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REVIEW ARTICLE Salim et al.

A Critical Review of Indonesia's PISA 2025 Results

Faisal Salim[1*], Izul Islamudin[2], Evi Faujiah[3], Anwar Marasabesy[4]

[1] Pendidikan Guru Sekolah Dasar, Universitas Pamulang, Indonesia
[2] Pendidikan Guru Madrasah Ibtidaiyah, STIT INSIDA Jakarta, Indonesia
[3] Pendidikan Guru Sekolah Dasar, STKIP Kusuma Negara Jakarta, Indonesia
[4] Pendidikan Guru Sekolah Dasar, Universitas Khairun, Indonesia

*Corresponding authors: faisals@unpam.ac.id

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Informasi Artikel

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Abstrak

Evaluasi hasil PISA perlu mempertimbangkan capaian akademik, pemerataan, dan konteks belajar siswa untuk merumuskan prioritas perbaikan pendidikan. Penelitian ini bertujuan mengkaji secara kritis hasil PISA 2025 Indonesia dan implikasinya bagi peningkatan mutu pendidikan. Metode yang digunakan adalah kajian kritis berbasis analisis dokumen terhadap catatan negara Indonesia PISA 2025, didukung literatur pembanding, dengan fokus pada tren capaian, distribusi kecakapan, kesenjangan sosial ekonomi, dan konteks belajar siswa. Hasil kajian menunjukkan skor rata-rata sains sebesar 389, membaca 365, dan matematika 364, yang tetap berada di bawah rata-rata OECD. Perubahan skor dibandingkan 2022 tidak signifikan secara statistik. Sebanyak 63% siswa berada di bawah Level 2 dalam sains, 73% dalam membaca, dan 83% dalam matematika, dengan hampir tidak ada siswa mencapai Level 5–6. Kesenjangan sosial ekonomi dalam capaian sains lebih kecil daripada rata-rata OECD, tetapi perlu ditafsirkan dalam konteks capaian keseluruhan yang rendah. Rasa ingin tahu dan kecenderungan mencari bantuan relatif tinggi, sedangkan hanya 30% siswa memiliki pola pikir bertumbuh dan 24% melaporkan mengalami perundungan setidaknya beberapa kali sebulan. Temuan ini mengindikasikan bahwa stabilitas capaian belum memberikan bukti kuat mengenai perbaikan struktural. Penguatan literasi membaca, numerasi, dan literasi sains sejak pendidikan dasar, disertai peningkatan kualitas pembelajaran serta penciptaan lingkungan sekolah yang aman dan mendukung, perlu diprioritaskan.

Kata kunci: PISA 2025; Hasil PISA Indonesia 2025; Kajian Kritis; Pendidikan Dasar.

Abstract

Evaluating PISA results requires consideration of academic achievement, equity, and students' learning contexts to identify priorities for educational improvement. This study critically examines Indonesia's PISA 2025 results and their implications for improving educational quality. A document-based critical review of the PISA 2025 country note for Indonesia, supported by comparative literature, examined achievement trends, proficiency distributions, socioeconomic disparities, and students' learning contexts. The findings show mean scores of 389 in science, 365 in reading, and 364 in mathematics, all below the OECD averages. Changes from 2022 were not statistically significant. Approximately 63% of students performed below Level 2 in science, 73% in reading, and 83% in mathematics, while almost none reached Levels 5–6. The socioeconomic gap in science performance was smaller than the OECD average but should be interpreted alongside low overall attainment. Students reported relatively high curiosity and help-seeking tendencies, whereas only 30% held a growth mindset and 24% reported experiencing bullying at least a few times a month. These findings suggest that stable performance does not provide strong evidence of structural improvement. Educational priorities should include strengthening foundational reading, numeracy, and scientific literacy from primary education, improving instructional quality, and creating safe and supportive school environments.

Keywords: PISA 2025; Indonesia's 2025 PISA Results; Critical Review; Primary Education.

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1. INTRODUCTION

The Programme for International Student Assessment (PISA) is a survey conducted by the OECD to assess the knowledge, skills, and attitudes of 15-year-old students, that is, the extent to which they can solve complex problems, think critically, and communicate effectively (OECD, 2026b). Indonesia has taken part in PISA since 2001 and, through international comparison, its results are often used by policymakers and educators to gauge the position of the national education system. The PISA 2025 cycle involved more than 760,000 students representing about 33 million 15-year-olds in 91 countries and economies. In Indonesia, 14,168 students from 419 schools participated, representing about 3,995,000 students, or an estimated 90% of the 15-year-old population (OECD, 2026b). Science was the major domain, while mathematics and reading were minor domains, accompanied by an assessment of computational problem solving.

The PISA 2025 results were released on 8 September 2026. Indonesia's scores in science (389) and reading (365) were recorded as higher than in 2022, while the mathematics score (364) fell slightly (OECD, 2026b). News coverage highlighted the increase as a sign of post-pandemic learning recovery (Jannah, 2026), while the Ministry of Primary and Secondary Education stated that Indonesia's performance was relatively stable while the scores of OECD countries declined (Voice of Indonesia, 2026). This narrative needs to be tested: whether an increase of a few points is meaningful, where students stand in absolute terms against the minimum proficiency standard, and whether the seemingly positive indicators of attitudes and learning environment are truly consistent with academic achievement.

Testing that narrative requires an understanding of what PISA measures and the limits of its interpretation. PISA does not measure mastery of a particular curriculum, but rather students' ability to apply knowledge and skills in real-life situations. In OECD reports, student proficiency is grouped into levels, with Level 2 as the minimum proficiency threshold (*baseline*) in science, mathematics, and reading. Students below Level 2 are categorised as low performers, while students at Level 5 or 6 are categorised as high performers (OECD, 2026b). This grouping allows results to be read not only through mean scores but also through the proportion of students at each proficiency level. In addition to the test, PISA collects questionnaire data from students and school principals. The OECD (2026b) cautions that differences between countries on indicators drawn from these reports should be interpreted carefully because they may reflect differences in response behaviour, non-response, cultural norms, and interpretation of questions, rather than true differences. This caution matters when attitude indicators are compared with test achievement, as is done in this article.

To place the 2025 results in perspective, it is necessary to look at what has been studied in earlier cycles. The literature on PISA in Indonesia has mostly discussed the 2022 results, when Indonesian students declined in mathematics, reading, and science, producing one of the lowest results since first participation in 2001, and disparities between socio-economic groups were reported to have widened (Bilad et al., 2024). The 2022 scores used as the comparison in this article are 383 (science), 366 (mathematics), and 359

(reading) (OECD, 2026b). Bilad et al. (2024) proposed curriculum renewal through the student-centred Merdeka Curriculum, stronger teacher training, more equitable access to education, and the development of local assessments such as AKMI and AKSI that are aligned with international standards. These proposals form a policy background relevant to reading the 2025 results. As for the determinants of achievement, these have been examined in earlier cycles, for example PISA 2015. A multilevel study of those data showed that Indonesian students' science achievement was influenced by student-level factors, namely gender, socio-economic and cultural status, enjoyment of science, science self-efficacy, and epistemological beliefs about science, as well as school-level factors, namely school type and disciplinary climate in science lessons (Ivanka & Setiawan, 2025). About 50.9% of the variation in achievement lay between students and the remainder between schools, so differences in school quality cannot be ignored. These findings provide a framework for reading the attitude and school-environment indicators in PISA 2025.

Beyond these factors, two contemporary issues also shape PISA 2025, namely the use of artificial intelligence (AI) and digital devices in schools. An experiment with high school students in mathematics showed that access to generative AI without *guardrails* can harm learning (Bastani et al., 2025). As for mobile phone restrictions, a commentary on a school study in England concluded that restrictive policies were not associated with better mental wellbeing or academic achievement, although they may help school functioning, so restrictions at school alone are not enough (Weiss & Bonell, 2025).

Because the 2025 results have only just been released, to the authors' knowledge there are not yet many critical studies that examine them comprehensively. This article fills that gap by weighing trends, proficiency distribution, socio-economic disparities, and students' attitudes and learning environment within a single analytical framework. This review is relevant to primary education. PISA participants were aged 15 years 3 months to 16 years 2 months and had completed at least six years of formal education (OECD, 2026b); their achievement therefore also reflects the quality of the foundations of literacy, numeracy, and science built since primary school. The aim of this article is to critically examine Indonesia's PISA 2025 results by answering four questions: (1) how do the achievement and trends of Indonesian students compare with previous cycles and with comparison countries; (2) what are the distribution of proficiency and its socio-economic disparities; (3) what do indicators of learning attitudes, school environment, and digital literacy show; and (4) what implications can be drawn for primary education policy and practice.

2. METHOD

2.1. Research design

This study is a critical review with a descriptive qualitative approach based on document analysis. A critical review does not merely summarise findings but also assesses the strength of evidence, compares it with the literature, and formulates interpretations and implications. This article does not re-analyse the raw PISA data.

2.2. Data sources

The main data source is the Indonesia country note in PISA 2025 Results (Volume I) published by the OECD (2026b) as a summary of the full OECD (2026a) report. The document contains five figures and supporting text on achievement, trends, disparities, learning attitudes, school life, digital resources, and readiness for environmental challenges. The figures presented in this article are taken from that document in accordance with the CC BY 4.0 licence, and the source is stated in each figure caption. Supporting data consist of news reports on the PISA 2025 results (Jannah, 2026; Voice of Indonesia, 2026) and comparative scholarly literature selected purposively for its relevance to the issues discussed (Bastani et al., 2025; Bilad et al., 2024; Ivanka & Setiawan, 2025; Weiss & Bonell, 2025).

2.3. Data analysis technique

The analysis was conducted in three steps. First, indicators were extracted from the document and grouped into five dimensions (Table 1). Second, each indicator was compared with the OECD average, previous cycles, and the comparison countries available in the document; simple differences, for example the change in scores from 2022 to 2025, were calculated by the authors from the figures shown in the charts. Third, the findings were examined critically using four questions: (a) whether the magnitude of change is meaningful relative to measurement uncertainty; (b) where its absolute position lies relative to minimum proficiency, not only relative to the average; (c) how strong the indicator is given that it is self-reported; and (d) whether it is consistent with or contradicts the literature. Because the data source is a summary, the authors did not conduct their own significance tests and only report the significance assessments stated by the OECD.

Table 1. Dimensions of analysis and indicators examined

Dimension	Indicators examined	Figures in the article
Achievement and trends	Mean scores in science, mathematics, reading, and computational problem solving; trends 2001–2025; country comparisons	Figures 1–3
Proficiency distribution	Proportion of students below Level 2 and at Levels 5–6	Figure 4
Disparities	Socio-economic quartiles, school achievement, academic resilience	Figure 5
Learning attitudes and school environment	Curiosity, growth mindset, bullying, teacher and family support, resource shortages	Figures 1, 6
Digital literacy and environment	Device use time, mobile phone policy, AI chatbots, readiness for environmental challenges	Figures 1, 6

Source: compiled by the authors from OECD (2026b)

3. RESULTS AND DISCUSSION

3.1. Average achievement and trends

Figure 1 summarises the position of Indonesian students. Only 37% of students reached Level 2 or higher in science (OECD average: 74%), 17% in mathematics (65%), 27% in reading (69%), and 30% in

computational problem solving (64%). On several attitude indicators, namely curiosity, goal setting, and help-seeking, Indonesia was above the OECD average.

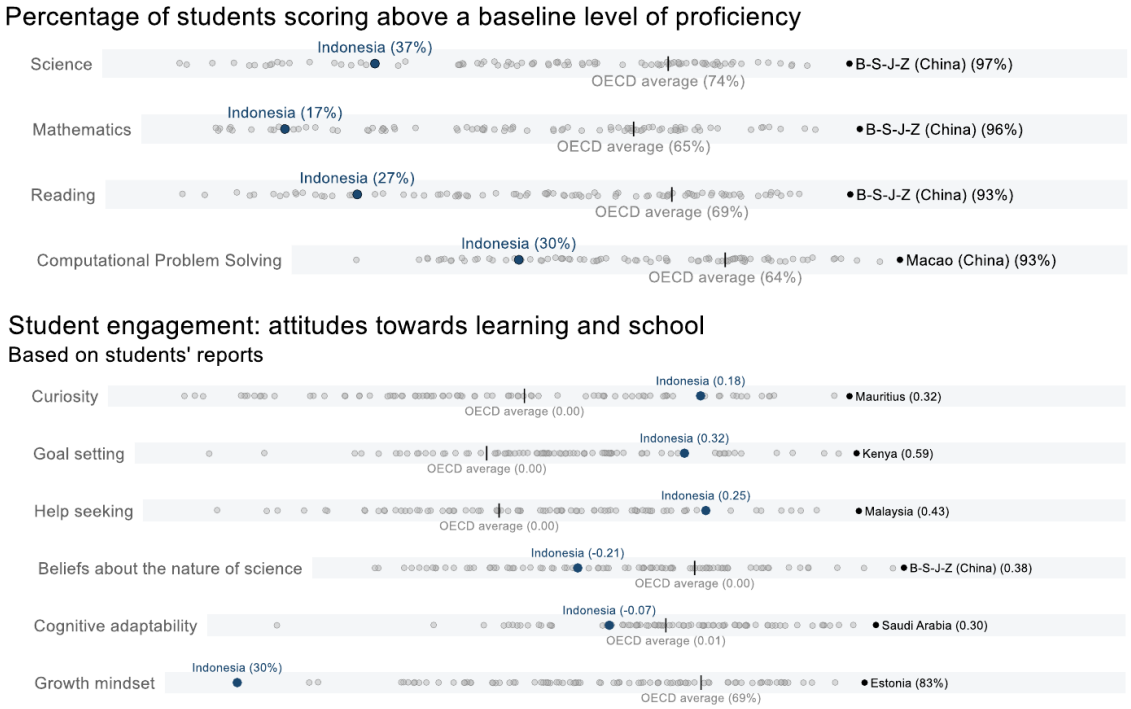


Figure 1. Multidimensional dashboard of Indonesian students' learning. *Source: OECD (2026b, Figure 1)*

Indonesia's mean scores were 389 in science, 364 in mathematics, and 365 in reading, which according to the OECD (2026b) are about the same as in 2022. Table 1 and Figure 2 show that the differences of +6, −2, and +6 points are far smaller than the decline since 2015, namely 14 points in science, 22 in mathematics, and 32 in reading. In Figure 2, only the 2015 science score differs significantly from the 2025 score; in mathematics, significant differences are found in 2006, 2015, and 2018; and in reading, from 2003 to 2015.

Table 1. Indonesia's mean PISA scores, 2001–2025 (points)

Year	Science	Mathematics	Reading
2001	–	–	371
2003	–	360	382
2006	393	391	393
2009	383	371	402
2012	382	375	396
2015	403	386	397
2018	396	379	371
2022	383	366	359
2025	389	364	365
Change 2022–2025	+6	−2	+6
Difference 2025 vs 2015	−14	−22	−32

Source: OECD (2026b, Figure 2); the change and difference rows were calculated by the authors. The symbol "–" indicates that the domain was not available in that cycle.

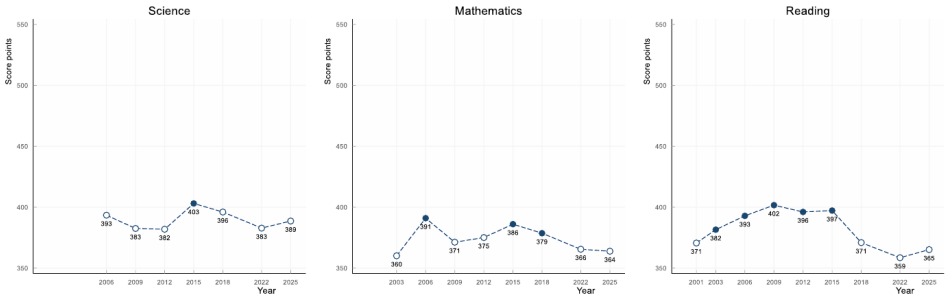


Figure 2. Trends in science, mathematics, and reading achievement. White dots indicate scores that do not differ significantly from the 2025 score. *Source: OECD (2026b, Figure 2).*

The word "rise" in news coverage (Jannah, 2026) therefore needs to be read cautiously. An increase of 6 points is better read as stabilisation at a low level, not a recovery to 2015 levels. The statement that Indonesia was relatively stable while OECD scores declined (Voice of Indonesia, 2026) is correct in relative terms: the OECD average fell by 14 points in reading, 9 in mathematics, and 3 in science, to 463, 465, and 484 (Jannah, 2026). However, the decline in other countries does not add to Indonesian students' proficiency, and the gap to the OECD average remains nearly 100 points, namely about 95 in science, 98 in reading, and 101 in mathematics.

Since 2018, Indonesia's scores have remained below those of Malaysia and Thailand. The gap with Malaysia narrowed in mathematics (62 to 34 points), reading (44 to 28), and science (42 to 32), while the gap with Thailand in science widened by 14 points (OECD, 2026b). However, Indonesia's own scores in 2018–2025 fell by 7 points in science, 15 in mathematics, and 6 in reading (Table 1), so the narrowing means that Malaysia's scores fell more, not that Indonesia's achievement improved. Abdillah and Syifa (2025) explain Malaysia's advantage in PISA 2022 through a more stable curriculum, a growth-oriented mindset, and strong socio-cultural support; these factors reappear in the findings below. Figure 3 shows that Indonesia was at the lowest position among the comparison countries in science, mathematics, and reading, and in computational problem solving Indonesia's score (427) was higher only than Brazil's.

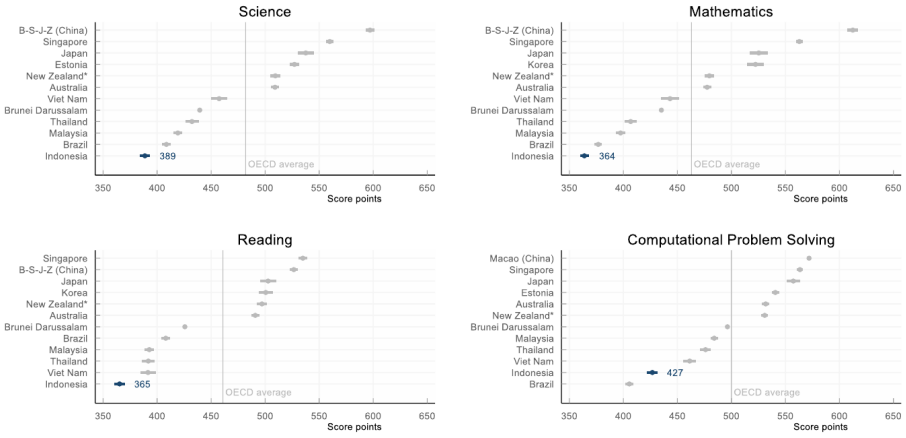


Figure 3. Mean scores in science, mathematics, reading, and computational problem solving: Indonesia, the OECD average, and selected comparison countries. *(Source: OECD (2026b, Figure 3).)*

3.2. Distribution of student proficiency

Figure 4 and Table 2 show that 63% of Indonesian students were below Level 2 in science, 83% in mathematics, and 73% in reading, compared with OECD averages of 26%, 35%, and 31%. Some of them were even below Level 1a: 22% in science, 34% in reading, and 48% in mathematics. Almost no Indonesian students reached Level 5 or 6, whereas the OECD averages were 7%, 8%, and 6%. At Level 2, students are at minimum able, for example, to interpret simple situations mathematically without direct instruction and to identify the main idea of a text of moderate length (OECD, 2026b); the majority of Indonesian students at age 15 do not yet consistently master these basic competencies.

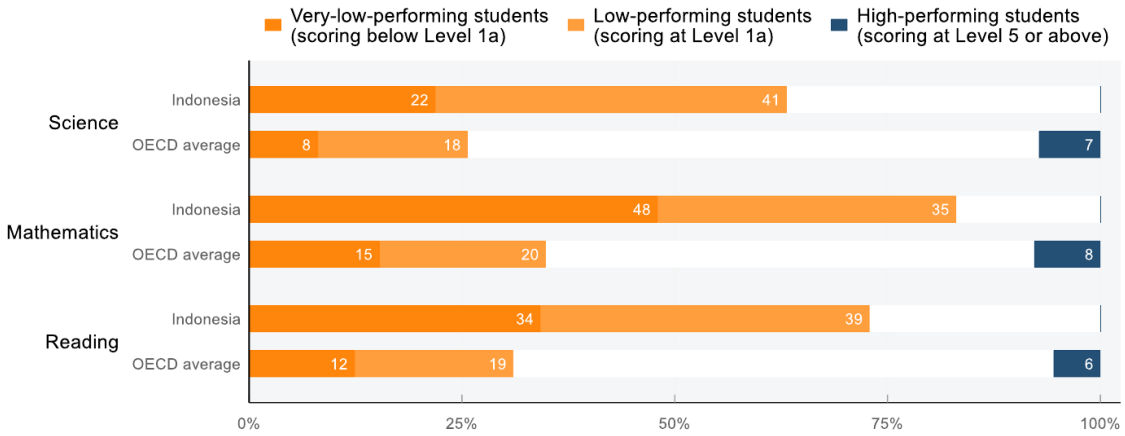


Figure 4. Proportion of very low-, low-, and high-performing students in science, mathematics, and reading: Indonesia and the OECD average (%). *(Source: OECD (2026b, Figure 4).)*

Table 2. Distribution of student proficiency levels: Indonesia and the OECD average (%)

Domain	Below Level 1a (ID)	Level 1a (ID)	Below Level 2 (ID)	Level 5–6 (ID)	Below Level 2 (OECD)	Level 5–6 (OECD)
Science	22	41	63	≈0	26	7
Mathematics	48	35	83	≈0	35	8
Reading	34	39	73	≈0	31	6

Source: OECD (2026b, Figure 4); the "below Level 2" column is the sum of the two low-performing categories. The symbol "≈0" means almost no students.

A distribution that is concentrated at the bottom makes a mean increase of a few points less meaningful. A more informative indicator is the proportion of students below Level 2, which according to the OECD (2026b) increased compared with 2015 by 14 percentage points in mathematics, 18 in reading, and 7 in science. This pattern is consistent with findings that madrasah teachers remain limited in HOTS-based teaching and literacy–numeracy strategies (Alfaruqi & Nurwahidah, 2025), with mathematics teachers' view that the 2022 decline was influenced by the pandemic, the curriculum, limited resources, and parental involvement (Wijaya et al., 2024), and with studies linking government efforts to improve teacher quality to PISA performance (Solihin et al., 2024). Developing teachers' professional competence, for example through coaching-based academic supervision by madrasah supervisors (Hidayati, 2026), is one route that has been studied at the madrasah ibtidaiyah level. When almost half of students are below Level

1a in mathematics, the diagnostic information the test provides about what these students can do is also limited, so plans to align the national assessment with PISA (Voice of Indonesia, 2026) need to be accompanied by targeted remedial teaching.

3.3. Socio-economic disparities

A total of 47% of Indonesian students were in the bottom quartile of the international socio-economic scale, the largest share among the four quartiles, with a mean science score of 375 (OECD, 2026b). The science score gap between the top and bottom quartiles was 47 points, far smaller than the OECD average (85 points); socio-economic status explained 9% of the variation in science scores (OECD: 12%); and 15% of disadvantaged students were academically resilient (OECD: 12%). This gap has been stable since 2015, while the OECD average has narrowed, and performance declined similarly among advantaged and disadvantaged students.

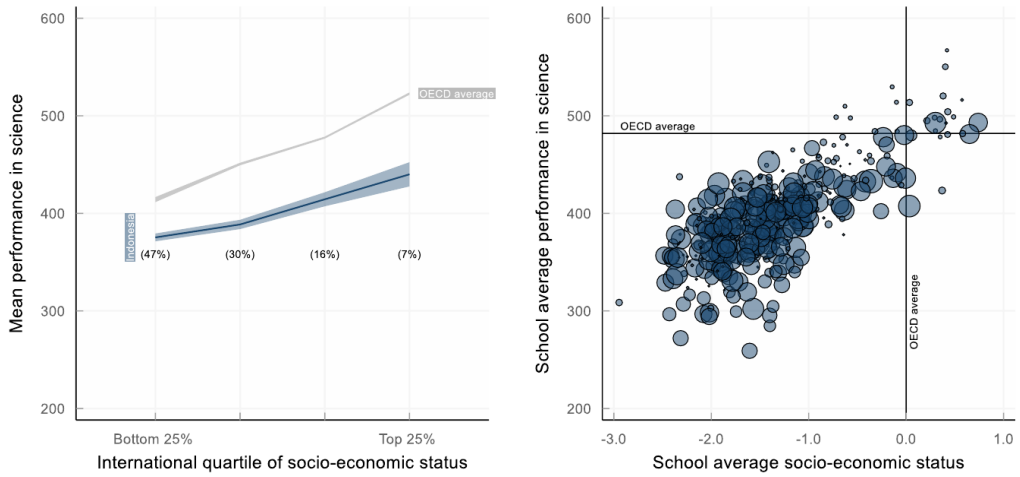


Figure 5. Science achievement and the socio-economic status of students and schools. *(Source: OECD (2026b, Figure 5))*

At first glance, these figures look positive. However, Figure 5 (left) shows Indonesia's curve below the OECD curve in every quartile, and the score of Indonesia's top quartile appears only slightly above that of the OECD's bottom quartile. The small gap is therefore better read as levelling down than as equality of quality. Figure 5 (right) adds to this observation: most schools cluster at the lower left, that is, schools with low socio-economic status and achievement far below the OECD average. This finding is consistent with Ivanka and Setiawan (2025) that variation in achievement is spread between students and schools, and with Sukowati and Kismiantini (2025), who found that socio-economic status and family support were positively associated with mathematics achievement in PISA 2022.

3.4. Learning attitudes, school environment, and digital literacy

Table 3 summarises the main indicators. Indonesian students reported curiosity, extra effort, and a habit of asking teachers for help that exceed the OECD average, but only 30% held a growth mindset (OECD: 69%) and only 32% believed that social status can change (OECD: 66%). After accounting for

socio-economic profile, students with a growth mindset outperformed others by 17 science points in Indonesia (OECD: 28 points) (OECD, 2026b).

Table 3. Indicators of student attitudes, school environment, and digital literacy (%)

Indicator	Indonesia	OECD	Earlier comparison
Curious about many things	80	73	–
Apply extra effort when tasks are difficult	74	60	–
Ask teachers for help	90	77	–
Growth mindset	30	69	–
Belief in social mobility	32	66	–
Teacher shows interest in every student's learning	82	69	46 (2015)
Teacher shortage hinders instruction	18	39	no significant change
Victim of bullying a few times a month or more	24	20	increased since 2022
Victim of cyberbullying	7	3	–
Parents ask about school activities every week	48	–	57 (2022)
Use AI chatbots for learning weekly	53	46	–
Students in schools that ban mobile phones	45	49	43 (2022)
Reach Level 2 in environmental science	39	74	–

Source: OECD (2026b). The symbol "–" means the value was not reported in the document. Growth mindset and belief in social mobility are the percentages of students who disagree that intelligence and social status are hard to change.

This pattern is paradoxical: positive self-reports sit alongside very low achievement. Besides the possibility that positive attitudes are not enough without a foundation of proficiency, self-report indicators can be influenced by cultural norms and response behaviour, as the OECD (2026b) cautions. What is weakest is precisely beliefs about ability: Abdillah and Syifa (2025) also noted a fixed mindset among Indonesian students, and Yeager et al. (2019) showed that the benefits of a growth mindset depend on the school context, so interventions need to take the school context into account. Among the lowest socio-economic group, which includes almost half of students, the belief that ability and social position are hard to change may reinforce disparities. The affective dimension in mathematics has also been the focus of instructional studies, for example mathematical disposition through schema-based instruction (Faujiah et al., 2026), which is relevant because 83% of Indonesian students were below Level 2 in mathematics.

Perceived teacher support is very strong (82%, up from 46% in 2015) and the disciplinary climate is better than the OECD average (index 0.47 compared with 0.14; Figure 6), yet science scores fell from 403 in 2015 to 389 in 2025, even though the OECD (2026b) notes that countries with an improving disciplinary climate tend to show stable or rising scores. Ping et al. (2025), using Indonesian national assessment data, found that students' perceptions of classroom management and affective support predicted literacy and numeracy, whereas cognitive activation showed no positive relationship. Warm support appears insufficient without cognitive challenge; this is consistent with the interpretation that perceived support measures process, not the quality of learning. Teacher shortages are perceived less often than the OECD average (18% compared with 39%), but this principal-reported measure concerns numbers, not competence, so the issue of teacher competence (Alfaruqi & Nurwahidah, 2025) remains relevant.

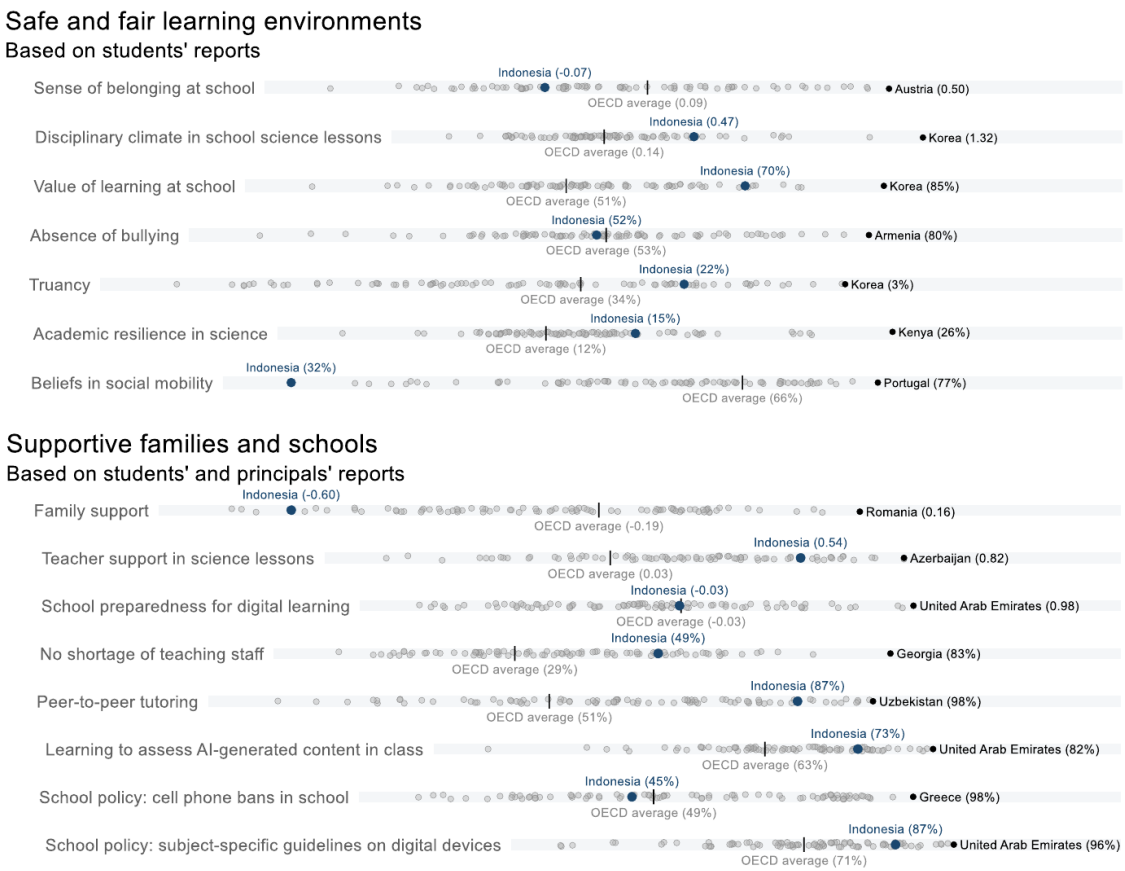


Figure 6. A safe and fair learning environment and family and school support. *Source: OECD (2026b, Figure 1).*

The dimensions of safety and family support, by contrast, have worsened. Bullying has risen since 2022 (24% of students; OECD: 20%) and cyberbullying, although less common (7%; OECD: 3%), is associated with science scores 18 points lower (OECD, 2026b). Sukowati and Kismiantini (2025) found that physical bullying was associated with lower mathematics achievement in PISA 2022. Family support is far below the OECD average (index −0.60 compared with −0.19; Figure 6), with the share of parents who ask about school activities every week falling from 57% in 2022 to 48%; mathematics teachers also cite parental involvement as a factor in the decline in achievement (Wijaya et al., 2024).

In digital literacy, 53% of students use AI chatbots for learning at least once a week (OECD: 46%), among other things to summarise reading texts (39%; OECD: 30%), and only 7% never use them (OECD: 14%). When 73% of students have not reached Level 2 in reading, summarising with AI risks replacing the process of understanding texts. Bastani et al. (2025) found that access to generative AI without guardrails can harm learning, although that evidence comes from secondary school mathematics outside Indonesia and PISA data do not show cause and effect. Students in schools that ban mobile phones are 38% less likely to report digital distraction, but only 45% of students attend such schools (OECD: 49%). Because school bans alone are not enough for student wellbeing (Weiss & Bonell, 2025), a ban is better treated as one component of clear guidelines on device and AI use. The integration of AI with other learning technologies in science literacy is itself being studied for its prospects and challenges (Wibowo et al., 2026),

so such guidelines need to be updated continually as evidence emerges. On environmental readiness, only 39% of students reached Level 2 in environmental science (OECD: 74%), even though 92% believe they can have a positive impact on the environment (OECD: 81%); high enthusiasm has not been matched by conceptual mastery.

3.5. Implications for primary education

The PISA 2025 results carry three messages: stabilisation at a low level; structural shortfalls (a majority of students below minimum proficiency, almost no high-performing students, and a dominant fixed mindset); and new risks in the form of bullying, weakening family support, and widespread AI use. The implication is that foundational literacy and numeracy should be prioritised from the early grades together with diagnosis-based remedial teaching, which can draw on digital assessment such as Google Forms, whose use in elementary school science learning has been studied from students' perceptions (Puspita et al., 2026); teaching needs to shift from rote memorisation to reasoning and problem solving, in line with the urging of P2G (Jannah, 2026), with experimental findings that problem-based learning assisted by animation media significantly affects fourth-grade students' science problem-solving ability (Salim et al., 2024a), with a comprehensive study of the implementation of problem-based learning in elementary schools (Salim et al., 2024b), and with studies of interactive multimedia for strengthening students' conceptual understanding (Fauzi et al., 2026); teachers need to build a growth mindset and challenge students cognitively; and schools need to strengthen protection from bullying, guidelines on AI use, and family involvement. It should also be noted that PISA is cross-sectional, so associations are not cause and effect, and that PISA 2025 participants completed most of their primary education before the Merdeka Curriculum was widely implemented, so these results cannot yet be used to evaluate that curriculum.

4. CONCLUSION

This article critically examined Indonesia's PISA 2025 results. The scores in science (389), mathematics (364), and reading (365) are about the same as in 2022 and remain below 2015 levels, so the 6-point rise in science and reading is better read as stabilisation, not recovery. A total of 63%, 83%, and 73% of students were below Level 2 in science, mathematics, and reading, and almost no students were high performers. Socio-economic disparities are smaller than the OECD average but occur at a low level of achievement. Positive learning attitudes sit alongside a weak growth mindset (30%), rising bullying (24%), declining family support, and high AI use. Practically, the focus should be on foundations of literacy and numeracy from primary education, teaching that builds reasoning, teacher competence, protection from bullying, and guidelines on the use of AI and digital devices.

The limitations of this article are its use of a country note, which is a summary without microdata and standard errors, the absence of its own significance tests, purposive selection of literature without a systematic review protocol, and the large number of self-report indicators. Future research could analyse PISA 2025 microdata using multilevel models to test the relationships among attitudes, school

environment, and achievement, and evaluate interventions to strengthen foundational literacy and numeracy and the use of AI in the classroom.

5. ACKNOWLEDGMENTS

The authors thank the OECD for making the PISA 2025 results openly available so that they could be analysed and cited in this article.

Ethics Statement

This study is a document review of publicly available secondary data. It involved no human or animal subjects, primary data collection, or fieldwork; therefore, ethical approval was not required.

Data Availability Statement

No new data were generated. All data come from the PISA 2025 Indonesia country note (OECD, 2026b) and the sources listed in the references. The full report is available at https://doi.org/10.1787/73451bc5-en (OECD, 2026a).

Conflict of Interest Statement

The authors declare no conflict of interest.

Statement on the Use of *Artificial Intelligence*

During the preparation of this work, the author(s) used Claude in order to improve the language and readability of the manuscript. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication..

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