JPPIPA 11(11) (2025)

Jurnal Penelitian Pendidikan IPA

http://jppipa.unram.ac.id/index.php/jppipa/index

Development of Inclusive Learning Based on Problem-Based Learning to Improve Critical Thinking Skills and Scientific Attitudes of Students in the 3T Areas of Riau Province

Azhar[1*], Talia Ananda[1], Daeng Ayub[2], Dedi Irawan[1]

[1] Physics Education Study Program, Faculty of Teacher Training and Education, Universitas Riau, Pekanbaru, Indonesia.
[1] PLS Study Program, Faculty of Teacher Training and Education, Universitas Riau, Pekanbaru, Indonesia.

Received: September 11, 2025
Revised: October 27, 2025
Accepted: November 25, 2025
Published: November 30, 2025

Corresponding Author:
Azhar
azhar@lecturer.unri.ac.id

DOI: 10.29303/jppipa.v11i11.12830

Abstract: This study aims to develop an inclusive learning model based on Problem-Based Learning (PBL) to enhance students' critical thinking skills and scientific attitudes in the 3T regions (frontier, outermost, and disadvantaged areas) of Riau Province, Indonesia. The research is motivated by the limited access to quality education in 3T areas, which affects students' higher-order thinking skills and mastery of scientific attitudes. The model was developed using a Research and Development (R&D) approach adapted from the Borg & Gall framework, involving preliminary studies, model design, expert validation, revision, and limited trials. The research subjects were high school students in one of the 3T schools. Instruments used included a critical thinking skills test, a scientific attitude questionnaire, observation sheets, and interview guidelines. The results show that the inclusive PBL model developed is valid, practical, and effective for classroom implementation. Its application successfully improved students' critical thinking skills through contextual problem-solving activities and fostered scientific attitudes such as curiosity, openness to evidence, and responsibility in the learning process. This study recommends the inclusive PBL model as an alternative instructional strategy for schools in 3T areas to support equitable improvement in education quality.

Keywords: 3T regions; Critical thinking skills; Education equity; Inclusive learning; Problem-based learning; Riau Province; Scientific attitudes

Introduction

The transformation of education in Indonesia continues to progress as a response to the demands of 21st-century learning, which emphasizes the development of critical thinking, collaboration, communication, and problem-solving skills. However, Indonesian students' achievements in international studies remain relatively low. The 2018 Programme for International Student Assessment (PISA) results indicate that Indonesian students performed below the OECD average in science, mathematics, and reading literacy, particularly in scientific reasoning and the application of concepts to real-life contexts (Organisation for Economic Co-operation and Development). This result indicates that the teaching approaches used in schools are still conventional and have yet to effectively foster higher-order thinking skills (Suhendra et al., 2023).

Riau Province, in addition to its abundant natural resource potential, also includes several 3T-designated areas, including remote island regions. Geographical isolation affects access to educational infrastructure,

How to Cite:
Azhar, Ananda, T., Ayub, D., & Irawan, D. (2025). Development of Inclusive Learning Based on Problem-Based Learning to Improve Critical Thinking Skills and Scientific Attitudes of Students in the 3T Areas of Riau Province. *Jurnal Penelitian Pendidikan IPA*, *11*(11), 79–85. https://doi.org/10.29303/jppipa.v11i11.12830

limits the availability of qualified teachers, and reduces access to learning resources and technology. Consequently, the quality of education in these areas lags behind that of urban regions (Yuliana et al., 2019). Students in these regions often have limited opportunities to develop higher-order thinking skills, including critical thinking and scientific attitudes—competencies essential for 21st-century science learning (Anderson & Krathwohl, 2010).

Critical thinking plays an important role in enabling students to analyze information, evaluate arguments, and solve problems logically (Facione, 2011). Meanwhile, a scientific attitude reflects dispositions such as curiosity, openness to evidence, objectivity, and responsibility in the learning process (OECD, 2019). Both competencies are essential for students to address real-world problems in their environment and to develop adequate scientific literacy (Azhar et al., 2024). However, based on observations and previous research findings, students in 3T regions tend to score low on indicators of critical thinking and scientific attitudes, largely due to the dominance of lecture-based teaching methods and the lack of opportunities to explore real-world problems (Putri et al., 2020).

At the same time, Indonesia is also developing an inclusive education system to provide equal learning rights for all students, including those with special needs (Azhar et al., 2022b). The implementation of inclusive education in mainstream schools has been regulated through various policies, yet its execution still faces challenges, especially in terms of teacher readiness and the availability of supporting facilities (Sunardi et al., 2011; Mujiafiat & Yoenanto, 2023). Research by Rukmini & Hartatik (2022) revealed that many teachers still struggle to design adaptive and inclusive learning environments that accommodate diverse student needs, particularly in science subjects, which are often abstract and require strong conceptual understanding.

In the 3T areas of Riau Province, the challenges of implementing PBL are not limited to student diversity but also include resource limitations (Suhendra et al., 2023). Teachers often face difficulties in providing relevant teaching materials, accessing technology-based learning resources, and designing problem scenarios that are contextually relevant to the local environment (Suryani et al., 2021). Therefore, the development of an inclusive PBL model specifically tailored to the conditions of 3T areas is urgently needed. This model must consider socio-cultural characteristics, availability of learning resources, and geographical constraints (Azhar et al., 2023).

This condition contributes to the low levels of critical thinking and scientific attitudes among Indonesian students. According to a study by Nuryani & Yuliati (2020), students demonstrate limited abilities in interpreting data, constructing evidence-based arguments, and expressing curiosity about scientific phenomena. Similar findings were reported by Adisty et al. (2021), who stated that students tend to accept information passively and are not accustomed to reflective or critical evaluation of it.

One approach proven effective in fostering students' critical thinking and scientific attitudes is Problem-Based Learning (PBL) (Ismaniati et al., 2025). This model places students in learning situations that involve solving real and challenging problems, encouraging them to gather information, collaborate, discuss, and draw conclusions based on data or evidence (Hmelo-Silver, 2004). Several empirical studies have indicated that the application of PBL can enhance student engagement, critical thinking skills, and scientific attitudes in science learning (Zubaidah et al., 2018; Kurniasari & Irwanto, 2020).

However, the implementation of PBL in inclusive settings presents its challenges. Students with learning difficulties require specific strategies such as scaffolding, visual media, and the adaptation of problems to match their cognitive capacity (Nugroho & Subali, 2021). Teachers also need to apply the principles of differentiated instruction to ensure that all students, including those with special needs, can actively participate in the learning process (Azhar et al., 2022a).

Therefore, it is necessary to develop an inclusive PBL model specifically designed for use in underdeveloped, frontier, and outermost (3T) regions such as Riau Province. This region faces complex challenges in terms of educational quality and resource accessibility. The development of this model is expected to serve as a solution for improving students' critical thinking skills and scientific attitudes equitably, while also promoting meaningful and fair learning experiences for all learners.

Problem Statements

This study investigates how a Problem-Based Learning (PBL) methodology can be developed to enhance critical thinking skills and scientific attitudes among students in the 3T areas of Riau Province, as well as whether there are significant differences in these skills and attitudes after the implementation of the PBL-based learning approach.

Objectives

The objectives of this study are twofold: first, to develop a Problem-Based Learning (PBL) methodology aimed at improving critical thinking skills and scientific attitudes among students in the 3T areas of Riau Province; and second, to examine the differences in

students' critical thinking skills and scientific attitudes after the implementation of the PBL-based learning approach.

Method

We conducted this research at SMAN 1 Kampar Kiri. This study adopts a Research and Development (R&D) approach to develop an inclusive and contextual Problem-Based Learning (PBL) model, with the primary objective of enhancing students' critical thinking skills and scientific attitudes, particularly in underdeveloped, frontier, and outermost (3T) regions. The development model follows the steps adapted from Borg and Gall (1983), consisting of six stages: preliminary study, model design, expert validation, model revision, limited trial, and effectiveness testing.

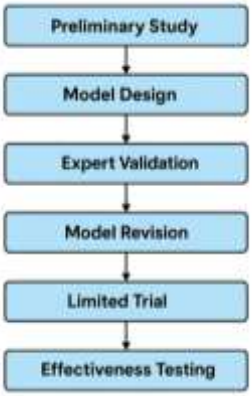

Figure 1. The development stages of the Problem-Based Learning (PBL) instructional model

The initial stage began with a preliminary study consisting of classroom observations and in-depth interviews with teachers and students in inclusive schools in Riau Province. This step aimed to identify the challenges faced in science learning, particularly related to students' low levels of critical thinking and scientific attitudes. These field findings are supported by previous studies, which reveal that science education in Indonesia is still dominated by conventional methods and lacks the empowerment of students to think critically (Zubaidah et al., 2018; Nuryani & Yuliati, 2020).

We then designed the PBL model with modifications to suit the inclusive context, based on the preliminary study's results. Adjustments were made to the PBL stages as proposed by Hmelo-Silver (2004), including the formulation of contextual problems, provision of scaffolding through guiding questions, use of visual media, and implementation of differentiation strategies. The model also includes a learning syntax, defined teacher and student roles, authentic assessment components, and an implementation guide tailored for inclusive classrooms. Once the design was completed, it underwent expert validation by three specialists: a science education expert, an inclusive education expert, and an instructional design expert. The validation assessed content relevance, structure, language clarity, and suitability for students with special needs. Feedback from the experts was used to refine the model before pilot testing.

Subsequently, a limited trial was conducted in one inclusive classroom to observe the feasibility of the learning syntax and to gather initial responses from students and teachers. Feedback from this stage served as the basis for further revisions prior to broader implementation during the effectiveness testing phase. In this phase, a quasi-experimental non-equivalent control group design was employed, involving two classes: an experimental class using the PBL model and a control class applying conventional methods. The learning process was carried out over four sessions using science topics aligned with the national curriculum. Data collection included a critical thinking test based on Ennis indicators, a science attitude questionnaire based on Fraser's indicators, observations of learning activities, and in-depth interviews.

Quantitative data were analyzed using an independent t-test to compare improvements between the experimental and control groups, while qualitative data were analyzed thematically to explore students' experiences during the learning process. The design and development of this PBL model are grounded in findings from previous studies, which have indicated that PBL can enhance critical thinking skills (Zubaidah et al., 2018; Kurniasari & Irwanto, 2020)), foster positive scientific attitudes (Hmelo-Silver, 2004; Nuryani & Yuliati, 2020), and create a collaborative classroom atmosphere, including for students with special needs (Nugroho & Subali, 2021).

Through this approach, the developed PBL model is expected not only to effectively improve students' cognitive learning outcomes but also to encourage the active participation of all students in scientific processes, without discrimination, in line with the values of inclusive education.

Result and Discussion

Instrument Validity

In the study Development of Inclusive Learning Based on Problem-Based Learning (PBL) to Improve Critical Thinking Skills and Scientific Attitudes of Students in the 3T Areas of Riau Province, the validity of instruments aims to ensure that the learning tools and measurement instruments accurately assess the

intended aspects. The validation process employed content validity, involving expert judgment from specialists in physics education, PBL, inclusive learning, and educational assessment. Experts evaluated the alignment of the indicators for critical thinking skills and scientific attitudes with the competencies being measured, the clarity of language, compatibility with the characteristics of 3T students, and conformity with the principles of PBL.

Validation was also conducted on learning tools, including lesson plans, teaching materials, student worksheets, and assessment instruments. The evaluation used a Likert-scale validation sheet, which was then analyzed using Aiken's V formula to determine the level of agreement among the raters. The critical thinking skills test was assessed based on indicators such as problem clarification, argument analysis, and inference, while the scientific attitude questionnaire covered aspects such as curiosity, openness to evidence, and scientific responsibility. High validation scores indicated that the instruments were appropriate for use in the field trials.

The feedback provided by the experts was then analyzed to determine the degree of suitability and validity of the instruments. Suggestions and recommendations served as the basis for revising the learning tools and assessment instruments, ensuring that the final version used in the field trials had undergone a systematic refinement process. Consequently, the validation process ensured the accuracy of measurement and enhanced the overall quality of the learning implementation in the 3T regions of Riau Province. It is expected that this rigorous validation will significantly contribute to improving students' critical thinking skills and scientific attitudes in an equitable and sustainable manner.

Table 1. Results validation

Item	Status
Module	Valid
LKPD	Very Valid
Critical Thinking Ability	Very Valid
Science Attitude Questionnaire	Very Valid
Observation of Teacher and Student Activities	Valid

Table 1 presents the validation results of the learning tools and research instruments developed in this study. The validation process was carried out by experts in physics education, Problem-Based Learning (PBL), inclusive education, and educational assessment. The results indicate that the learning module obtained a valid status. This result suggests that its content, structure, and alignment with the learning objectives meet the established criteria; however, several aspects can still be refined to enhance its effectiveness in the field, such as language adjustments or the addition of more contextually relevant examples tailored to students in the 3T areas.

The Student Worksheet (LKPD) received a Very Valid category, indicating a high level of conformity with PBL principles, containing clear instructional steps, and effectively facilitating students in developing both critical thinking skills and scientific attitudes. Similarly, the Critical Thinking Skills Test and the Science Attitude Questionnaire were categorized as Very Valid, meaning their indicators, test items, and statements are relevant, formulated, and appropriately aligned with the competencies being assessed. These instruments were deemed capable of accurately measuring students' skills and attitudes without the need for major revisions.

Meanwhile, the observation sheet for teacher and student activities was rated as valid, showing that it is suitable for monitoring the implementation of learning activities, though minor improvements could enhance its clarity and usability for classroom observers. Overall, the validation results confirm that most of the developed learning tools and research instruments achieved a high level of validity, making them feasible for field trials to evaluate the effectiveness of the inclusive PBL approach in the 3T areas of Riau Province.

Discussion

The development of the Problem-Based Learning (PBL) model within an inclusive context was carried out to address the challenges of science instruction that have yet to fully accommodate the diversity of students' abilities and needs. This development process followed a Research and Development (R&D) approach, adapting the stages proposed by Borg & Gall, which include a preliminary study, model design, expert validation, revision, limited trial, and effectiveness testing.

In the preliminary study phase, classroom observations and interviews with teachers and students were conducted to identify the challenges of science learning in inclusive classrooms. The analysis revealed that many students were passive, showed limited engagement in the learning process, and demonstrated a lack of positive attitudes toward science. Teachers also admitted that they lacked effective instructional strategies to foster critical thinking and scientific attitudes across all students, including those with special needs.

The PBL model was then designed in alignment with the principles of differentiated instruction, with modifications made to the PBL phases, such as the selection of contextual problems, the use of scaffolding during discussions, and the provision of visual media to support the involvement of students with cognitive difficulties. The model design included a detailed

learning syntax, defined teacher-student roles, authentic assessments, and implementation guidelines.

Model validation was carried out by three experts: one in science education, one in inclusive education, and one in instructional design. They assessed the model based on content accuracy, structure, language clarity, and suitability for inclusive classroom conditions. The validation results indicated that the PBL model was in the "highly appropriate" category with an average score of 89.5%. Expert suggestions for improvement were incorporated to refine the classroom implementation guide.

A limited trial was conducted in one inclusive school to examine the practicality of the model and gather feedback from both teachers and students. The teacher implementing the lesson reported that the PBL syntax was easy to apply and helped students become more active in thinking and discussion. Students also demonstrated high enthusiasm in solving problems, especially when dealing with contextual topics such as environmental and health issues.

Following revisions based on the limited trial, the model was fully implemented in a field test. The study was conducted in two classes: one experimental class applying the PBL model and one control class using conventional methods. The learning process took place over four sessions using science topics aligned with the curriculum.

Data collection involved observation instruments, a science attitude questionnaire, and interviews. Observations indicated that students in the experimental class were more actively engaged in discussions, expressed curiosity about scientific phenomena, and were willing to share their opinions based on observations or references. Teachers employed reflective and collaborative approaches to facilitate the learning process.

Students' scientific attitudes significantly improved after implementing the model. The attitudes measured included indicators such as curiosity, openness to evidence, scientific responsibility, and collaboration in scientific processes. Quantitative data showed that the average science attitude score in the experimental class increased from 68 to 84 in the posttest, while the control class only improved from 66 to 73.

Qualitative data from interviews revealed that students felt the learning process was more enjoyable, challenging, and meaningful. They reported being more actively involved and learning to value peer opinions and think based on scientific data or evidence. Students demonstrated responsibility by diligently completing assignments and presenting their group discussion results.

Even students with learning difficulties responded positively. With the support of peers and teachers, they were able to actively participate in group projects, ask questions, and share simple opinions. These results demonstrated that the inclusively designed PBL approach successfully facilitated the participation of all students without discrimination.

Teachers involved in the study also stated that the implementation of PBL made students more active and independent. They observed that PBL helped students understand science concepts better as they were directly involved in the discovery process. Teachers also noted a more dynamic classroom environment with improved positive interactions between regular and special needs students.

Overall, the development results indicate that the PBL model designed for the inclusive context has high validity, is practical to implement, and is effective in improving students' scientific attitudes. These findings reinforce previous studies by Harahap et al. (2021), which demonstrate that problem-based approaches can shape students' scientific character.

Problem-based learning improves cognitive learning outcomes and cultivates a scientific perspective in daily life. Students begin to understand the importance of evidence in decision-making, practice listening to others' opinions, and demonstrate empathy and collaboration in solving problems.

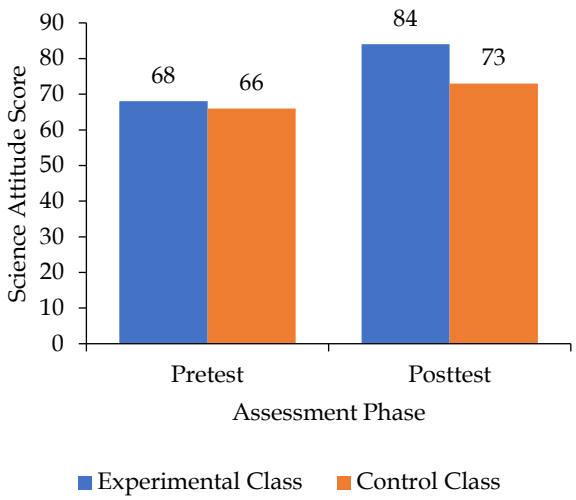

Figure 2. Comparison of science attitude scores between the experimental and control classes at the pretest and posttest stages out in SMAN 1 Kampar Kiri

Figure 2 illustrates the comparison of science attitude scores between the experimental and control classes during the pretest and posttest stages. It is evident that the experimental class experienced a more significant improvement than the control class following the implementation of the inclusive PBL model.

Therefore, the findings of this study recommend that schools—especially those with inclusive students—begin to consider adopting an adaptively designed PBL instructional model. In addition to enhancing learning outcomes, this approach has been proven effective in fostering positive and participatory scientific attitudes, which are essential in addressing the challenges of 21st-century education.

Conclusion

This study demonstrates that the development of an inclusive Problem-Based Learning (PBL) model is effective in enhancing students' critical thinking skills and scientific attitudes in 3T (underdeveloped, frontier, and outermost) areas of Riau Province. The model was developed using a Research and Development (R&D) approach, adapted from the Borg & Gall framework, which includes preliminary study, model design, expert validation, revision, limited trial, and effectiveness testing. Adjustments were made to the PBL stages to accommodate the diverse abilities of students, including those with special needs, through the implementation of differentiated instruction, scaffolding, and the use of supportive visual media. Expert validation results indicated that the PBL model was highly feasible to implement, with an average score of 89.5%. Trials conducted in inclusive classrooms showed that this approach increased student participation in discussions and fostered curiosity, openness to evidence, scientific responsibility, and collaboration among students. Full implementation of the model during field testing revealed significant improvements in both critical thinking and scientific attitudes in the experimental class compared to the control class, including among students with learning difficulties. In addition, qualitative data showed that students felt more engaged, the learning process was more challenging and meaningful, and teachers observed increased student interaction and independence. These findings indicate that the inclusive PBL model is relevant and applicable in 3T areas, where educational challenges are more complex. Therefore, this model is recommended to support equitable education quality and to foster the profile of Pancasila students who think critically, collaborate effectively, and demonstrate scientific attitudes in their daily lives.

Acknowledgments
We would like to thank the Ministry of Research, Technology, and Higher Education for providing funding support in this research, DPPM Fundamental Research, by contract no. 19641/UN19.5.1.3/AL.04/2025. We would also like to thank the head of the Optoelectronic Laboratory at the University of Riau.

Author Contributions
Conceptualization, A, and D.I.; validation, A, T.A and D.I.; formal analysis, D.I. and D.D; investigation, A, and D.I; resources, A, and D.I; data curation, A, and T.A: writing—original draft preparation, D.I, T.A, D.D; writing—review and editing, D.I.: visualization, A, D.I. All authors have read and agreed to the published version of the manuscript.

Funding
This research was funded by DRTPM-PTM Magister Thesis Research Schame year 2024 with contract number 19641/UN19.5.1.3/AL.04/2025.

Conflicts of Interest
There is no conflict of interest in this research article.

References

Adisty, A. N., Evayenny, E., & Hasanah, N. (2021). Analisis Kemampuan Bepikir Kritis pada Pembelajaran Ilmu Pengetahuan Alam (IPA). *Prosiding Seminar Nasional Pendidikan STKIP Kusuma Negara*. Retrieved from https://jurnal.stkipkusumanegara.ac.id/index.php/semnara2020/article/view/1227

Anderson, L. W., & Krathwohl, D. R. (2010). *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. Longman.

Azhar, A., Irawan, D., & Ramadhan, K. (2022a). STEM Education Implementation to Enhance Student Learning Outcomes in Optics Concept. *Jurnal Penelitian Pendidikan IPA*, *8*(2), 1023–1029. https://doi.org/10.29303/jppipa.v8i2.1525

Azhar, A., Ramadhan, K., & Irawan, D. (2022b). Social Competence Analysis of Science Teachers During the Covid-19 Pandemic. *Jurnal Penelitian Pendidikan IPA*, *8*(3), 1308–1313. https://doi.org/10.29303/jppipa.v8i3.1656

Azhar, A., Junilita, W., & Irawan, D. (2023). Enhancement of Mastery Physics Concept of Momentum and Impulse Among Class X High School Students by Implementing 8E Leaning Model. *Jurnal Penelitian Pendidikan IPA*, *9*(12), 11735–11740. https://doi.org/10.29303/jppipa.v9i12.5305

Azhar, A., Manik, R. E., Nabila, R., Natuna, D. A., & Irawan, D. (2024). Critical Thinking Skills of Students Through Guided Discovery Learning Model Assisted by PhET Media on Stationary and Walking Wave. *Jurnal Penelitian Pendidikan IPA*, *10*(7), 3548–3555. https://doi.org/10.29303/jppipa.v10i7.7212

Facione, P. A. (2011). *Critical Thinking: What It Is and Why It Counts*. Insight Assessment.

Harahap, H. S., Hrp, N. A., Nasution, I. B., Harahap, A., Harahap, A., & Harahap, A. (2021). Hubungan

Motivasi Berprestasi, Minat dan Perhatian Orang Terhadap Kemandirian Siswa. *EDUKATIF: Jurnal Ilmu Pendidikan*, *3*(4). https://doi.org/10.31004/edukatif.v3i4.463

Hmelo-Silver, C. E. (2004). Problem-Based Learning: What and How Do Students Learn? *Educational Psychology Review*, *16*(3), 235–266. https://doi.org/10.1023/B:EDPR.0000034022.16470.f3

Ismaniati, C., Syamsudin, E., & Khairaty, N. I. (2025). Designing Problem-Based E-Learning to Foster Critical Thinking and Motivation: A Feasibility and Practicality Study. *Jurnal Penelitian Pendidikan IPA*, *11*(5), 708–717. https://doi.org/10.29303/jppipa.v11i5.11280

Kurniasari, L., & Irwanto. (2020). Pengaruh PBL terhadap Sikap Ilmiah dan Hasil Belajar IPA. *Jurnal Pendidikan Sains*, *8*(1), 57–63.

Mujiafiat, K. A., & Yoenanto, N. H. (2023). Kesiapan Guru dalam Pelaksanaan Pendidikan Inklusi. *Edukatif: Jurnal Ilmu Pendidikan*, *5*(2), 1108-1116. https://doi.org/10.31004/edukatif.v5i2.4918

Nugroho, A., & Subali, B. (2021). Implementasi Pembelajaran Inklusif Berbasis Masalah pada Siswa Berkebutuhan Khusus. *Jurnal Pendidikan Indonesia*, 10(1), 22–30.

Nuryani, L., & Yuliati, L. (2020). Profil Kemampuan Berpikir Kritis dan Sikap Ilmiah Siswa SMP. *Jurnal Pendidikan Fisika Indonesia*, *16*(1), 32–38.

OECD. (2019). *PISA 2018 Results*. Retrieved from https://www.oecd.org/pisa/publications/pisa-2018-results.htm

Putri, S. M., Mulyani, S., & Saputro, A. N. C. (2020). Analysis of Students' Critical Thinking Skills in Science Learning. *Journal of Physics: Conference Series*, *1567*(2), 022026. https://doi.org/10.1088/1742-6596/1567/2/022026

Rukmini, D., & Hartatik, R. (2022). Strategi Pembelajaran Inklusif dalam Pendidikan Sains. *Jurnal Pendidikan Sains Indonesia*, *10*(2), 75–84.

Suhendra, H., Yennita, Y., & Irawan, D. (2023). Students' Perception of Guided Inquiry Learning in Physics Viewed from Collaboration Skills and Scientific Attitude. *Jurnal Penelitian Pendidikan IPA*, *9*(8), 6707–6713. https://doi.org/10.29303/jppipa.v9i8.4068

Sunardi, S., Yusuf, M., Gunarhadi, G., Priyono, P., & Yeager, J. (2011). The Implementation of Inclusive Education for Students with Special Needs in Indonesia. *Excellence in Higher Education*, *2*(1), 1–10. https://doi.org/10.5195/ehe.2011.27

Suryani, N., Lestari, I., & Rahman, A. (2021). Challenges in Implementing Problem-Based Learning in Rural Schools. *International Journal of Instruction*, *14*(4), 889–906. https://doi.org/10.29333/iji.2021.14451a

Yuliana, W., Sari, N., & Rahayu, T. (2019). Pendidikan di Daerah 3T: Tantangan dan Strategi Peningkatan Mutu. *Jurnal Pendidikan dan Kebudayaan*, *4*(1), 45–56.

Zubaidah, S., Fuad, N. M., Mahanal, S., & Suarsini, E. (2018). Improving Critical Thinking Skills of Students Through Problem Based Learning. *Journal of Education and Learning*, *12*(2), 219–228.