

PISA Under the Spotlight: Science Literacy Levels of Junior High Students in Samarinda

Nurul Wahdah^{1*}, Nurul Fitriyah Sulaeman², Zulkarnanen³, Atin Nuryadin⁴

^{1*,2,3,4} Physics Education, Mulawarman University, Samarinda, Indonesia

*Email: nurulwahdah@fkip.unmul.ac.id

Abstract

Science literacy is a fundamental competency measured by the PISA and serves as a global indicator of science education quality. This study aims to analyze the science literacy levels of junior high school students in Samarinda using the PISA framework and to examine differences by gender, school location, and school accreditation. The study employed a descriptive-quantitative approach involving students from two schools: SMPN 4 Samarinda (Accreditation A, urban) and SMPN 19 Samarinda (Accreditation B, suburban). Research instruments included PISA-based items from level 1b to level 6, and interview guidelines for science teachers. The results revealed student completion percentages across PISA levels: level 1b (98%), level 1a (78%), level 2 (62%), level 3 (48%), level 4 (29%), level 5 (18%), and level 6 (21%). Significant differences were found based on gender, with male students outperforming female students. Urban school students achieved higher average scores than suburban students, and Accreditation A schools demonstrated higher science literacy levels compared to Accreditation B schools. Interview results with science teachers indicated the need to strengthen teacher capacity in implementing PISA-aligned science curricula and developing appropriate evaluation instruments. This study is expected to serve as a reference for policymakers in designing strategies to improve science education quality in the region.

Keywords: accreditation; gender; PISA; science literacy.

Abstrak

Literasi sains merupakan kompetensi fundamental yang diukur dalam PISA dan menjadi indikator kualitas pendidikan sains secara global. Penelitian ini bertujuan untuk menganalisis tingkat literasi sains siswa SMP di Kota Samarinda berdasarkan kerangka PISA, serta mengkaji perbedaannya berdasarkan gender, lokasi sekolah, dan akreditasi sekolah. Penelitian menggunakan pendekatan deskriptif-kuantitatif dengan melibatkan siswa dari dua sekolah, yaitu SMPN 4 Samarinda (akreditasi A, perkotaan) dan SMPN 19 Samarinda (akreditasi B, pinggiran kota). Instrumen penelitian berupa soal PISA level 1b hingga level 6, serta pedoman wawancara untuk guru IPA. Hasil penelitian menunjukkan distribusi persentase ketuntasan siswa pada setiap level PISA: level 1b (98%), level 1a (78%), level 2 (62%), level 3 (48%), level 4 (29%), level 5 (18%), dan level 6 (21%). Terdapat perbedaan signifikan berdasarkan gender, di mana siswa laki-laki menunjukkan performa lebih tinggi dibandingkan dengan perempuan. Siswa dari sekolah perkotaan memiliki rata-rata nilai lebih tinggi dibandingkan siswa dari pinggiran kota, serta sekolah dengan akreditasi A menunjukkan tingkat literasi sains yang lebih tinggi dibandingkan dengan sekolah berakreditasi B. Hasil wawancara guru IPA mengindikasikan perlunya peningkatan kapasitas guru dalam menerapkan kurikulum IPA berbasis PISA dan pengembangan instrumen evaluasi yang selaras dengan standar PISA. Penelitian ini diharapkan dapat menjadi acuan bagi pemangku kebijakan dalam merancang strategi peningkatan kualitas pendidikan sains di daerah.

Kata kunci: akreditasi sekolah; gender; literasi sains; PISA.

Article History: Received: 10 March 2026

Accepted: 6 May 2026

Revised: 4 May 2026

Published: 8 May 2026

How to cite: Wahdah, N., Sulaeman, N. F., Zulkarnanen, & Nuryadin. (2026). *PISA under the spotlight: Science literacy levels of junior high students in Samarinda*, Jurnal Literasi Pendidikan Fisika, 7(1), 53-61. <https://doi.org/10.30872/jlpf.v7i1.6396>

Copyright © April 2026, Jurnal Literasi Pendidikan Fisika

INTRODUCTION

The Programme for International Student Assessment (PISA) is a global evaluation instrument conducted by the Organisation for Economic Co-operation and Development (OECD) every three years to measure the literacy abilities in mathematics, reading, and science of 15-year-old students worldwide (OECD, 2023). Scientific literacy within the PISA framework is defined as an individual's ability to engage with issues related to science, as well as possessing the capability to be a reflective citizen regarding problems in science and technology (Jufri et al., 2019). This competence encompasses three main dimensions: explaining phenomena scientifically, evaluating and designing scientific investigations, and interpreting data and evidence scientifically (OECD, 2019). The PISA scientific literacy competence levels are divided into seven levels, ranging from level 1b (lowest) to level 6 (highest), which reflect the complexity of cognitive tasks that students can accomplish.

The results of PISA 2022 indicate that Indonesia remains at a low ranking with a score of 383 in science literacy, significantly below the OECD average of 476 (AlAli & Wardat, 2024). Although Indonesia experienced an improvement in ranking by 5-6 positions compared to PISA 2018, this achievement still places the country at 76th out of 79 participating countries in the science domain (OECD, 2023). Meanwhile, the Vision of Golden Indonesia 2045 targets the Social Transformation Achievement Indicators in the National Long-Term Development Plan for 2025-2045, focusing on the development of quality and equitable education, with a targeted PISA science score of 487 (Shandy et al., 2025).

Samarinda holds a strategic position as the city closest to the new National Capital (IKN) Nusantara, making this city play a crucial role in supporting Indonesia's vision for 2045. As a city set to undergo significant transformation due to the development of the IKN, Samarinda requires the preparation of highly skilled human resources, particularly in the fields of science and technology (A. Hakim et al., 2023). Mapping the educational needs in this city is crucial, given the potential for growth and social changes that will occur alongside the development of the IKN. In-depth research on the understanding of junior high school students in Samarinda regarding PISA can provide valuable insights for improving the quality of education in the city (A. Hakim et al., 2023; Qadar et al., 2022). However, comprehensive data on the science literacy profile of junior high school students in Samarinda is not yet available, which could serve as a basis for designing targeted educational interventions.

Several previous studies indicate that there is variation in students' science literacy based on various contextual factors. Gender-based differences in science literacy have been widely reported, although the results are not always consistent; some research finds that male students perform better, while others show the opposite, depending on the cultural context and the type of instruments used (Baltikian et al., 2024; Kristiyasari et al., 2018). School location is also an important determinant, where urban schools generally have better access to facilities and learning resources compared to suburban schools (Altun & Kalkan, 2021; Innatesari et al., 2019). In addition, school accreditation as a representation of educational institutional quality standards also contributes to students' academic achievement (A. R. Hakim & Suharto, 2019).

Nevertheless, research that specifically integrates these three factors (gender, location, and accreditation) in the context of PISA-based science literacy in cities in Kalimantan is still very limited. This research gap underlines the importance of conducting a more in-depth and comprehensive study in Samarinda. Furthermore, teachers' perceptions and readiness in implementing PISA-oriented learning are critical supporting factors that have not been extensively studied together with student achievement data (Khery et al., 2024).

Based on this background, this research aims to: (1) describe the distribution of science literacy levels of junior high school students in Samarinda according to the PISA framework, from level 1b to level 6; (2) analyze the differences in students' science literacy based on gender, school location (urban and suburban), and school accreditation; and (3) identify science teachers' perceptions regarding the implementation of PISA-based learning and assessment. The results of this research are expected to provide an empirical overview of students' science literacy profiles in Samarinda and serve as input for

the development of more effective and equitable science education policies.

METHODS

This research employed a mixed-methods approach with a sequential explanatory design. The study was conducted during the 2024/2025 academic year at two public junior high schools in Samarinda, East Kalimantan: SMPN 4 Samarinda (accredited A, urban area) and SMPN 19 Samarinda (accredited B, suburban area). These schools were selected purposively based on differences in accreditation and geographical location to obtain a more representative overview. The research subjects were eighth-grade students from both schools, totaling 66 students selected through proportionate stratified random sampling.

The quantitative instrument consisted of a set of PISA-based test items for science literacy adapted from official PISA questions published by the OECD. The test had 21 questions, three for each of the seven proficiency levels (level 1b to level 6). The adaptation process involved translation into Indonesian and contextual adjustment to suit students' backgrounds without altering the original construct. The instrument underwent expert validation by subject matter experts, followed by revisions based on their feedback to ensure content validity. The scoring rubric followed PISA guidelines, particularly for open-ended items, where responses were categorized into full credit, partial credit, and no credit based on the completeness and scientific accuracy of students' answers. Reliability was examined through internal consistency analysis after the pilot testing phase.

Data collection was conducted in two stages. First, students completed the written PISA-based science literacy test. Each proficiency level was analyzed based on the percentage of correct responses to determine students' mastery distribution across levels. Second, semi-structured interviews were conducted with two science teachers (one from each school). Each interview lasted approximately 10–15 minutes. Prior to the interviews, informed consent was obtained from the participants, and permission for audio recording was requested to ensure accurate data capture. The interviews aimed to explore teachers' perceptions and experiences in implementing competency-based science curricula and PISA-oriented assessment practices.

Quantitative data were analyzed using descriptive statistics (percentages and means) and inferential statistics using the Independent Sample T-Test to examine differences based on gender, school location, and school accreditation. Prior to hypothesis testing, data normality was assessed using the Shapiro-Wilk test. Qualitative data from the interviews were analyzed using thematic analysis, which included data reduction, data display, and conclusion drawing. The qualitative findings were used to explain and enrich the quantitative results, particularly in interpreting differences in students' performance across schools. The validity of qualitative data was ensured through source triangulation and member checking.

RESULTS AND DISCUSSION

Distribution of Students' Science Literacy Levels

The results of the analysis on the science literacy skills of junior high school students in Samarinda show an interesting distribution pattern within the PISA framework. Overall, the majority of students are able to solve questions at the low level, but the percentage decreases progressively as the difficulty level increases. The complete distribution of student proficiency at each PISA level is presented in Table 1. Based on Table 1, there is a fairly sharp decrease in the percentage from level 1b (98%) to level 3 (48%), which indicates that almost half of the students are already experiencing difficulties when faced with questions that require the ability to interpret data in various contexts. An interesting point is the anomaly at level 6 (21%), which is slightly higher compared to level 5 (18%). This phenomenon can be explained by the difference in question types at each level; the level 6 questions used in this instrument focus more on open-ended conceptual thinking, whereas level 5 questions require more structured and systematic analytical procedures.

Table 1. Percentage Distribution of Student Achievement at PISA Science Literacy Levels

PISA Level	Core Competency Description	Student Percentage (%)	Category
1b	Identifying simple scientific phenomena based on information provided explicitly	98%	Very High
1a	Recognizing simple scientific explanations in familiar contexts	78%	High
2	Using basic scientific knowledge to interpret simple situations	62%	Medium
3	Identifying scientific problems and interpreting data in various contexts	48%	Medium
4	Using scientific knowledge and procedures to design investigations and interpret evidence	29%	Low
5	Identifying scientific components in complex situations and applying concepts critically	18%	Low
6	Consistently identifying, explaining, and applying scientific knowledge in various complex situations	21%	Low

This distribution pattern is in line with national findings which show that most Indonesian students are at low to medium levels of science literacy in the PISA assessment (Jufrida et al., 2019; Nasor et al., 2023; Sholikah & Novika Pertiwi, 2021). The highest achievement at level 1b (98%) indicates that almost all students already have basic science literacy, which is the ability to identify simple scientific phenomena. However, this ability is not yet adequate to face the challenges of the digital era that require higher-level scientific thinking.

The low percentage of students at level 4 and above (29%, 18%, and 21%) reflects the still limited ability of students to engage in complex scientific reasoning, namely designing investigations, interpreting evidence, and evaluating scientific problems critically and contextually. This condition is consistent with the research by Arlinwibowo et al., (2020) which states that the main weakness of Indonesian students in PISA is in the competencies of “evaluating and designing scientific investigations” and “scientifically interpreting data and evidence”.

The research data is also differentiated based on gender, school location, and school accreditation. A summary of the comparison of research results based on the three variables is presented in Table 2.

Table 2. Comparison of Science Literacy Based on Gender, Location, and School Accreditation

Variable	Group	Average Score	Description
Gender	Male	Higher	Significant difference
	Female	Lower	
Location	Urban Area (SMPN 4)	Higher	Significant difference
	Suburban Area (SMPN 19)	Lower	
Accreditaion	Accreditation A (SMPN 4)	Higher	Significant difference
	Accreditation B (SMPN 19)	Lower	

Prior to hypothesis testing, the assumption of normality was assessed using the Shapiro–Wilk test. The results showed that the data were normally distributed across all comparison groups ($p > 0.05$), thereby satisfying the assumptions required for parametric analysis using the Independent Samples T-Test. Subsequently, the Independent Samples T-Test was conducted to examine differences in

students' science literacy scores based on gender, school location, and school accreditation. The analysis revealed statistically significant differences across all three variables ($p < 0.05$), indicating that these factors significantly influence students' science literacy performance. The results of the T-Test analysis are presented in Table 3.

Table 3. T-Test Analysis Results

Variable	Group	N	M	SD	t	df	p-value	Mean Difference
Gender	Male	32	68.45	10.21	2.31	64	0.024*	6.12
	Female	34	62.33	9.87				
School Location	Urban	33	70.12	9.45	3.12	64	0.003**	8.54
	Suburban	33	61.58	10.02				
Accreditation	Accreditation A	33	70.12	9.45	3.12	64	0.003**	8.54
	Accreditation B	33	61.58	10.02				

Differences in Science Literacy Based on Gender

Analysis based on gender shows that male students overall have higher average science literacy scores compared to female students. This difference is observed at almost all levels of the PISA tested. These results add empirical evidence to the discourse on the gender gap in science literacy, which remains a concern in the context of Indonesian education. Figure 1 shows a graph of the percentage of student responses based on gender.

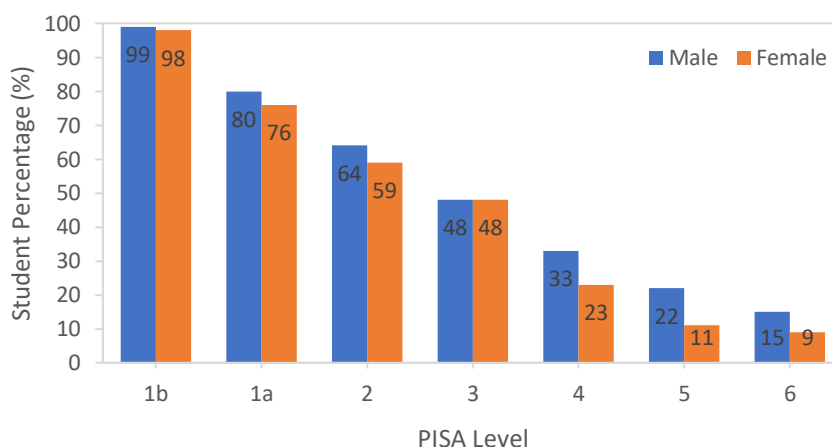


Figure 1. Percentage of student responses based on gender

These findings are in line with the results of the research by (Hardinata et al., 2019) which found that male students tend to excel more in aspects of scientific reasoning, particularly on questions that demand spatial ability and empirical data-based problem solving. However, it should be noted that gender differences in science achievement are not universal. Several international studies indicate that these differences are more influenced by socio-cultural factors, learning motivation, and exposure to science content outside of school, rather than innate cognitive factors (Hanson et al., 2018). Thus, efforts to realize gender equality in science literacy need to be directed at creating a learning environment that is inclusive and gender-responsive.

Differences in Science Literacy Based on School Location

The comparison between SMPN 4 Samarinda (urban) and SMPN 19 Samarinda (suburban) shows a quite significant difference in students' science literacy achievements. Figure 2 shows a graph of the percentage of student responses based on school location. Students from the urban school have higher average scores at all PISA levels compared to students from the suburban school. The achievement gap between urban and suburban students can be understood through the perspective of differing social capital and cultural capital. Urban schools generally have advantages in terms of science laboratory

facilities, the availability of textbooks and relevant teaching materials, as well as internet access that supports digital-based learning. Lawrence et al., (2021) emphasize that the disparity in educational infrastructure between urban and suburban areas is one of the structural factors contributing to students' academic achievement gaps. These findings suggest the need for affirmative policies that ensure the equitable distribution of quality facilities and educational resources to suburban areas.

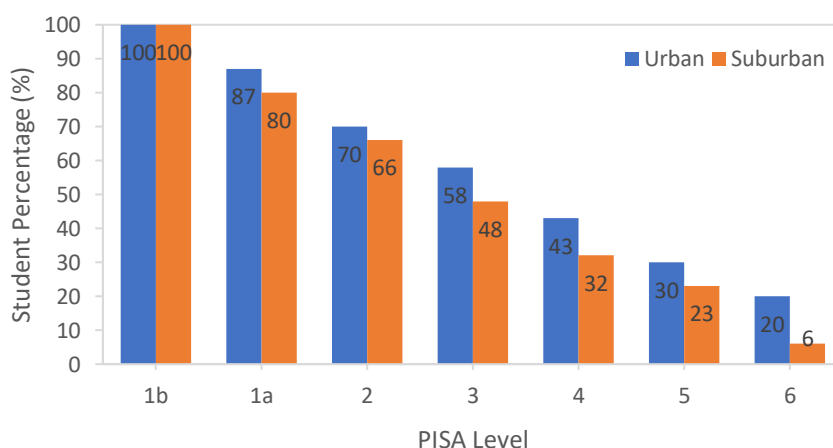


Figure 2. Percentage of student responses based on school location

Differences in Science Literacy Based on School Accreditation

School accreditation as a representation of compliance with national quality standards has been proven to positively correlate with students' science literacy achievements. SMPN 4 Samarinda, with an A accreditation, demonstrates consistently higher achievements compared to SMPN 19 Samarinda, which holds a B accreditation. These results indicate that institutional standards reflected in school accreditation, including the quality of teaching staff, the adequacy of facilities, and curriculum implementation, have a tangible impact on students' science literacy skills.

A. R. Hakim & Suharto, (2019) in their research stated that schools with higher accreditation generally have a more structured learning management system, stricter teaching quality supervision, and a stronger scientific culture within the school environment. These factors, directly or indirectly, contribute to the improvement of students' scientific competencies. This finding is also relevant to the research by Shal et al., (2024) which found a positive relationship between school accreditation standards and students' readiness to face international competency-based assessments.

Science Teachers' Perception of the Implementation of PISA-Based Learning

The results of interviews with science teachers from both schools revealed several important findings. In general, the teachers recognized the importance of PISA-based science literacy but acknowledged limitations in its implementation in the classroom. Three main themes were identified from the thematic analysis: (1) the gap between curriculum understanding and instructional practice; (2) limitations of PISA-based assessment instruments; and (3) the need for ongoing professional training.

Teachers stated that although the Merdeka Curriculum has indicated a competency-based and contextual learning approach, implementation at the classroom level is still often hindered by time constraints, less relevant teaching materials, and pressure to meet curriculum targets. This situation results in the majority of questions given to students still being at a low cognitive level, so students are less trained in working on PISA-type questions that require high-level scientific reasoning.

These findings reinforce the results of the study by (Teig et al., 2022), which stated that teachers'

readiness to integrate PISA-based science literacy into daily learning still needs to be systematically improved. Teachers require not only a conceptual understanding of the PISA framework but also practical skills in designing questions and learning activities that stimulate students' scientific thinking abilities. The availability of a validated and easily accessible PISA-based question bank is also an urgent need that policymakers should provide (Lestari & Wijaya, 2020).

CONCLUSION

This research successfully revealed the science literacy profile of junior high school students in Samarinda based on the PISA framework comprehensively. Overall, students showed good achievement at the lower levels (1b and 1a), but experienced a quite significant decline at the upper middle levels. Almost all students (98%) were able to solve level 1b questions, but only 29% were able to reach level 4 and above, and less than 21% could answer questions at the highest levels (levels 5 and 6). This pattern indicates that high-level scientific reasoning skills remain a major challenge for the majority of junior high school students in Samarinda.

Findings based on subgroups indicate significant differences based on gender (male students perform better), school location (urban areas score higher than suburban areas), and school accreditation (A accreditation is higher than B). These three factors are interconnected structural dimensions that reflect the complexity of challenges in equalizing the quality of science education in Indonesia. Interviews with science teachers emphasized the need for systematic teacher capacity development in terms of understanding competency-based curriculum and utilizing PISA-type assessment instruments. Given that the sample comprises only 66 students from two purposively selected schools, the findings cannot be generalized to represent all junior high school students in Samarinda. Instead, they should be viewed as indicative patterns within a constrained case context.

Based on the results and discussion, several recommendations are formulated as follows. First, the Samarinda City Education Office needs to design a science teacher training program that focuses on strengthening science literacy based on PISA results. Second, efforts are needed to equalize educational facilities, especially science laboratories and access to technology, for schools in the suburban areas. Third, the development of teaching materials and a question bank based on PISA competencies that can be accessed by all schools should become a policy priority. Fourth, further research with a larger sample scope and involving more diverse contextual variables is needed to obtain a more comprehensive picture of students' science literacy conditions in East Kalimantan.

ACKNOWLEDGEMENT

The authors would like to thank Perkumpulan Pendidikan IPA Indonesia (PPII) for funding this research, the Physics Education Study Program, Universitas Mulawarman, and SMPN 4 Samarinda and SMPN 19 Samarinda for supporting and facilitating this research activity.

REFERENCES

- AlAli, R., & Wardat, Y. (2024). Low PISA Performance Students: Factors, Perceptions, and Improvement Strategies. *International Journal of Religion*, 5(9), 334–348. <https://doi.org/10.61707/nve8gj33>
- Altun, A., & Kalkan, Ö. K. (2021). Cross-national study on students and school factors affecting science literacy. *Educational Studies*, 47(4), 403–421.
- Arlinwibowo, J., Kistoro, H. C. A., Retnawati, H., Kassymova, G. K., & Kenzhaliyev, B. K. (2020). Differences between Indonesia and Singapore based on PISA 2015: Five-factor students' perception in science education. *Jurnal Inovasi Pendidikan IPA*, 6(1). <https://doi.org/10.21831/jipi.v6i1.32637>

PISA Under the Spotlight...

- Baltikian, M., Kärkkäinen, S., & Kukkonen, J. (2024). Assessment of scientific literacy levels among secondary school students in Lebanon: Exploring gender-based differences. *Eurasia Journal of Mathematics, Science and Technology Education*, 20(3), em2407.
- Hakim, A., Efwindi, S., Damayanti, P., & Nurtasya, T. R. (2023). Exploration of Climate Literacy Level of High School Students In Prospective New Capital City of Indonesia. *JIPF (Jurnal Ilmu Pendidikan Fisika)*, 8(2), 248. <https://doi.org/10.26737/jipf.v8i2.3240>
- Hakim, A. R., & Suharto, N. (2019). The role of accreditation in improving education quality. *2nd International Conference on Research of Educational Administration and Management (ICREAM 2018)*, 297–300.
- Hanson, S. L., Sykes, M., & Pena, L. B. (2018). Gender equity in science: The global context. *Int'l J. Soc. Sci. Stud.*, 6, 33.
- Hardinata, A., Putri, R. E., & Permanasari, A. (2019). Gender difference and scientific literacy level of secondary student: A study on global warming theme. *Journal of Physics: Conference Series*, 1157(2), 022016.
- Innatesari, D. K., Sajidan, S., & Sukarmin, S. (2019). Middle School Students' Mastery of Scientific Inquiry Literacy based on Gender and School Location. *Journal of Physics: Conference Series*, 1241(1), 012046.
- Jufrida, J., Basuki, F. R., Kurniawan, W., Pangestu, M. D., & Fitaloka, O. (2019). Scientific literacy and science learning achievement at junior high school. *International Journal of Evaluation and Research in Education*, 8(4), 630–636. <https://doi.org/10.11591/ijere.v8i4.20312>
- Khery, Y., Ahzan, S., Efendi, I., Nufida, B. A., Dasna, I. W., Megapratiwi, F. I., Cahayani, L., & Febriani, N. (2024). Teacher readiness on promoting merdeka curriculum considering experience in implementing science process skill and scientific literacy learning. *AIP Conference Proceedings*, 3106(1), 070019.
- Kristiyasari, M. L., Yamtinah, S., Utomo, S. B., Ashadi, & Indriyanti, N. Y. (2018). Gender differences in students' science literacy towards learning on integrated science subject. *Journal of Physics: Conference Series*, 1097(1), 012002.
- Lawrence, S., Jones-Alexander, D., Keller, E., King, M. B., Mitchell, E., Johnson, E., & Land, C. W. (2021). BRIEF OVERVIEW OF DISPARITIES BETWEEN STUDENT EDUCATIONAL ACCESS IN RURAL, URBAN, AND SUBURBAN AREAS. *Journal of Education & Social Justice*, 7(1).
- Nasor, A., Lutfi, A. L., & Prahani, B. K. (2023). Science literacy profile of junior high school students on context, competencies, and knowledge. *IJORER: International Journal of Recent Educational Research*, 4(6), 847–861.
- OECD. (2019). *PISA 2018 assessment and analytical framework*. OECD publishing Paris, France.
- OECD. (2023). *PISA 2022 Results (Volume I)*. OECD Publishing. <https://doi.org/10.1787/53f23881-en>
- Qadar, R., Haryanto, Z., Subagiyo, L., Junus, M., & Syam, M. (2022). Indonesian Science Teachers' Ability to Design Scientific Literacy Test. *International Journal of STEM Education for Sustainability*, 2(1), 133–139. <https://doi.org/10.53889/ijses.v2i1.52>
- Shal, T., Ghamrawi, N., & Ghamrawi, N. A. R. (2024). Does accreditation lead to school improvement? Perceptions of educators in K-12 settings. *Sage Open*, 14(3), 21582440241281224.

PISA Under the Spotlight...

- Shandy, B., Pane, D., Yuriza, F., Gupta, K., Fadila, L., Dominika, M., Nabila, N., & Bahar, W. (2025). *Indonesia's Accession to OECD Understanding the Economic Implications*.
- Sholikah, L., & Novika Pertiwi, F. (2021). Analysis of Science Literacy Ability of Junior High School Students Based on Programme for International Student Assessment (PISA). *Analysis of Science Ability ...*, 2, 2021. <https://jurnal.iainponorogo.ac.id/index.php/insecta>
- Teig, N., Scherer, R., & Olsen, R. V. (2022). A systematic review of studies investigating science teaching and learning: over two decades of TIMSS and PISA. *International Journal of Science Education*, 44(12), 2035–2058. <https://doi.org/10.1080/09500693.2022.2109075>