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Implementation of Authentic Learning on Problem-Solving Skills: A Review of the Effectiveness of the *Kurikulum Merdeka* Teaching Module

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Abstract

One crucial 21st-century competency is problem-solving. Based on the results of the 2022 PISA, Indonesia's mathematics, literacy, and science skills remain low. These skills are the foundation of students' problem-solving skills. This finding is also based on a baseline test conducted at a school in Tanah Laut Regency, which showed that students' problem-solving skills were still low and there was a lack of teaching modules that practiced these skills. Therefore, this study aims to describe a review of the effectiveness of the authentic learning teaching module of the Kurikulum Merdeka on problem-solving skills. This study applies the R&D research type using the ADDIE model. A total of 48 students participated in the trial, comprising 24 students from Class XI C and 24 students from Class XI D at a public high school in Tanah Laut Regency. The data were collected through a learning achievement test. The analysis used an independent sample t-test, complemented by an effect size calculation. Based on the data calculation, the effect size was 1.85, which is categorized as high. This indicates that the developed module is highly effective in training students' problem-solving skills and students' learning performance. Thus, it can be concluded that the authentic learning teaching module of the *Kurikulum Merdeka* is effective for training problem-solving skills. The implication of this study is that the application of authentic learning through teaching modules can be an alternative support for physics learning to train students' problem-solving skills.

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INTRODUCTION

A nation's advancement fundamentally depends on the strength and quality of its educational foundation. Through education, people can become more progressive, critical, and moral thinkers, capable of competing with other nations. Quality education serves as the foundation for developing reliable and skilled human resources. Therefore, a curriculum is needed to organize, provide direction, and provide guidance as a reference for implementing learning activities within an educational setting (Anas et al., 2025; Hutagalung & Kurniati, 2024; Mudzakir & Aslan, 2025). A curriculum should be purposefully structured to embody the transformation of twenty-first-century learning and to cultivate in students the competencies and skills required to confront contemporary global challenges (Anwar & Umam, 2023; Dariyono & Rusman, 2023; Hanipah, 2023).

Kurikulum Merdeka is an innovative approach to educational advancement. In this curriculum, teachers are trained to understand students' needs based on their interests, environment, and culture (Alwi et al., 2023; Aini & Adiyono, 2023). According to Bahriah et al. (2022), *Kurikulum Merdeka* is often referred to as an evaluation of the 2013 curriculum. According to the Ministry of Education and Culture, *Kurikulum Merdeka* emphasizes diversity in intracurricular learning activities. *It* is defined as a form of learning where students are given the opportunity to learn in a calm, relaxed, enjoyable atmosphere, and are free to demonstrate their natural talents (Cahayani & Suastra, 2024; Zainudin et al., 2025). *Kurikulum Merdeka* highlights the significance of cultivating 21st-century competencies among students. One of these skills is problem-solving skills (Arifuddin et al., 2023; Asyafaah et al., 2024; Ayudha & Setyarsih, 2021; Hanipah, 2023; Qotrunnada, 2022).

Problem-solving skills involve students' ability to interpret available information and choose the best course of action in a given situation. These skills prepare students by practicing the ability to transform information into problem-solving actions in various situations (Nadrah, 2023; Wardani, 2020). Problem-solving skills are a critical component for students' success in learning, particularly in physics (Haratua & Sirait, 2016; Musengimana et al., 2025). This is because nearly all aspects of physics focus on problem-solving. Beyond focusing on problem-solving, physics is also closely related to real-life situations (Ridho et al., 2020; Supriyadi et al., 2022). According to Heller, indicators of problem-solving skills include focusing on the problem, describing the physics, planning a solution, implementing the solution, and re-checking. However, according to Adinia *et al*. (2022), The skills of Indonesian students to solve problems is still considered relatively low.

The low problem-solving skills are evidenced by findings from the Program for International Student Assessment (PISA). The 2022 PISA results showed that Indonesia experienced a decline in scores, with mathematics ability declining 13 points to a score of 366, literacy ability declining 12 points to a score of 359, and science ability declining 13 points to a score of 383. These scores are below the average for Organization for Economic Co-operation and Development (OECD) countries (Schleicher, 2023). PISA findings demonstrate low problem-solving skills. The low PISA results in reading, mathematics, and science literacy indicate that students lack the ability to understand, analyze, and connect information. These skills are essential foundations in the problem-solving process. This is in line with Riyani & Hadi (2023) who stated that low PISA results are related to low problem-solving skills (Riyani & Hadi, 2023).

Initial testing in two high school classes in Tanah Laut District showed that students achieved average scores of 0.00 in focusing on problems, 16.67 in describing physics, 1.04 in planning solutions, 0.46 in implementing the solution, and 0.00 in re-checking, indicating low problem-solving performance across all stages. The results of the data show that below 55, according to Hadi & Radiyatul (2014), students have not yet reached the sufficient category reflects that their problem-solving skills remain low. Students reach the good category if they get a minimum score of 65 (Hadi & Radiyatul, 2014).

Based on interviews with the school's physics teacher, it was discovered that some students still struggle with problems requiring analytical problem-solving. If these students are less active, they will face challenges in solving these problems. The school uses the Kurikulum Merdeka. The teacher frequently employs conventional methods (lectures). The school already has a physics learning toolkit developed by the physics teacher. This module is quite helpful, but further development is needed because the existing module does not meet the demands of the Kurikulum Merdeka. According to the teacher, it is crucial to include problem-solving skills as part of the learning process. Therefore, the teacher needs a variety of learning modules. One approach that can train problem-solving skills related

to real life is authentic learning (Humayrah et al., 2022; Ridho et al., 2020; Supriyadi et al., 2022).

Authentic learning emphasizes engagement with real-world contexts through problem-based tasks, case analyses, individual and collaborative practices, as well as exploration of complex problems and their possible solutions (Nadrah, 2023; Ramadhani et al., 2021; Wati et al., 2024). One focus of authentic learning is problem-based activities. These problem-based activities, when implemented, will certainly train students' problem-solving skills (Ridho *et al*., 2020). This aligns with Wati *et al*. (2022), who stated that problem-solving skills can be practiced by applying learning concepts to real-world problems, enabling students to rationalize the physics material they are learning and making the learning more meaningful. In addition to enhancing problem-solving skills, authentic learning supports the Kurikulum Merdeka's principles of flexibility and meaningful learning (Khalik *et al*., 2025).

Integrated learning innovations by authentic learning can help students connect physics concepts with real-world problems (Aynas & Aslan, 2021; Oktaviana et al., 2017). Authentic learning offers students opportunities to engage in discussion, exploration, and conceptual construction while linking their understanding to real-world issues. This approach motivates learners to relate the challenges they encounter in everyday life to the new concepts being learned (Ramadhani et al., 2021; Wati et al., 2023). Authentic learning implemented in the Merdeka Curriculum teaching modules has significant potential for fostering problem-solving skills. Various studies have shown that the authentic learning approach can develop students' problem-solving skills. Studies conducted earlier by Arsyad *et al*. (2020), Wati *et al*., (2022), (Saputri et al., 2021), and Supriyadi *et al.* (2022) show that authentic learning-based teaching materials and modules can train problem-solving skills.

Based on the aforementioned background, problem-solving skills are essential for students to possess. Nevertheless, findings from a preliminary study conducted at a senior high school in Tanah Laut Regency indicate that these skills remain relatively low. Therefore, it is necessary to provide specific intervention through the development of a teaching module aligned with the Kurikulum Merdeka. However, previous research findings still reveal gaps that require further study. Previous research developed learning tools that were developed referring to the curriculum in effect at that time, namely the 2013 curriculum. To date, according to the Google Scholar database, there has been the development of authentic learning-based physics teaching modules to train problem-solving skills. However, no research has been reported in the Google Scholar database on the development of *Kurikulum Merdeka-based* physics teaching modules that use authentic learning as a means to train students' problem-solving skills. The module developed in this study was designed in accordance with *Kurikulum Merdeka* and is characterized by the integration of authentic learning elements. In this developed teaching module, there is the development of authentic problems presented in the problem orientation of Student Worksheets 1, 2, and 3 that can be searched in the news and near the location studied. In addition, the Learning Outcome Test developed raises authentic issues in the area of the school studied. This study aims to describe a review of the effectiveness of the authentic learning teaching module of *Kurikulum Merdeka* on problem-solving skills.

METHODS

This research is a type of Research and Development (R&D) study designed to produce a physics learning module that is aligned with *Kurikulum Merdeka* and integrated with authentic learning elements to train students' problem-solving skills. The integration of authentic learning in this module is found in authentic images on the module cover, authentic problems in the student worksheets, and the learning outcome test, which are

arranged based on the stages of problem-solving skills. The development process followed the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model (Ali, 2018). The ADDIE development model was applied in this study using a posttest-only control group design. Prior to its implementation, the module had been examined for both validity and practicality to ensure its readiness for classroom application. The ADDIE flowchart is shown in Figure 1.

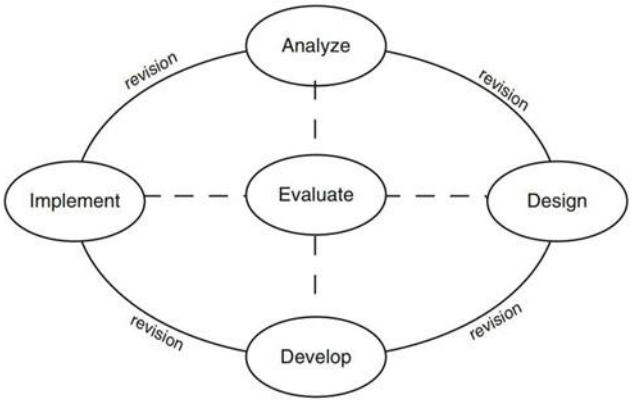


Figure 1 ADDIE flowchart
(Branch, 2009)

The trial involved 24 students of class XI D as the experimental group and 24 students of class XI C as the control group from a school in Tanah Laut District. The research period was from August 2024 to July 2025. The study collected data via a student learning outcomes posttest for both the experimental and control groups. The learning outcome test consists of three essay questions, each with a 90-minute time limit. The developed learning outcome test includes indicators of problem-solving skills: focusing on a problem, describing physics, planning a solution, implementing the solution, and re-checking. The scores were analyzed using an independent sample t-test, preceded by assumption checks including normality and homogeneity, and followed by effect size computation.

A normality test serves to identify if the sample data represent a population with a normal distribution pattern (Nuryadi *et al*., 2017). Two approaches are commonly utilized: Kolmogorov-Smirnov for large sample sizes (> 50), and Shapiro-Wilk for smaller samples (≤ 50). Data are regarded as normally distributed when the P-value (Sig.) is > 0.05, for both Kolmogorov-Smirnov and Shapiro-Wilk (Setyawan, 2021). In this study, the type of normality test used was the Shapiro-Wilk test because the sample was ≤ 50. Next was the homogeneity test.

Homogeneity testing assesses whether different data groups share equal variances, indicating comparable population variability (Nuryadi *et al*., 2017). If the Significance Value (P-Value) > 0.05 then it can be concluded that "the variance of two or more data groups is the same (homogeneous)" (Setyawan, 2021). Once normality and homogeneity checks were completed, the data were analyzed using an independent sample t-test.

The effect of an independent variable on a dependent variable can be assessed using an independent sample t-test. This analysis was performed with a significance threshold of 0.05 (α=5%). A p-value lower than 0.05 denotes that the independent variable significantly contributes to the dependent variable (Magdalena & Krisanti, 2019). In the present research, once it was confirmed that the developed instructional module produced a significant effect on students' achievement, the effect size was computed to evaluate the strength of that influence.

There are two calculation processes used to obtain effect size values: Cohen's d and Hedges' g. However, Cohen's d contains an anomaly that can inflate the effect size. This

anomaly can be corrected by applying the correction contained in the Hedges' g formula by multiplying it by the correction factor J (Rosyadi *et al*., 2024). In this study, the formula used was the Hedges'g formula. The effect size criteria are shown in Table 1.

Table 1 Effect size criteria

Effect Size	Category
$\mathbf{0-0,20}$	Less
$\mathbf{0,21-0,50}$	Low
$\mathbf{0,51-1,00}$	Medium
$\mathbf{\geq 1,00}$	High

(Barus et al., 2023)

In this study, the effect size was calculated using the website https://www.campbellcollaboration.org/calculator/. The effect size of this study indicates the magnitude of the influence of the developed learning module on students' problem-solving skills. The problem-solving skill indicators, according to Heller, that are observed and assessed are in Table 2.

Table 2 Problem-solving skill indicators

Stages	Indicator
Focus on the problem	1. Determine questions, make sketches, and choose a qualitative approach.
Physics Description	1. Define symbols and write qualitative relationships. 2. Identify known variables and write them in the form of symbols and values.
Planning Solutions	1. Write down concepts and principles for solving the problem. 2. Determine whether the equation is sufficient to solve the problem. 3. Requires selecting relationships that include multiple targets, eliminating unnecessary statements.
Implementing the Solution	1. Execute plans, make simple statements, explore, measure, observe, and calculate to answer questions; 2. Enter the values of the identified variables into the resulting equation.
Checking back from the solution plan that has been implemented (re-checking)	1. Evaluate reasonable, complete solutions and check whether they have been implemented well or not.

Adaptation of (Heller & Heller, 2010) and (Buhungo et al., 2016)

The criteria for problem solving skills are listed in Table 3.

Table 3 Criteria for problem-solving skills

Mark	Criteria
80.0 – 100.0	Very well
65.0 – 79.9	Good
55.0 – 64.9	Sufficient
40.0 – 54.9	Not sufficient
0.0 – 39.9	Very less

(Hadi & Radiyatul, 2014)

RESULTS AND DISCUSSION

The teaching module was developed based on authentic learning to train students' problem-solving skills. The cover page and contents of the teaching module are shown in Figure 2.

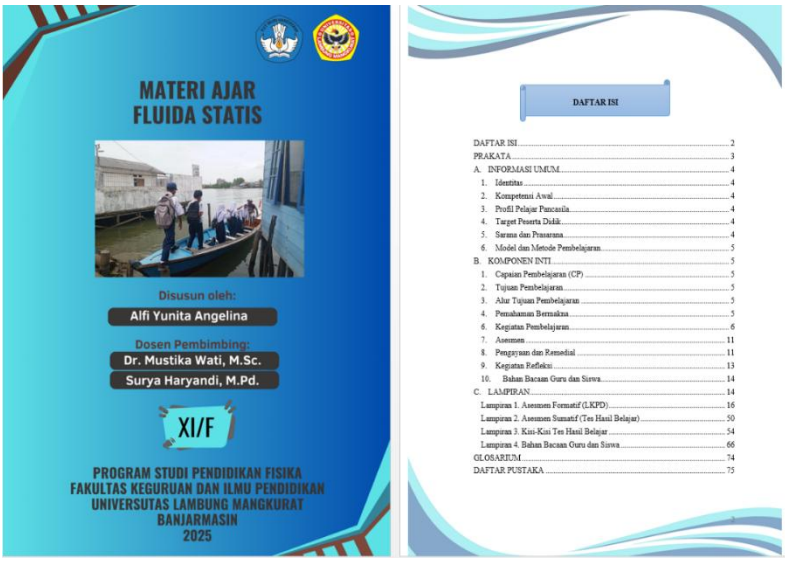
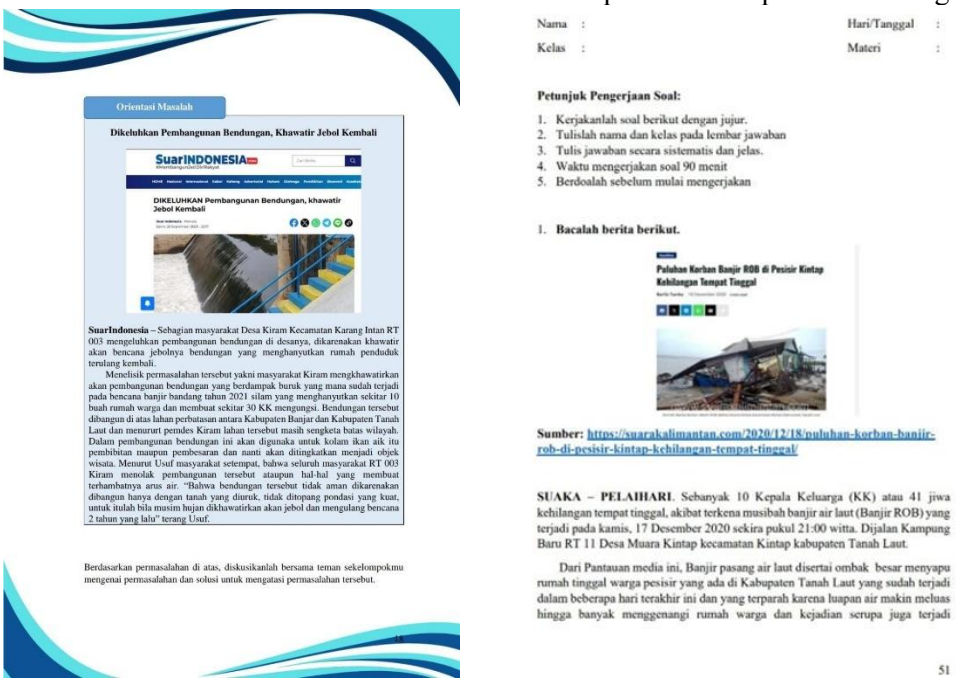


Figure 2 View of the authentic cover and table of contents of the teaching module

The developed teaching module contains authentic learning. Authentic learning integration is evident in the authentic images shown in Figure 2 on the teaching module cover. The image on the cover is an authentic image that demonstrates one of the applications of Archimedes' Law, namely, a boat. This image was photographed directly by the researchers, where the location is close to the school being studied, so it can arouse students' curiosity. Furthermore, authentic learning in the teaching module presents authentic problems for students to solve. The module's authentic problems are presented in Figure 3.



(a) (b)

Figure 3 (a) Integration of authentic learning in the module and (b) Integration of authentic learning in the module

Figure 3a shows an authentic problem found in student worksheet 1, which presents a problem regarding a dam burst. Figure 3b shows an authentic problem in the learning outcome test, which presents an authentic problem in the form of tidal flooding.

The module effectiveness was determined based on student learning outcomes using a posttest as data collection. Data analysis was carried out using an independent sample t-test (with normality and homogeneity tests as prerequisite tests) and continued with effect size. Comparison of posttest scores between the experimental and control groups was performed using an independent sample t-test, followed by an analysis of the effect size to evaluate the magnitude of impact. The results of the normality, homogeneity, and t-test analyses are summarized in Table 4.

Table 4 Outcomes of the independent sample t-test analysis

	Test of Normality (Shapiro-Wilk)		**Test of Homogeneity of Variance**	**T-test for Equality of Means**
	Experiment Posttest	**Control Posttest**		
Sig value.	0.91	0.15	0.75	0.00
Conclusion	Normally distributed data	Normally distributed data	homogeneous	Has a significant influence

The data presented in Table 4 reveal that the experimental group outperformed the control group, with the difference in their average learning outcomes found to be statistically significant. The diagram showing the difference in average scores between the experimental class and the control class is shown in Figure 4.

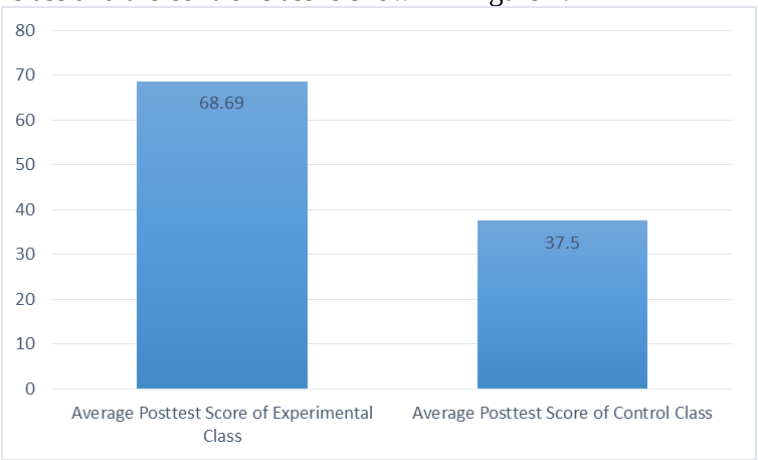


Figure 4 Diagram displaying the average score differences between the experimental and control classes

An analysis of effect size was subsequently carried out to quantify the influence of the authentic learning module. Table 5 presents the results, reflecting the module's level of effectiveness.

Table 5 Results of calculating the effectiveness of the teaching module

Average Posttest Score of Experimental Class	**Average Posttest Score of Control Class**	**Standard Deviation of Experimental Class**	**Standard Deviation of Control Class**	**Effect Size**	**Category**
68.69	37.50	13.59	19.13	1.85	High

Referring to Table 5, the effect size value obtained was 1.85, which is in the high category. A teaching module is considered effective if the minimum effect size is in the medium category. This result demonstrates that *Kurikulum Merdeka* teaching module, which incorporates authentic learning, effectively enhances students' problem-solving skills. The table also shows that the experimental class achieved a higher mean posttest score compared to the control class, confirming the module's strong effectiveness. This high category of effectiveness is in line with the training of students' problem-solving skills. This large influence is inseparable from the approach and learning model used in the developed module.

The approach used in this module is authentic learning. This module provides authentic problems that are close to students' lives. The availability of authentic problems greatly helps students practice their problem-solving skills. According to Priyanto et al. (2021), learning centered on authentic tasks can stimulate students' curiosity to solve real-life problems. This finding aligns with research conducted by Arsyad et al., (2020), Wati et al. (2022), Humayrah et al. (2022), and Supriyadi et al., (2022). The results of previous research showed that modules or teaching materials containing authentic learning can train students' problem-solving skills. The novelty of the development carried out was that the authentic problems presented in the modules could be found in the news and were close to the research location. In addition to the approach used, the high effect size was also due to the influence of the learning model used.

The learning approach implemented in this study is Problem-Based Learning (PBL), which emphasizes active student participation through a student-centered process. According to Sari et al,. (2016) and Sawitri et al., (2016), applying the PBL model can encourage students to participate actively in learning and contribute to improvements in both their learning motivation and problem-solving skills. This corresponds with Suyidno et al. (2021), who stated that PBL is mainly structured to enhance students' thinking, problem-solving, and intellectual competencies; to expose them to adult roles through real-life or simulated tasks; and to cultivate autonomy and independence in learning.

Based on experience gained during the trial teaching of both classes using different models and methods, students in the experimental class were more active and motivated in solving problems. In the experimental class, students actively sought as much information as possible to solve problems and actively asked questions when they encountered difficulties. In the control class, students were less active. This is due to the differences in learning methods used in the two classes. According to Hamzah et al., (2021) who stated that classes taught using the PBL model had higher motivation than classes taught conventionally (direct learning).

In the experimental class, students were trained with authentic problems that guided them to solve the problems and develop appropriate solutions through investigation. In the control class, more information was provided, examples of problems were solved without using authentic problems, and students were given the opportunity to ask questions and then work on the next example problem in front of the class. In the experimental class, students were actively involved in digging up information to complete the Student Worksheet and actively asked questions if there was anything they did not understand. In the control class, only two of the same students were willing to work on the example problems on the board, while many other students appeared less active in the learning process.

Figure 5 presents a sample of the students' answers obtained from the experimental class.

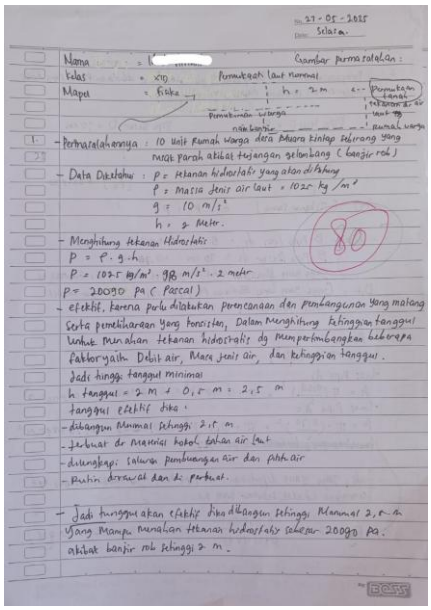


Figure 5 Students' answers

As shown in Figure 5, the students have demonstrated mastery of problem-solving competencies. They successfully engaged in problem focusing, applied relevant physics concepts, designed and implemented appropriate solutions, and carried out verification. Such performance aligns with the five-step problem-solving skills described by (Heller & Heller, 2010). The maximum score for number 1 is 25. The scoring analysis refers to the accuracy of the answers and problem-solving indicators with a total of 2+4+3+9+9+1 points.

Based on the effect size calculation, the implementation of the Kurikulum Merdeka teaching module, incorporating authentic learning, demonstrated high effectiveness in developing students' problem-solving skills. This aligns with previous research by Arsyad et al. (2020), Saputri et al. (2021), Wati et al. (2022), Wati et al. (2024) and Supriyadi et al. (2022), which found that the use of an authentic learning approach effectively trains students' problem-solving skills. Such results can be explained by the fact that authentic learning provides opportunities for students to explore, interact through discussion, and develop conceptual understanding connected to everyday or real-world problems, thus ensuring that learning becomes more contextually relevant.

CONCLUSION

According to the independent sample t-test, the developed teaching module exerted a statistically significant effect. The extent of this effect was determined by calculating the effect size, which was categorized as high. Therefore, it can be concluded that the authentic learning teaching module of the *Kurikulum Merdeka* is effective in practicing problem-solving skills. The findings of this study are anticipated to serve as a basis for implementing authentic learning in different physics subject matter. The implication of this study is that the application of authentic learning through teaching modules can be an alternative support for physics learning to train students' problem-solving skills. A limitation of this research is that the stages of problem-solving skills were not written on the students' answer sheets. However, the student worksheets were structured based on the indicator of problem-solving skills.

CONFLICTS OF INTEREST

The authors confirm that there are no conflicts of interest related to this study.

AUTHOR CONTRIBUTIONS STATEMENT

AYA played a role in instrument preparation, data collection, and data analysis; MW played a role in methodology and variable analysis; SH played a role in conceptualization and analysis consultation.

AI DISCLOSURE STATEMENT

During the preparation of this work, the author utilized ChatGPT solely for the purpose of grammar correction and linguistic refinement. Following the use of this tool, the author critically reviewed, edited, and verified the content to ensure its scientific accuracy. The author assumes full accountability for the integrity, originality, and overall content of this publication.

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REFERENCES

Adinia, R., Suratno, S., & Iqbal, M. (2022). Efektivitas pembelajaran aktif berbantuan lkpd problem solving terhadap keterampilan pemecahan masalah dan penguasaan konsep biologi siswa di sekolah kawasan perkebunan kopi. *Jurnal Inovasi Pembelajaran Biologi*, *3*(2), 64–75. https://doi.org/10.26740/jipb.v3n2.p64-75

Aini, Q., & Adiyono, A. (2023). Implementing an independent curriculum in supporting students' freedom to create and learn. *Journal of Scientific Research, Education, and Technology (JSRET), 2*(3). https://doi.org/10.58526/jsret.v2i3.18

Ali, M. (2018). Pengembangan modul fisika berbasis model pembelajaran assurance, relevance, interest, assessment, and satisfaction (ARIAS) pada materi kalor dan perpindahannya. *Berkala Ilmiah Pendidikan Fisika*, *6*(2), 247. https://doi.org/10.20527/bipf.v6i2.4918

Alwi, A. M., Arsyam, M., Syam, M. N., Wekke, I. S., Hasan, & Sulaiman, U. (2023). Konsep implementasi kurikulum merdeka sekolah penggerak di kabupaten polewali mandar. *Al-Ubudiyah: Jurnal Pendidikan Dan Studi Islam*, *4*(1), 1–13. https://doi.org/10.55623/au.v4i1.168

Anas, M. H., Bakti, S., Nasril, Y., & Adawiyah, R. (2025). Analisis perkembangan kurikulum pendidikan nasional di indonesia dari kurikulum 1947 hingga kurikulum merdeka : Studi literatur. *Didaktika: Jurnal Kependidikan*, *14*(1), 1259–1272.

Anwar, S., & Umam, H. (2023). Transformative education: Emphasizing 21st century skills and competencies in the independent learning curriculum. *AIM: Journal of Islamic Education Management*, *1*(1), 1–16. https://journal.uinsgd.ac.id/index.php/aim

Arifuddin, M., Syifa, L. N., Mahardika, A. I., & Mastuang, M. (2023). The effectiveness of e-modules through physics modeling learning to improve problem solving skills. *Kasuari: Physics Education Journal (KPEJ)*, *6*(1), 11–22. https://doi.org/10.37891/kpej.v6i1.452

Arsyad, Z., Wati, M., & Suyidno, S. (2020). The effectiveness of the module static fluid with authentic learning to train students' problem-solving skills. *SEJ (Science Education Journal)*, *4*(2), 113–128. https://doi.org/10.21070/sej.v4i2.1017

Asyafaah, Zainuddin, & Dewantara, D. (2024). Bahan ajar dengan model group investigation untuk melatih keterampilan pemecahan masalah. *Jurnal Literasi Pendidikan Fisika (JLPF)*, *5*(1), 8–14. https://doi.org/10.30872/jlpf.v5i1.2568

Aynas, N., & Aslan, M. (2021). The effects of authentic learning practices on problem-solving skills and attitude towards science courses. *Journal of Learning for Development*, *8*(1), 146–161. https://doi.org/10.56059/jl4d.v8i1.482

Ayudha, C. F. H., & Setyarsih, W. (2021). Studi literatur : Analisis praktik pembelajaran fisika. *Jurnal Pendidikan Fisika Undiksha*, *11*(1), 15–28.

Bahriah, E. S., Yunita, L., & Nur Sholihat, R. (2022). Kurikulum merdeka: Implementation and effect on learning loss in chemistry caused by covid-19 outbreak. *Jurnal Pendidikan MIPA*, *23*(4), 1916–1927. https://doi.org/10.23960/jpmipa/v23i4.pp1916-1927

Barus, A. N., Syah Putra Sembiring, J., & Haridsya Aditia, Y. (2023). Meta analisis efektivitas model pembelajaran berbasis masalah terhadap kemampuan pemecahan masalah dan hasil belajar fisika di sma. *Jurnal Inovasi Pendidikan Sains Dan Terapan (INTERN)*, *2*(2), 40–50. https://doi.org/10.58466/intern.v2i2.1146

Branch, R. M. (2009). Instructional design: The ADDIE approach. In *Digital Learning: The Key Concepts*. https://doi.org/10.4324/9780429425240-105

Buhungo, T. J., Prabowo, P., & Prastowo, T. (2016). Kajian konseptual problem solving pada perkuliahan fisika dasar i. *Seminar Nasional Pendidikan Dan Saintek 2016*, *2016*, 599–603.

Cahayani, N. L. P., & Suastra, I. W. (2024). Implementation of independent learning curriculum in the perspective of progressivism philosophy. *Indonesian Journal of Educational Development (IJED)*, *4*(4), 538–545. https://doi.org/10.59672/ijed.v4i4.3379

Dariyono, & Rusman. (2023). Curriculum transformation in the 21st century education: perspectives, challenges, and prospects. *The 2nd International Conference on Education Innovation and Social Science*, *July*, 57–68.

Hadi, S., & Radiyatul, R. (2014). Metode pemecahan masalah menurut polya untuk mengembangkan kemampuan siswa dalam pemecahan masalah matematis di sekolah menengah pertama. *EDU-MAT: Jurnal Pendidikan Matematika*, *2*(1), 53–61. https://doi.org/10.20527/edumat.v2i1.603

Hamzah, A., Yunus, M., & Sulfikar. (2021). Perbandingan model pembelajaran berbasis masalah dan model pembelajaran langsung terhadap hasil belajar peserta didik kelas xi ipa sma negeri 1 pancarijang kab. sidrap (studi pada materi pokok hidrolisis garam). *Jurnal Chemica*, *22*(1), 13–22.

Hanipah, S. (2023). Analisis kurikulum merdeka belajar dalam memfasilitasi pembelajaran abad ke-21 pada siswa menengah atas. *Jurnal Bintang Pendidikan Indonesia (JUBPI)*, *1*(2), 264–275.

Haratua, T., & Sirait, J. (2016). Representations based physics instruction to enhance students' problem solving. *American Journal of Educational Research*, *4*(1), 1–4. https://doi.org/10.12691/education-4-1-1

Heller, K., & Heller, P. (2010a). Cooperative problem solving in physics a user's manual. In *University of Minnesota*.

Heller, K., & Heller, P. (2010b). Cooperative problem solving in physics a user's manual. *University of Minnesota*, 310.

Humayrah, H., Zainuddin, Z., & Mahtari, S. (2022). Pengembangan modul fisika bermuatan authentic learning untuk meningkatkan kemampuan pemecahan masalah peserta didik pada materi elastisitas dan hukum hooke. *Reflection Journal*, *2*(2), 64–73. https://doi.org/10.36312/rj.v2i2.1090

Hutagalung, S. D. G., & Kurniati, E. (2024). Analisis perubahan kurikulum terhadap hasil belajar fisika siswa sman 3 kota jambi (studi perubahan kurikulum 2013 ke kurikulum merdeka). *Scientica Education Journal*, *1*(2), 1–8. https://doi.org/10.62872/de6xve94

Khalik, A., Eriyani, R. N., & Anwar, M. (2025). Implementasi autehntic learning strategies di sman 2 kendari terhadap kemampuan literasi bahasa indonesia: Studi etnografi.

Jurnal Manajemen Pendidikan Dan Ilmu Sosial, *6*(4), 2944–2957. https://doi.org/10.38035/jmpis.v6i4.5067

Magdalena, R., & Krisanti, M. A. (2019). Analisis penyebab dan solusi rekonsiliasi finished goods menggunakan hipotesis statistik dengan metode pengujian independent sample t-test di pt.merck, tbk. *Jurnal Tekno*, *16*(2), 35–48. https://doi.org/10.33557/jtekno.v16i1.623

Mudzakir, & Aslan. (2025). The relationship between curriculum and educational policy in improving human resource quality: A literature review. *Indonesian Journal of Education (INJOE)*, *5*(3), 483–492.

Musengimana, T., Yadav, L. L., Uwamahoro, J., & Nizeyimana, G. (2025). Instructional strategies for enhancing students' problem-solving skills in physics: A systematic review. *Discover Education*, *4*(1). https://doi.org/10.1007/s44217-025-00733-x

Nadrah, N. (2023). Linear motion materials on authentic learning in collaborative problem-solving model: Validity aspects. *Journal of Research in Science Education*, *9*(11), 10067–10076. https://doi.org/10.29303/jppipa.v9i11.5587

Nuryadi, Astuti, T. D., Utami, E. S., & Budiantara, M. (2017). Buku ajar dasar-dasar statistik penelitian. In *Sibuku Media*.

Oktaviana, D., Hartini, S., & Misbah, M. (2017). Pengembangan modul fisika berintegrasi kearifan karakter sanggam. *Berkala Ilmiah Pendidikan Fisika*, *5*(3), 272–285.

Priyanto, A., Hanif, F., & Asmara, D. (2021). Pengembangan authentic learning terhadap hasil belajar siswa. *Edukasi STKIP Abdi Pendidiikan Payakumbuh*, *01*(1), 1–5.

Qotrunnada, N. A. (2022). Analysis of the difficulties of high school students in improving problem solving ability in physics learning. *International Journal of Current Educational Research*, *1*(1), 84–101. https://doi.org/10.53621/ijocer.v1i1.141

Quratul Aini, & Adiyono. (2023). Implementation of an independent curriculum in supporting students' freedom to create and learn. *Journal of Scientific Research, Education, and Technology (JSRET)*, *2*(3), 999–1008. https://doi.org/10.58526/jsret.v2i3.187

Ramadhani, F. D., Wati, M., Misbah, & Wiyono, K. (2021). The validity of electronic learning materials optical instruments based on authentic learning to train students ' problem solving skills. *Kasuari: Physics Education Journal (KPEJ)*, *4*(2), 78–89.

Ridho, M. H., Wati, M., Misbah, M., & Mahtari, S. (2020). Validitas bahan ajar gerak melingkar berbasis authentic learning di lingkungan lahan basah untuk melatih keterampilan pemecahan masalah. *Journal of Teaching and Learning Physics*, *5*(2), 87–98. https://doi.org/10.15575/jotalp.v5i2.8453

Riyani, P., & Hadi, M. S. (2023). Upaya meningkatkan kemampuan pemecahan masalah siswa dalam pembelajaran matematika dengan pendekatan keterampilan proses. *Jurnal Riset Pembelajaran Matematika Sekolah*, *7*(1), 9–20. https://doi.org/10.21009/jrpms.071.02

Rosyadi, M. K. R., Karim, K., & Sari, A. (2024). Meta-analisis: Pengaruh model pbl dan model pjbl terhadap kemampuan pemecahan masalah dan hasil belajar matematika siswa. *Jurmadikta*, *4*(1), 92–102. https://doi.org/10.20527/jurmadikta.v4i1.2185

Saputri, R. S., Wati, M., & Misbah, M. (2021). Penggunaan materi ajar elektronik gerak harminik sederhana bermuatan authentic learning untuk melatihkan keterampilan pemecahan masalah: Analisis persepsi peserta didik. *Prosiding Seminar Nasional Pendidikan IPA Tahun 2021*.

Sari, S. M., Indrawati, & Handayani, R. D. (2016). Pengaruh model pembelajaran pbl (problem based learning) terhadap keterampilan proses dan hasil belajar siswa dalam pembelajaran fisika di smp. *Jurnal Pembelajaran Fisika*, *5*(2), 103–108.

Sawitri, I., Suparmi, & Aminah, N. S. (2016). Pembelajaran fisika berbasis problem based learning (pbl) menggunakan metode eksperimen dan demonstrasi ditinjau dari

kemampuan berpikir kritis terhadap prestasi belajar dan keterampilan metakognitif. *Jurnal Inkuiri*, *5*(2), 79–86.
Schleicher, A. (2023). Programme for international student assessment (pisa) 2022 : insights and interpretations. *Oecd 2023*, 1–72.
Setyawan, D. A. (2021). Petunjuk praktikum uji normalitas & uji homogenitas data dengan spss. In *Paper Knowledge . Toward a Media History of Documents*.
Supriyadi, Wati, M., Miriam, S., & Sasmita, F. D. (2022). Efektivitas modul bermuatan authentic learning pada materi gerak lurus untuk melatihkan keterampilan pemecahan masalah. *Edufisika: Jurnal Pendidikan Fisika*, *7*(1).
Suyidno, Haryandi, S., & Sunarti, T. (2021). *Pembelajaran Kreatif Berbasis Otonomi*.
Wardani, D. S. (2020). Usaha peningkatan keterampilan pemecahan masalah melalui model problem based learning di kelas v sdn babatan v/460 surabaya. *Journal of Elementary Education*, *03*(04), 104–117.
Wati, M., Larasati, V., Suyidno, S., & Sasmita, F. D. (2022). Pengembangan materi ajar bermuatan authentic learning untuk meningkatkan keterampilan pemecahan masalah peserta didik. *Jurnal Pendidikan Fisika*, *10*(2), 229. https://doi.org/10.24127/jpf.v10i2.5782
Wati, M., Lestari, D. M., & Mahtari, S. (2024). The effect of digital worksheets on dynamic fluids with authentic learning in training problem-solving skills. *Jurnal Ilmiah Pendidikan Fisika*, *8*(2), 266. https://doi.org/10.20527/jipf.v8i2.9245
Wati, M., Munir, M. J. M., Mahtari, S., Dewantara, D., & Wiyono, K. (2023). Integrating authentic learning in collaborative problem-solving model : Stacking analysis of students' problem-solving abilities. *Kurdish Studies*, *11*(2), 5165–5181. https://doi.org/10.58262/ks.v11i2.374
Zainudin, A., Hepni, Nawangsari, D., & Ubaidillah. (2025). Analysis of the independent curriculum (independent learning, independent transformation, and independent sharing). *Falasifa: Jurnal Studi Keislaman*, *16*(01).

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