate graduates who are prepared to compete on a global scale, in

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keeping with the global shifts in the educational paradigm. The goal is to produce graduates who are collaborative, inventive, inventive, competitive, and of high character. Thus, it is imperative to apply learning models that actively engage students in the process of learning (Muslim, 2017). Using the Problem-Based Learning (PBL) model is one learning strategy that can inspire pupils to learn. This learning approach places a strong emphasis on students' problem-solving and solution-seeking activities (Meilasari et al., 2020). PBL requires students to gather as much information as they can, analyze it, and come up with answers to the problems that are presented. PBL equips students with the communication and thinking abilities they need to succeed in the twenty-first century. Furthermore, PBL uses the intelligence of people, groups, and the environment to solve pertinent, meaningful, and contextual problems during the learning process; hence, PBL-appropriate instructional materials are required (Aji et al., 2017).

With the help of the Problem-Based Learning (PBL) paradigm, which is learner-centered, students are exposed to a variety of real-world challenges and work to find solutions. Under this methodology, each session centers upon a problem that needs to be solved by the students, who then have to use their own skills to examine and solve it. A facilitator who offers assistance to the students is the job of the educator (Meilasari et al., 2020). This methodology is made to ensure that students learn critical information that will enable them to solve problems with proficiency and function well in groups. Working in learning teams, students integrate material, communicate, and pool their combined skills (Herlinda, 2017). This model is made to help students learn the fundamentals, which will enable them to solve problems effectively and develop their teamwork skills. In learning teams, students work together to integrate information, communicate, and pool their combined expertise (Herlinda, 2017). It is preferable for educators to equip their pupils to be researchers and problem solvers so they can meet the problems of the twenty-first century (Harefa and Gumay, 2020).

Physics education requires the ability to solve problems, particularly in the twenty-first century. This is due to the fact that the ability to solve problems is a crucial component of learning and is required for both the process of learning and its completion. Students are given the opportunity to practice using the knowledge they have learned (Aulia et al., 2022). This is founded on the premise that problem-solving is a type of learning in which new concepts are generated and prior rules are utilized to develop strategies or solutions (Hadi & Munawir, 2022). As a result, problem-solving is essential to understanding physics (Lukitawanti et al., 2020). Furthermore, the process of problem-solving calls for critical, methodical, logical, creative, and cooperative thinking abilities (Barus and Anil, 2020). Thus, it is essential to solve problems when learning physics (Lukitawanti et al., 2020). According to Sayyadi et al. (2016), the goal of studying physics is for students to be able to use what they have learned to address issues in the real world. Because not all physics material can be explicitly described or provided, learning physics is fundamentally different from learning other subjects (Aripin et al., 2021).

According to Aji et al.'s earlier research, the physics learning module based on Problem-Based Learning (PBL) and covering equilibrium and rotational dynamics is regarded appropriate and can improve high school students' problem-solving skills (Aji et al., 2017). An inquiry-based, scientific learning methodology must be implemented in order to help students become better problem solvers. Problem-based learning, often known as problem-based learning, is one such designed learning strategy. According to Pucangan et al. (2018), problem-based learning can offer real-world experiences that motivate students to take initiative, expand their own knowledge, and apply what they have learned in the classroom to real-world circumstances.

Kurniawan, referenced in Agustina et al. (2022), asserts that the application of the problem-based learning model causes a paradigm change in learning from one that is teacher-centered to one that is student-centered. Therefore, whether basic or technology-based, the use of problem-based learning necessitates the use of media that can support the learning process in order to support this paradigm. The physics module is the chosen medium for this investigation.

A learning module comprises instructional materials that are methodically arranged and captivating, encompassing assessments, techniques, and content. To attain the required capabilities, it can be utilized on its own (Syafri, 2018). Modules often have a well-organized set of exercises pertaining to medium, content, and assessment (Triyono, 2021).

Chomaidi (2018) claims that learning with modules has a number of benefits, such as: Pay attention to each student's unique skills because they are naturally capable of working independently and accepting accountability for their activities, mastery of learning objectives through the application of competency standards that students must meet in every module and the existence of objectives and guidance on how to reach them demonstrates the relevance of the curriculum and helps students make the connection between their learning and the results they will achieve.

By adhering to the modules' specified components, students can participate in self-directed learning through the module. Utilizing this learning module is in line with Indonesia's curriculum development, as modules have the potential to change the focus of instruction from being teacher-centered to being more student-centered. Additionally, modules help teachers mentor students and enhance their resources for learning. An alternative to the typical learning setting is the existence and use of modules, which enable students to study autonomously without the support or presence of an educator. As a result, there is less reliance on professors as pupils gain the ability to independently investigate information and materials. Najuah et al. (2020) have highlighted that this approach is especially pertinent given the current constraints, particularly in situations where face-to-face learning is not feasible. Using modules to teach physics

One of the skills that students have when learning physics is the ability to solve problems, as problem solving activities can help students to build new knowledge and facilitate physics learning (Puspitasari, 2019). This can guide learners to identify problems in daily life, formulate problems, seek solutions, or test answers to a problem through an investigation that ultimately leads to drawing conclusions and presenting them orally or in writing. Problem-Based Learning-based modules exhibit characteristics such as problem-solving instructions, observation of presented problems, problem formulation, hypothesis generation, data presentation, analysis result presentation, conclusion presentation, learning summary, process evaluation, and outcome evaluation (Fakhrudin, 2015).

Based on the interview results conducted by the researcher at SMA Darul Falah, several issues were identified in physics learning. Students perceive physics learning as difficult and boring, mainly because it involves theories/concepts and mathematical equations, resulting in a low problem-solving ability among students. The learning process is still teacher-centered, leading to a lack of student engagement in the classroom. Additionally, the instructional materials, in the form of workbook containing descriptive questions without concepts or theories, fail to capture students' interest in reading. To improve problem-solving skills, it is essential to foster a reading interest among students. The success of a learning process is influenced by the instructional materials used, indicating that teachers have not developed students' problem-solving abilities during the learning process.

Based on the above description, a physics module based on Problem-Based Learning plays a role that can be considered as an alternative in physics learning, enabling students to actively participate and comprehend physics concepts correctly. Therefore, there is a need for research with the title "The Influence of Using a Physics Module Based on Problem-Based Learning on Students' Problem-Solving Abilities in the Topic of Optical Instruments."

There are five phases in the problem-based learning methodology. The following are these stages: developing, directing, organizing, orienting, and assessing.

Table 1. Syntax of Problem Based Learning

Phases	Activities Of The Teacher
Phase 1 Introducing the issue to the class.	The instructor encourages students to participate in the selected problem-solving activities by outlining the necessary practicalities and outlining the learning objectives.
Phase 2 Arranging pupils in order to learn.	The instructor helps students define and arrange assignments that are relevant to the issue.
Phase 3 Directing both individual and group research projects.	The teacher encourages students to conduct experiments, collect relevant information, seek explanations, and think though problems.
Phase 4 Creating and presenting the work's outcomes.	In addition to supporting students in sharing assignments with their peers, the teacher helps them plan and create acceptable works such as reports, videos, and models.
Phase 5 Examining and assessing the process of fixing problems.	In order to reflect or evaluate the investigation and the procedures they have employed, the teacher offers assistance.

(Maulidia, 2019)

Method

The kind of study that was done was quantitative research. There is a quasi-experimental design being used as the research approach. Sugiyono (2018) claims that this experimental design is an expansion of the real experimental design, which has a control group but is unable to completely control outside factors that affect how the experiment is carried out. The effects of employing problem-based learning physics modules on students' problem-solving skills in the area of optical equipment are observed through quasi-experiments.

The research design that was selected is the Nonequivalent Control Group Design. It has two groups, and a pretest is given to both groups prior to any treatment being applied, and a posttest is given following the treatment. The design utilized in this study is shown in Table 2 below for your better understanding.

Table 2. Research design

Class	Pretest	Independent variable	Posttest
Experiment	O_1	X	O_2
Control	O_3	-	O_4

(Sugiyono, 2021)

Information:

X	:	Treatment with physics module based on Problem Based Learning for the Experiment group
$-$	:	Direct (conventional) learning for the Control group
O_1	:	Giving pretest to Experimental group
O_2	:	Giving posttest to the Experimental group
O_3	:	Giving pretest to Control group
O_3	:	Giving posttest to Control group

The high school pupils of SMA Darul Falah's grade XI for the academic year 2022–2023 make up the study's population. The population's overall size and makeup include the sample as well. Purposive sampling, which is a way of selecting samples based on certain concerns, is the sampling methodology that is being employed (Sugiyono, 2018). In this study, XI IPA 1 is the sample that was chosen for the control group and XI IPA 2 for the experimental group.

Tests are the method of data collection employed in this study, and the data consist of pretest and posttest results. Five essay questions will be used as part of the test procedure to collect data for this study, which will gauge students' problem-solving skills. Students in both the experimental and control groups will take this test both before and after class. The development of the essay questions is predicated on signs of problem-solving. A total of 5 items were obtained for the problem-solving ability test after validity, reliability, difficulty level, and discrimination power tests were performed. Preliminary tests for homogeneity, normalcy, and hypothesis testing are part of the data analysis method.

Results and Discussion

This study, which focused on optical instruments, was carried out at SMA Darul Falah from September 2, 2023 until September 16, 2023. The nonequivalent control group design, a type of quasi-experimental research design, is the methodology employed. Two classes with an identical number of participants—21 students—are used in the design: Class XI MIPA 2 as the experimental group and Class XI MIPA 1 as the control group. While the control group was taught using traditional teaching techniques, the experimental group used physics modules based on Problem Based Learning.

Prior to doing hypothesis testing, the researcher created a test instrument consisting of five essay questions. On Wednesday, August 23, 2023, in Class XII IPA 3 at MAN 1 Mataram, the instrument's trial was carried out. The items were deemed genuine when the researcher used the product-moment correlation formula to conduct a validity test and found that $r_{xy} > r_{table}$. After then, a reliability test was carried out with the KR-21 formula, and the results showed that $r_{11} > r_{table}$. The five tasks were deemed easy after a test of difficulty was conducted using the difficulty index. The five examined items were classified as acceptable after a discrimination power test was performed on the item discrimination test. This was done by determining the difference in the percentage of right responses between the two student groups. Based on the conducted instrument tests, the summary of the results can be seen in Table 3.

Tabel 3. Summary of Instrument Test Results

Validity					Reliability	Level Of Difficulty			Differentiating Power
r_{tabel}	r_{xy}	Ket.	r_{tabel}	r_{11}	result	TK	result	DP	result
0.361	0.635	Valid	0.361	20.632	Reliable	2.72	Easy	0.55	Accepted
0.361	0.766	Valid	0.361	20.632	Reliable	2.45	Easy	1.1	Accepted
0.361	0.805	Valid	0.361	20.632	Reliable	2.52	Easy	0.95	Accepted
0.361	0.574	Valid	0.361	20.632	Reliable	1.94	Easy	0.98	Accepted
0.361	0.513	Valid	0.361	20.632	Reliable	2.74	Easy	0.52	Accepted

The test instrument can be used to gauge students' problem-solving skills after the trial. The purpose of the pretest is to gauge the students' initial aptitudes prior to receiving any treatment, and the posttest is to gauge their aptitudes following that treatment. Prior to conducting hypothesis testing, which tries to ascertain whether using physics modules based on problem-based learning affects students' problem-solving skills, the posttest data are examined for normality and homogeneity.

Percentage of Problem-Solving Ability (Pretest)

IPM-1 understanding the problem (visualize the problem), IPM-2 describing the problem (describe the problem in physics), IPM-3 planning a solution (plan a solution), IPM-4 implementing the plan (execute the plan), and IPM-5 evaluating the solution (check and evaluate), are the categories based on the results of the pretest for each indicator, the percentage of the average pretest score can be seen in Table 4.

The percentage of students' average pretest scores for problem-solving abilities is derived from the findings displayed in Table 4. See Figure 1 for a better understanding of the percentage of the experimental and control courses that met the problem-solving skills indicators. The experimental class for IPM-1 to IPM-5 belongs to the extremely low group, as can be seen in the diagram. The control class showed similar outcomes, with IPM-1 through IPM-5 likewise falling into the extremely low category.

Tabel 4. Percentage of Average Pretest Scores for Problem-Solving Skills

Class	Average Pretest Score (%)				
	IPM-1	IPM-2	IPM-3	IPM-4	IPM-5
Experiment	19.047	20.952	33.333	19.999	8.571
Control	17.142	13.333	30.475	24.761	3.809

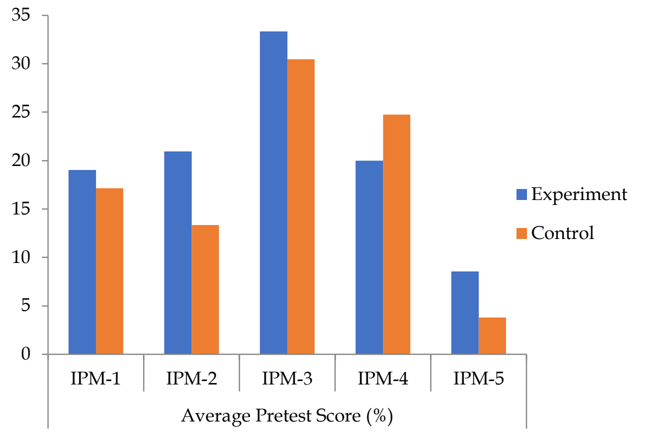

Figure 1. Percentage of Achievement of Problem-Solving Skills Indicators

Homogeneity Test

The homogeneity test for pretest data in the experimental class and control class can be seen in Table 5. It was discovered that the pretest results for problem-solving abilities in the experimental and control groups were homogenous. Prior to treatment, students in the experimental and control groups had similar problem-solving abilities, with a $F_{value} < F_{table}$ value of 1.04 < 2.12. Therefore, it may be said that before to the treatment, both samples were homogeneous.

Percentage of Problem Solving Ability (Posttest)

Table 6 displays the average score for the posttest, which was determined by looking at the problem-solving skills posttest results for each indicator: IPM-1 understanding the problem (visualize the problem), IPM-2 describing the problem (describe the problem in physics), IPM-3 planning a solution (plan a solution), IPM-4 executing the plan (execute the plan), and IPM-5 checking and evaluating the solution.

The percentage of students' posttest average scores for problem-solving abilities is shown in Table 6. See Figure 2 for a better understanding of the experimental and control groups' achievement percentages for the indicators of problem-solving skills.

Table 5. Homogeneity Test Results of Pretest Data on Problem-Solving Skills

Class	Number Of Samples	Variance	F_{count}	F_{tabel}	Meaning
Experiment	21	136.201	1.04	2.12	Homogen
Control	21	126.04			

Tabel 6. Percentage of Average Posttest Score for Problem-Solving Skills

Class	Average Posttest Score (%)				
	IPM-1	IPM-2	IPM-3	IPM-4	IPM-5
Experiment	79.99	66.66	81.90	71.42	37.14
Control	42.85	34.28	77.14	71.42	2.85

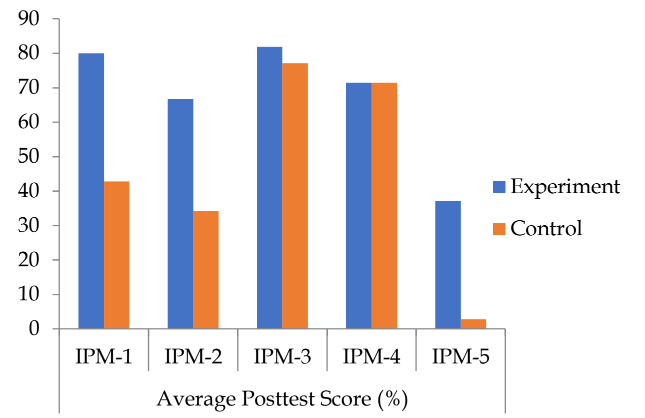

Figure 2. Percentage Achievement of Problem-Solving Skills Indicator

The experimental group indicates in Figure 2 that IPM-1, IPM-2, IPM-3, and IPM-4 are classified as good, and IPM-5 is classified as less satisfactory. IPM-1, IPM-3, and IPM-4 are in the good category of outcomes for the control group, whereas IPM-2 and IPM-5 are in the less desirable category.

Normality Test Results

To ascertain whether or not the test data were normally distributed, the posttest results for the experimental and control groups were subjected to the normality test. Chi-Square formula with degrees of freedom $db = k - 1$. is the formula used to determine sample normality. Table 7 displays the findings of the normality test for posttest data on students' capacity for problem-solving. Table 7 indicates that the experimental and control groups' posttest data are regularly distributed, as indicated by the value ${x_{count}}^2 < {x_{table}}^2$.

Tabel 7. Normality Test Results for Posttest of Problem-Solving Skills

Class	Number Of Samples	db	$x_{tabel}{}^2$	$x_{hitung}{}^2$	Result
Experiment	21	5	11.070	4.3849	Normal
Control	21			1.839	Normal

Hypothesis Testing Results

After homogeneity testing on pretest data and normality testing on posttest data, hypothesis testing is the last step of data analysis in this study. There are 21 students overall ($n_1 = n_2$) between the experimental and control groups, according to the statistics. In this study, the t-test with degrees of freedom (dk) of $n_1 = n_2 - 2$ is used for hypothesis testing. Table 8 displays the data from the results of the hypothesis tests.

Table 8 indicates that in the posttest data, T_{count} < T_{table} table is 6.33 > 2.02. As a result, H_a is approved and H_0 is refused, suggesting that students' problem-solving skills with the material of optical instruments are impacted by physics courses that use problem-based learning.

The purpose of this study was to investigate how students' ability to solve problems in the context of optical equipment was affected by physics courses that utilize problem-based learning. A nonequivalent control group and a quasi-experimental design were employed in the study. Two classes—class XI MIPA 2 as the experimental class and class XI MIPA 1 as the control class—each with an identical number of students, 21, served as the samples for the study, which was carried out at SMA Darul Falah. Problem-Based Learning (PBL)-based physics modules were taught to the experimental class, while traditional learning methods were used with the control group. Treatment was administered to both classes for three sessions, lasting ninety minutes each. Prior to the intervention, both groups completed a pretest consisting.

A test of problem-solving skills was employed as the study's instrument. Thirty students from class XII MIPA 3 at MAN 1 Mataram participated in a pre-test of the problem-solving ability instrument. Empirical validity testing, encompassing validity, reliability, difficulty level, and discrimination power tests, was employed in the problem-solving ability instrument. Class XII MIPA 3 was used for the instrument test because the students had already studied the subject on optical instruments. Out of the five problem-solving questions that were examined, all five were deemed valid based on the computations, with r_{xy} > r_{table} . Because r_{11} > r_{table} was shown in the results, all five questions were classified as reliable. Based on the five questions that were assessed, the questions were categorized as easy in terms of difficulty. The ability to discriminate for the.

Tabel 8. Hypothesis Testing Results for Posttest of Problem-Solving Skills

Class	Number Of Samples	Average	Variance	t_{count}	t_{tabel}
Experi-ment	21	83.66	89.03	6.33	2.02
Control	21	60.09	202.38		

While the control class was taught using the syntax of the traditional learning model, the experimental class was taught using physics modules based on PBL syntax. Following the structure of the Problem-Based Learning model, the experimental class's instruction was divided into five phases: 1) introducing students to the problem; 2) setting them up for learning; 3) supervising individual and group investigations; 4) creating and presenting findings; and 5) assessing and evaluating the problem-solving procedure. During the first phase, the instructor explained the learning goals, encouraged participation and excitement for problem-solving exercises, and gave instances of phenomena that were connected to the subject matter being covered. During the second phase, students were assisted by the teacher in forming learning groups and receiving investigation work sheets.

Afterwards, in the treatment for the control group was administered using the five-stage conventional learning model's syntax. 1) outlining goals and getting students ready; 2) showcasing information and abilities; 3) directing instruction; 4) assessing comprehension and offering comments; and 5) offering chances for additional instruction and application. The teacher gave an apperception in the form of questions regarding the reasons for a specific phenomenon in the first stage, and then the teacher presented the information in the second. Students were given multiple exercises in the form of individual tasks throughout the third stage. During the fourth phase of the lesson, the instructor requested that student representatives write down and clarify how to answer these challenges. The teacher gave the material's final findings in the fifth step.

The five signs of problem-solving ability are as follows: comprehending the issue (visualize the issue), characterizing the issue in physics (describe the issue in physics), planning a solution (plan a solution), carrying out the plan (carry out the plan), and verifying and assessing the outcome (verify and assess). For every indication, the percentage values from the pretest results were acquired. The results of the students' solutions to the offered questions demonstrate that, in terms of IPM-1 understanding the problem (visualize the problem), neither class was able to comprehend the significance of the given problems. Low scores on the IPM-2 describing the problem in physics (describe the problem in physics) test showed that neither class was able to adequately explain the challenges that were asked. IPM-3 solution planning (opportunity planning) based on

To ascertain the students' starting abilities, a pretest was given in both the experimental and control classrooms. The pretest findings showed that the pupils' early problem-solving skills were lacking, as seen by the outcomes being relatively low. In the experimental class, the pretest mean score was 23.62; the maximum score was 46, and the minimum score was 8. For the control class, the average score was 24.95; the highest score was 44, and the lowest was 8. Homogeneous data were acquired for both classes based on the homogeneity test for pretest data on students' problem-solving ability.

The following qualities of problems that can be solved to gauge a student's problem-solving ability: 1) The problem is complicated; 2) It needs to be made interesting for the students to solve; and 3) It is made such that solving it will take more than one or two steps. 4) The challenge is applicable to real-world issues, and 5) The solution's purpose is evident (Nabilah, 2021). When physics modules built on PBL are used instead of traditional learning models, indicators of problem-solving abilities are trained more. The average posttest results for students' problem-solving skills show that this is the case, with the experimental class scoring higher overall than the control group. The mean score on the posttest.

In comparison to the pretest data, the percentage scores for each problem-solving ability indicator in the posttest results rose in both classes. In comparison to the prior findings, both classes demonstrated improvement for IPM-1 understanding the problem (visualize the problem), with the experimental class demonstrating noticeably more progress than the control group. Students were able to comprehend the meaning of the supplied difficulties. IPM-2's description of the physics problem produced positive outcomes for the experimental class, but it was nevertheless rated as fair for the control group in terms of physics problem description. This suggests that, despite a minor improvement over the pretest results from earlier, the control class did not pay attention to the teacher's explanations in class, which led to less progress. Based on the outcomes, both classes have successfully demonstrated improvement in IPM-3 planning a solution (plan a solution) for tackling the given challenges. This shows that the students in both classrooms are always aware of and attentive to the teacher's explanations during class. But the experimental class also has an advantage over the control group as they have received extra help in problem-solving and are able to recognize physics concepts and principles and apply them methodically in the form of equations. The findings of IPM-4 carrying out the plan (carry out the plan) showed that both classes could apply solutions to solve issues precisely and correctly. The identical answers that were produced demonstrate the students' abilities to solve problems by changing the values of each variable in the physics equations. For the experimental class, IPM-5 verifying and evaluating the solution (check and evaluate) also produced a minor improvement, although it was still in the fair category for evaluating or double-checking the completed answers. In contrast, the control class's scores from the prior pretest showed a decline. This suggests that the control group's pupils are not confident in the solutions they have been working on, which leaves them perplexed about the last units of.

These findings demonstrate that both the experimental and control groups' pupils' problem-solving skills have increased. The treatments that the experimental class and the control class received differ, which accounts for the variation in the pupils' problem-solving skills. The experimental class, which used PBL-based physics modules, outperformed the control class, which used traditional learning models directly, even though both classes' average scores were higher. The evidence of the disparity in the mean posttest results between the two classes supports this. It is established that physics modules based on problem-based learning have a considerable impact on students' problem-solving skills based on statistical analysis using the t-test.

The hypothesis test was run following the administration of homogeneity and normality tests on the pretest and posttest, respectively. The information gathered indicates that there are exactly 21 students in the experimental class ($n_1 = n_2$), which is the same number as in the control class. The posttest results indicate that, at a 5% significance level, the t_{value} of 6.33 is bigger than the t_table of 2.02 in the hypothesis test of this study, which employs parametric statistics, specifically the t-test. As a result, the alternative hypothesis (H_a) is accepted and the null hypothesis (H_0) is rejected. It is evident that the application of problem-based learning physics modules enhances students' capacity for problem-solving in the subject matter of. This research's findings are corroborated by a prior study by Sudi Dul Aji (2017), which found that using PBL-based physics modules can help high school students become more adept at solving problems. Furthermore, research by Emi Destianingsih (2016) and Mega Ilyasa Wisic (2021) indicates that there are variations in the degree of effectiveness of using Problem Based Learning based learning modules on students' problem-solving abilities. The former demonstrates the influence of the Problem-Based Learning model on students' problem-solving abilities in physics learning in class XI at SMA Negeri 1 Tanjung Lubuk.

As can be seen from the discussion above and the research findings, using physics modules based on Problem-Based Learning can be seen as an alternative resource that helps teachers in schools offer lessons in the classroom. Furthermore, data analysis calculations have demonstrated that the usage of physics modules based on problem-based learning significantly improves students' problem-solving skills in the subject of optical instruments, corroborated by the findings of prior study.

Conclusion

It can be concluded from the research done at SMA Darul Falah, data analysis, and discussions that applying physics modules based on Problem-Based Learning has an impact on students' ability to solve problems when it comes to the material of optical instruments.

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