Jurnal Pendidikan Matematika Universitas Lampung
Vol. 13, No. 4, 2025, pp. 217 – 228
https://jurnal.pbs.fkip.unila.ac.id/index.php/jpm/
ISSN: 2715-856X

Portrait of Junior High School Students' Statistical Literacy through PISA on Uncertainty and Data Content

Satria Bayu Herlambang[1], Duano Sapta Nusantara[2]*, Feri Tiona Pasaribu[3]

[1,2,3]Universitas Jambi, Jambi–Ma Bulian Street, Jambi 3631, Indonesia
duanosaptanusantara@unja.ac.id*

*corresponding author

ARTICLE INFO

Article history
Received: 17 September, 2025
Revised: 29 October, 2025
Accepted: 25 November, 2025
Published: 7 December, 2025

Keywords
basic literacy;
junior high school students; PISA;
statistical literacy;
uncertainty and data

ABSTRACT

Statistical literacy is a critical 21st-century competency, as students increasingly encounter data-driven information in their everyday lives. However, international assessments such as PISA consistently show that Indonesian students struggle to interpret and reason with data. This study aims to investigate junior high school (JHS) students' statistical literacy in solving PISA-based problems related to uncertainty and data, while also linking the results to Sustainable Development Goal (SDG) 4: Quality Education. A descriptive qualitative approach was employed involving 40 ninth-grade students from JHS Negeri 6 Kota Jambi, selected through purposive sampling to represent high, medium, and low academic ability groups. Data were collected through a validated PISA 2012 item focusing on uncertainty and data, along with semi-structured interviews designed to explore students' statistical-literacy strategies. Data analysis followed an interactive model consisting of data reduction, data display, and conclusion drawing, guided by Schield's (2011) statistical-literacy indicators. The findings indicate that only 17.5% of students demonstrated a high level of statistical literacy, while most were categorized as medium (37.5%) or low (45%). Further analysis revealed persistent difficulties in identifying trends, calculating averages, and drawing valid conclusions. These findings underscore the need for contextual, PISA-based learning tasks that foster statistical reasoning and strengthen students' fundamental literacy skills as a foundation for achieving quality education.

How to Cite: Herlambang, S. B., Nusantara, D. S., Pasaribu, F. T. (2025). Portrait of junior high school students' statistical literacy through PISA on uncertainty and data content. *Jurnal Pendidikan Matematika Universitas Lampung*. 13(4), 217 – 228. http://dx.doi.org/10.23960/mtk/v13i4.pp217-228

INTRODUCTION

In today's world, Statistical literacy is a key 21st-century competency, as students today face a constant flow of data (Pratama et al., 2020). It goes beyond calculating averages and involves the ability to read, interpret, and use data for decision-making (Gal, 2024; Gould, 2017). Therefore, statistics education should emphasize critical thinking about data rather than repetitive calculations. International assessments such as PISA reveal that Indonesian students still struggle with literacy. Reading scores declined from 2015 to 2022 (OECD, 2016, 2019, 2023), reflecting broader challenges in interpreting graphs and analyzing data (Efriani & Wachyuni, 2024; Lusinda et al., 2025; Ramli et al., 2022). This is significant because the "uncertainty and data" domain in PISA is highly relevant for developing statistical literacy (OECD, 2016; Podworny et al., 2024).

At the national level, the Indonesian government has recognized this issue through

the Kurikulum Merdeka, which promotes higher-order thinking and contextual learning, as well as through Asesmen Nasional Berbasis Komputer (ANBK) that emphasizes numeracy and literacy as indicators of educational quality (Kartini et al., 2025; Koro et al., 2025). These initiatives demonstrate a growing policy shift from procedural learning toward competency-based and data- literate education. However, the classroom implementation of these frameworks still faces challenges in integrating statistical reasoning with real-life contexts.

Unfortunately, statistics teaching practices in schools still tend to emphasize routine task that focus on technical procedures, so that students are not trained much in interpreting data contextually (Hariyanti, 2019). PISA-type task offer an alternative by promoting contextual statistical literacy and connecting mathematics to real life (OECD, 2023; Yuda & Rosmilawati, 2024). Research by Nusantara et al. (2021) confirms that the development of PISA-based task with real contexts, such as the COVID-19 pandemic, can provide a more meaningful learning experience for students while training their literacy skills.

Later studies also highlight the importance of digital-based PISA tasks, which fit better with 21st-century learning needs where technology and data are basic literacies (Nusantara et al., 2024a). Students' strategies in solving PISA tasks also reveal their literacy levels. Nusantara et al. (2024b) found diverse approaches in change-and-relationship problems, reflecting varying degrees of critical thinking. This indicates that contextual task are not only assessment tools but also effective means of strengthening literacy.

Previous studies have explored statistical literacy from different perspectives. However, most remain descriptive and have not conducted in-depth analysis comparing methodological or contextual differences. For example, Utari et al. (2025) explored strategies to improve the statistical literacy of pre-service teachers, while Gould (2017) argued that "data literacy" is as important as statistical literacy and should be an integral part of mathematics education. Meanwhile, Gal (2024) shows that to build statistical literacy, students need to be given a clear understanding and appropriate learning strategies so that they can relate data to everyday situations. Despite these contributions, prior research rarely focuses on junior high school students' statistical literacy in relation to PISA-type tasks, particularly in examining students' thinking processes across different ability levels and contextual problem types. Therefore, this study aims to analyze students' statistical literacy skills in solving PISA task on uncertainty and data content. The analysis focuses on three main aspects, namely problem understanding, data processing, and data interpretation. This analysis is expected to provide a clearer picture of students' skill profiles and serve as a basis for improving statistics learning in schools.

METHOD

This research employed a qualitative descriptive approach aimed at portraying students' statistical literacy skills in solving PISA task on uncertainty and data (Sugiyono, 2023). The research was conducted on August 27, 2025, at JHS Negeri 6 Kota Jambi with 40 ninth-grade students as research subjects. The class was selected based on the recommendation of the mathematics teacher, considering that the class represented a variety of academic abilities, including high, medium, and low.

Two main instruments were used: written tests and semi-structured interviews. The test consisted of one item adapted from the original PISA 2012 tasks in the uncertainty and data domain, selected to align with junior high school students' cognitive levels. The items represented three types of statistical literacy: (1) interpreting data trends presented in graphs, (2) calculating averages and comparing data distributions, and (3) making predictions or conclusions based on real-life statistical contexts. Each task was chosen to measure one or more of Schield (2011) statistical literacy indicators. The items were validated by two mathematics education lecturers focusing on content relevance, linguistic clarity, and structural suitability.

Students were given 30 minutes to complete the test. Afterward, semi-structured interviews were conducted to gain deeper insights into students' statistical literacy skills, the difficulties they encountered, and their reasoning behind certain steps. Interview prompts were prepared based on the written responses to explore students' thinking processes and the emergence of statistical literacy. Students' answers were first scored using a rubric based on statistical literacy indicators and then categorized into three ability levels, as shown in Table 1.

Table 1. Criteria for Students' Statistical Literacy Proficiency Levels

Interval	Criteria
$80 \leq \text{Score} \leq 100$	High
$60 \leq \text{Score} < 80$	Medium
$\text{Score} < 60$	Low

(Nuryani et al., 2022)

Table 1 shows the criteria for categorizing statistical literacy levels. Students scoring 80–100 were classified as high, 60–79 as medium, and below 60 as low. From each group, several students were selected for interviews to obtain deeper qualitative data on their thinking processes and challenges. From each ability category, several students were selected for interviews to obtain more in-depth data on their thought processes and the difficulties they experienced. The analysis of the students' answers referred to the statistical literacy indicators proposed by Schield (2011), as shown in Table 2.

Table 2. Indicators Statistical Literacy Ability

Indicators	Descriptors
Problem understanding	Students are able to identify and explain the given information as well as the task posed in several forms (graphs, table, etc)
Data processing	Students are able to choose and apply appropriate data-processing strategies in line with the context of the statistical problem
Data interpretation	Students are able to interpret the data, draw conclusions, and present the results clearly and logically according to the context of the problem

(Schield, 2011)

Student responses were analyzed using the indicators proposed by Schield (2011), summarized in Table 2. The Problem Understanding (PU) indicator referred to students' comprehension of the problems, the Data Processing (DP) indicator reflected their strategies in handling relevant data, and the Data Interpretation (DI) indicator assessed their ability to interpret results and draw conclusions. The data were collected through the written test and interviews. The test provided information on students' ability to solve PISA tasks, while the interviews offered deeper insights into their strategies and difficulties. Data analysis followed Sugiyono (2023) interactive model, which consists of three stages: (1) data reduction, (2) data display, and (3) conclusion drawing and verification, all carried out with reference to the statistical literacy indicators.

RESULTS AND DISCUSSION

Results

In general, the results of students' statistical literacy abilities are presented in Table 1. The table shows considerable variation, with most students falling into the medium and low categories. This suggests that many students still struggle to solve statistical literacy problems, especially those requiring more complex reasoning.

Table 3. Results of Student Statistical Literacy

Category	Number of Students	Student Presentation (%)
High	7	17,5
Medium	15	37,5
Total	18	45
Total	40	100

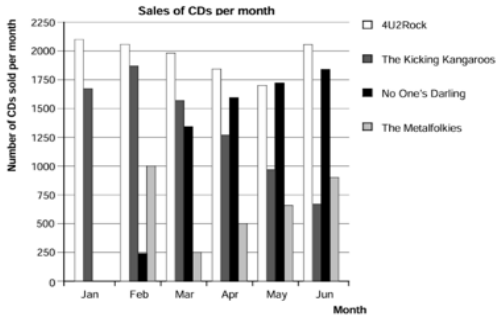
As shown in Table 3, only 17.5% of students achieved the high category, while 37.5% were in the medium category, and the majority, 45%, were in the low category. These findings indicate that students' statistical literacy levels are generally still in the

medium-to-low range. Further analysis was conducted on the test results by examining specific task and students' responses. The following is one of the 2012 PISA task with the code PM918Q05, along with a description of the students' answers.

English Version

CHARTS

In January, the new CDs of the bands 4U2Rock and The Kicking Kangaroos were released. In February, the CDs of the bands No One's Darling and The Metalfolkies followed. The following graph shows the sales of the bands' CDs from January to June.



The manager of The Kicking Kangaroos is worried because the number of their CDs that sold decreased from February to June.
What is the estimate of their sales volume for July if the same negative trend continues?

A. 70 CDs B. 370 CDs
C. 670 CDs D. 340 CDs

Write down your reasons for choosing that answer!

Figure 1. PISA Task

This question shows a charts of CDs sales from several music groups between January and June. The focus of the question is on the music group The Kicking Kangaroos, whose sales appear to have continued to decline from February to June. Their manager is concerned about this downward trend, so students are asked to estimate sales for July if the same downward pattern continues. Thus, this question requires students to read the graph, pay attention to existing data trends, and then use them to make estimates for the following month. The indicators assessed in this question are as follows. The indicators measured in this question are: PU is measured by the students' ability to identify the downward trend in sales and the information on the number of CDs sold each month; DP is measured by the students' ability to calculate the average monthly decline (~300 CDs) and project it to the following month; Then DI is measured by the students' ability to conclude that if the trend continues, sales in July will reach 370 CDs.

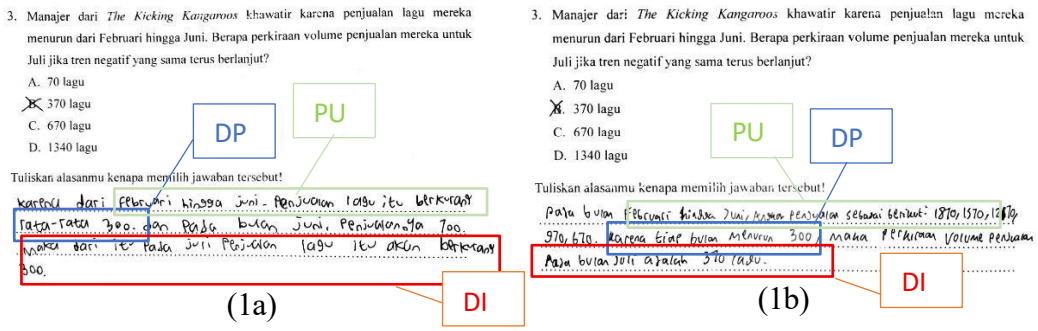


Figure 2. Potrait Student Statistical Literacy High Level

Figure 2 illustrates three examples of high-level student responses. For instance, Student 1a earned a score of 6 by noting that from February to June, sales declined by an average of 300 per month, and therefore predicted July sales at 370. Similarly, Student 1b scored 6 by listing the exact sales figures for each month (1870, 1570, 1270, 970, 670), recognizing the consistent decline of 300, and concluding that July sales would be 370 CDs.

Based on these three answers, it is clear that students met all three indicators. Under PU, they correctly identified the downward trend. Under DP, they calculated the consistent monthly decrease of 300 CDs. Finally, under DI, they concluded accurately that July sales would total 370 CDs. These responses were therefore categorized as high level, as they demonstrated strong conceptual understanding, correct calculations, and valid conclusions.

To confirm these findings, follow-up interviews were conducted with students who gave similar answers. Here are some excerpts from the interviews:

R : "How do you determine the sales figures for July?"

S : "I look at the data for each month, which always shows a decline of 300. So, from 670 in June, I subtract 300 to get 370."

R : "Are you sure this pattern will continue?"

R : "Yes, because the graph and data consistently show a decrease of 300, so I think July will follow the same pattern." will follow the same pattern."

The interview results supported the written answers. The student was able to explain their reasoning clearly, in line with the statistical literacy indicators: understanding the problem, applying a calculation strategy, and drawing a logical conclusion. Thus, it can be confirmed that the student demonstrated statistical literacy skills at the high level.

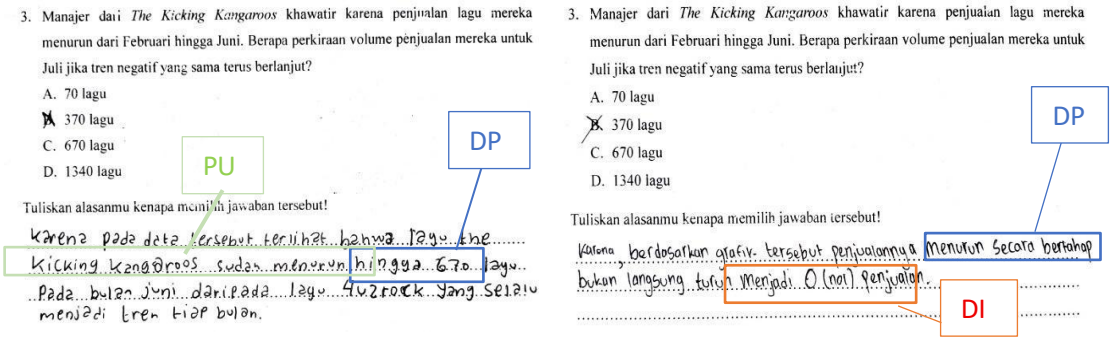


Figure 3. Potrait Student Statistical Literacy Medium Level

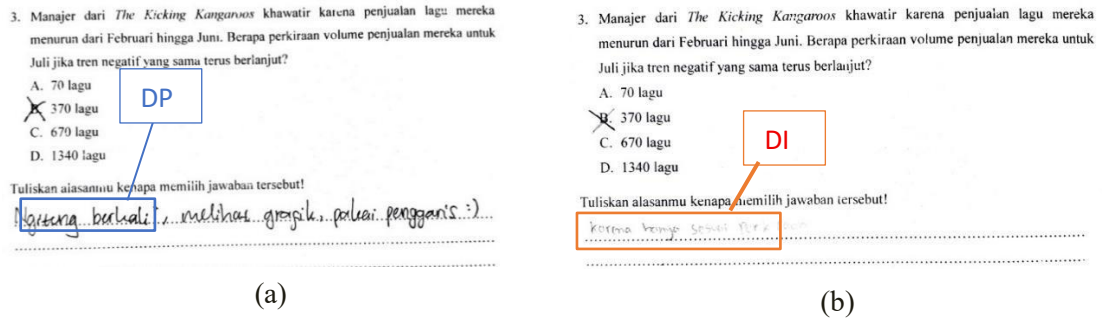
Figure 3 presents the answers of students in the medium category. Most of these students actually selected the correct option, but their reasoning was not sufficiently detailed. For instance, student 3a received a score of 4 because they only mentioned that The Kicking Kangaroos' data declined to 670 CDs, while 4U2Rock appeared more stable. Similarly, student 3b also scored 4 by noting that the decline occurred gradually, yet they did not explicitly connect this reasoning to the result of 370.

From the students' answers in Figure 3, it can be seen that most students were able to identify the downward trend in song sales and choose the correct answer. However, their justifications were not fully aligned with the statistical literacy indicators. n the PU indicator, students successfully recognized the decreasing trend, but on the DP indicator, many failed to clearly explain the process of a 300-song decline per month. Likewise, in the DI indicator, they did not explicitly state the sales projection for July. Their answers happened to be correct largely because the problem was presented in a multiple-choice format.

Interview results further reveal the students' uncertainty in explaining their answers:

P : "Can you tell me how you got the answer 370?"
S : "Because I saw that the number of CDs decreased every month, so when I added up the decreases, it was approximately 370."
P : "Did you calculate the average decrease for each month in detail?"
S : "Not really, I just estimated it because I saw a downward pattern."

These responses suggest that students in the medium category could reach the correct answer, yet their reasoning and problem-solving steps did not fully meet the statistical literacy indicators. Their answers were more based on estimation or reliance on the multiple-choice format, rather than complete mathematical reasoning.



(a) (b)

Figure 4. Potrait Student Statistical Literacy Low Level

Figure 4 presents the answers of students in the low category. In this group, many students provided explanations that did not correspond to the indicators, or in some cases, gave no reasoning at all. For example, student 4a scored 2 by stating that they made repeated calculations using a ruler, but failed to explain the mathematical process. Student 4b scored 1, merely saying that their answer was based on estimation.

From the answers in Figure 4, it can be seen that most students had difficulty identifying trends and calculating average declines. In terms of PU, many were still unsure about reading the graph and interpreting the data. On the DP indicator, most were unable to calculate the average decrease correctly, with some even attempting to estimate values using a ruler. For the DI indicator, their conclusions were unclear, relying mostly on guesses or unrelated reasons.

The interview results reinforce these findings:

R : "How did you determine the result of 370 in this question?"

S : "I used a ruler, then estimated its position on the graph, so I got 370."

R : "Why did you choose that method instead of calculating the decrease each month?"

S : "Because when I looked at the table, I got confused when calculating, so I chose to use an estimate."

These statements demonstrate that students in the low category did not fully grasp the data pattern or the concept of an average decrease. Instead, they relied on guessing or using tools without a clear calculation basis. Their performance shows that they have not yet developed the ability to use graphical data accurately for calculations or to draw valid conclusions. Students in the low category showed that they were unable to use the data in the graph correctly to perform calculations or draw conclusions. Most of them only guessed or estimated without understanding the statistical concepts measured in the task.

Discussion

The results of this study indicate that students' statistical literacy skills are still mostly in the medium and low categories. Many students answered only part of the tasks correctly or relied on guessing, revealing limited conceptual understanding. However, this study also provides new insights by analyzing students' responses qualitatively based

on three literacy indicators, namely Problem Understanding (PU), Data Processing (DP), and Data Interpretation (DI), rather than relying solely on quantitative test results. Unlike previous studies that only measured literacy levels numerically, this research explores how students reason with contextual data, thereby offering a deeper picture of their cognitive processes when solving PISA-type problems.

When examined across each indicator, the differences become more apparent. On the Problem Understanding (PU) indicator, students in the high category were able to understand the downward trend in song sales, while students in the medium category only looked at the data without explaining its meaning properly. Students in the low category were even confused when reading the graph, so they tended to guess randomly. These findings are consistent with previous studies that mention that many students have difficulty connecting information from graphs or tables with contextual task (Fadillah & Munandar, 2021; Wijayanti et al., 2024).

On the Data Processing (DP) indicator, high-level students can correctly calculate the average decline of 300 CDs and then use it to predict future sales. However, students in the medium category were unable to explain the calculation process coherently, and students in the low category used inappropriate methods, such as estimating with a ruler or guessing. This difficulty in choosing the right method supports previous research that PISA task can reveal students' limitations in processing data (Fadillah & Munandar, 2021; Gunawan et al., 2022).

For the DI indicator, only a small proportion of students could draw valid conclusions supported by evidence. Most either guessed or gave incomplete reasoning. These patterns align with prior studies (Lusinda et al., 2025; Gustiningsi & Somakim, 2021;Efriani & Wachyuni, 2024) but provide additional insight into why this occurs students rarely receive reflective feedback that encourages them to justify interpretations. Consequently, they perceive statistical interpretation as a mechanical task rather than a reasoning process.

Overall, the findings demonstrate that contextual understanding strongly influences how students reason across all literacy indicators. The persistence of medium-to-low performance highlights a systemic issue in teaching approaches that prioritize procedural learning over inquiry-based discussion. This study contributes to the growing body of research on statistical literacy by showing how PISA-based contextual problems can reveal distinct reasoning pathways and by offering empirical evidence of the need for learning designs aligned with Indonesia’s Kurikulum Merdeka and ANBK, which emphasize contextual, reflective, and competency-oriented literacy learning.

CONCLUSION

This study reveals that the statistical literacy skills of students at JHS Negeri 6 Kota Jambi in solving PISA-type task on uncertainty and data are still largely in the medium and low categories. Across the three indicators, students demonstrated difficulties in problem understanding, inaccuracies in data processing, and inconsistencies in data interpretation. These findings indicate that students' statistical literacy has not yet developed optimally. Nevertheless, this study has several limitations. The research was conducted with a limited number of participants, and the test instruments were restricted to items from PISA 2012. As a result, the findings cannot be generalized to a wider population. In light of these limitations, further research is recommended to develop a wider variety of PISA- type task, particularly those that incorporate contexts closer to students' daily lives, and to involve larger and more diverse samples. Such efforts are essential to design PISA- based learning that integrates real-world issues such as environmental challenges and climate change so that students are not only mathematically proficient but also critically aware of the problems surrounding them.

ACKNOWLEDGMENT

This study was funded by the 2025 DIPA of Universitas Jambi (Contract Number: SP DIPA 139-03.2.693426/2025) under the early-career faculty research scheme. The author gratefully acknowledges the mathematics teacher and the students of Class IX at JHS 6 Kota Jambi for their invaluable contributions and active participation.

.

REFERENCE

Efriani, A., & Wachyuni, D. R. (2024). Pengembangan soal matematika model PISA konteks ramadhan dengan konten uncertainty and data. *Jurnal Pendidikan Matematika*, 15(1), 60–69. https://doi.org/10.36709/jpm.v15i1.80

Fadillah, F., & Munandar, D. R. (2021). Analisis kemampuan literasi matematis siswa pada soal PISA di SMPN 2 Karawang Barat. *Wahana Matematika dan Sains: Jurnal Matematika, Sains, dan Pembelajarannya*, 15(3), 15–26. https://doi.org/10.23887/wms.v15i3.32118

Gal, I. (2024). *Statistical literacy: conceptual and instructional issues*. https://www.researchgate.net/publication/387503749

Gould, R. (2017). Data literacy is statistical literacy. http://iase-web.org/Publications.php?p=SERJ

Gunawan, Asriani, N. W., Kumala, F. Z., Akhsani, L., & Rohmawati, S. (2022). Karakteristik kemampuan literasi statistika siswa dalam menyelesaikan masalah model PISA. *Aksioma: Jurnal Program Studi Pendidikan Matematika*, 11(3), 2282. https://doi.org/10.24127/ajpm.v11i3.5443

Gustiningsi, T., & Somakim. (2021). Pengembangan soal matematika tipe PISA level 5

dengan konteks pribadi. *Aksioma: Jurnal Program Studi Pendidikan Matematika*, 10(2), 915. https://doi.org/10.24127/ajpm.v10i2.3535

Hariyanti, F. (2019). Statistical literacy siswa SMP dalam pembelajaran matematika. *Jurnal Penelitian Hukum dan Pendidikan*, 18(2), 911–920. http://jurnal.iainbone.ac.id/index.php/ekspose

Kartini, E., Darmawan, D., Omonovich, K. D., & Kibrio, B. (2025). The Role of Policy in Improving Student Literacy and Numeracy in the Era of the Merdeka Curriculum. *Journal of Innovation and Research in Primary Education*, 4(3), 476–484. https://doi.org/10.56916/jirpe.v4i3.1349

Koro, M., Benu, A. B. N., & Mariana, P. (2025). Strategies to Improve Literacy and Numeracy Based on Computer-Based National Assessment Indicators. *Mimbar Sekolah Dasar*, 12(3), 597–610. https://doi.org/10.53400/mimbar-sd.v12i3.89088

Lusinda, U., Pasaribu, F. T., Gustiningsi, T., & Nusantara, D. S. (2025). Pengembangan soal matematika tipe PISA konten uncertainty and data menggunakan konteks museum siginjai jambi. *Journal Numeracy*, 12(1), 99–117. https://doi.org/10.46244/numeracy.v12i1.3128

Nuryani, V., Effendi, A., & Fatimah, A. T. (2022). Analisis kemampuan pemecahan masalah matematis siswa SMP pada pokok bahasan segiempat. *Jurnal Keguruan dan Ilmu Pendidikan*, 3(1), 103–110. https://doi.org/10.25157/j-kip.v3i1.6736

Nusantara, D. S., Zulkardi, & Putri, R. I. I. (2021). Designing PISA-like mathematics problem using a COVID-19 transmission map context. *AIP Conference Proceedings*, 2438. https://doi.org/10.1063/5.0071596

Nusantara, D. S., Zulkardi, & Putri, R. I. I. (2024a). How to design PISA-like digital mathematics problems: a preliminary study. *AIP Conference Proceedings*, 3046(1). https://doi.org/10.1063/5.0194756

Nusantara, D. S., Zulkardi, & Putri, R. I. I. (2024b). Students' strategies in solving PISA-like mathematics problems on change and relationship content. *AIP Conference Proceedings*, 3052(1). https://doi.org/10.1063/5.0201003

OECD. (2016). *PISA 2015 Results (Volume I): Excellence and Equity in Education (Vol. 1)*. OECD Publishing. https://doi.org/10.1787/9789264266490-en

OECD. (2019). *PISA 2018 Results (Volume I): What Students Know and Can Do (Vol.1)*. OECD Publishing. https://doi.org/10.1787/5f07c754-en

OECD. (2023). *PISA 2022 Results (Volume I): The State of Learning and Equity in Education (PISA) (Vol. 1)*. OECD Publishing. https://doi.org/10.1787/53f23881-en

Podworny, S., Frischemeier, D., Dvir, M., & Ben-Zvi, D. (2024). *Reasoning with data models and modeling in the big data era Editors Colophon*. https://doi.org/10.17619/UNIPB/1-1815

Pratama, M. A., Supahar, Lestari, D. P., Sari, W. K., Putri, T. S. Y., & Adiatmah, V. A. K. (2020). Data literacy assessment instrument for preparing 21 Cs literacy: Preliminary study. *Journal of Physics: Conference Series*, 1440(1). https://doi.org/10.1088/1742-6596/1440/1/012085

Ramli, M., Susanti, B. H., & Yohana, M. P. (2022). Indonesian students' scientific literacy in Islamic Junior High School. *International Journal of STEM Education for Sustainability*, 2(1), 53–65. https://doi.org/10.53889/ijses.v2i1.33

Schield, M. (2011). Statistical literacy: A new mission for data producers. *Statistical Journal of the IAOS*, 27(3–4), 173–183. https://doi.org/10.3233/SJI-2011-0732

Sugiyono. (2023). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Alfabeta. www.cvalfabeta.com

Utari, R. S., Putri, R. I. I., Zulkardi, & Hapizah. (2025). Advancing statistical literacy for prospective teachers: A systematic review of contemporary approaches and best practices. *Jurnal Elemen*, 11(2), 390–407. https://doi.org/10.29408/jel.v11i2.28044

Wijayanti, P., Setianingsih, R., Matematika, P., & Negeri Surabaya, U. (2024). Literasi matematis siswa SMP dalam menyelesaikan soal matematika model PISA dengan konten change and relationship. *Pi: Mathematics Education Journal*, 7(2), 72–83. https://doi.org/10.21067/pmej.v7i2.10497

Yuda, E. K., & Rosmilawati, I. (2024). Literasi numerasi di Sekolah Dasar berdasarkan indikator PISA 2023; Systematic literatur review. Journal of Instructional and Development Researches, 4(3), 172–191. https://doi.org/10.53621/jider.v4i3.326