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# Consideration of mathematics education in Indonesia from the perspective of Mathematics and Literacy

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**Abstract:** Today's data-driven society is highly dependent on immense data and requires its citizens to interpret it meaningfully. Such interpretation requires finding patterns within the data, which may seem irregularly arranged at first glance. This is related to mathematics and literacy, which is in line with the current trend of OECD-PISA. In mathematics education, it is about problem-solving with context. Therefore, this paper considers the direction of mathematics education in Indonesia from the perspective of mathematics and literacy. This research employs literature reviews and reflection on mathematics education in Indonesia. Literature reviews reveal various aspects of problem-solving and propose a socially open-ended problem as a new approach. Reflections on mathematics education in Indonesia reveal that the country has a similar intention to OECD-PISA; however, its achievements are far behind the international mean. This research identifies two issues – reconfirmation of the direction of PISA and consideration of how to improve PISA results based on such reconfirmation.

**Keywords:** mathematics literacy; context; critical reading; data-driven society

## INTRODUCTION: READING THE DATA IN A DATA-DRIVEN SOCIETY

The current society is described as a data-driven society (Wolff et al, 2016). This name highlights the nature of its characteristics. While the Japanese government use the expression 'Society 5.0' (Cabinet Office, 2025), 'fourth industrial revolution' is used as well (Schwab, 2017). These expressions denote the difference between the present-day society and previous societies. A closer examination highlights data, information and communications technology (ICT), and network to be the key differentiators.

Data has existed since the beginning of history. However, today, data's quantity, speed, connectedness, copying, editing, and manipulating are much greater. These characteristics allow us to achieve previously-unattainable goals, such as much precise weather forecasting and diagnosing cancer at earlier stages. However, they create confusing and annoying situations, such as fake news, phishing scams, and money laundering.

Mathematics education provides students with the ability to make sense of society from a mathematical perspective. This ability is misinterpreted as speedy and precise calculation or merely logical thinking. This may have held until the emergence of artificial intelligence (AI). AI can accumulate, explore and summarise data, mirroring logical thinking. This has blurred the distinction between truth and non-truth or reality and non-reality. Thus, it is critical to go beyond calculation and logical thinking to consider and reflect on the context behind the problem. This is the 'criticalness' in reading a problem. Critical reading using mathematics is proposed by two big figures – matheracy (D'Ambrosio, 1999) and matheracy (Skovemose, 1994). Additionally, ethnomathematics is proposed as an alternative to mathematics and critical mathematics education is to mathematics education.

Today, it is crucial to materialise critical reading in mathematics education. Therefore, this paper considers the direction of mathematics education in Indonesia from the perspective of mathematics and literacy. This research employs a review of related literature and reflects on current mathematics education in Indonesia for its intentions and achievements.

## LITERACIES DEMANDED BY PISA

This chapter analyses the Organisation for Economic Co-operation and Development-Programme for International Student Assessment (OECD-PISA) definition of literacies because several developed and developing countries participate in the international education assessment. PISA started in 2000 to assess three main literacies – mathematical literacy, science literacy, and reading literacy. Additionally, it assesses other areas, such as financial literacy and problem-solving. Sample items are considered for the confirmation of such interpretation.

Trend of international educational survey

Table 1 shows that the number of participating countries has consistently increased. Nearly half the countries worldwide participated in the 2025 survey, confirming OECD-PISA's impact.

Table 1. Number of participating countries

| Year | 2000 | 2003 | 2006 | 2009 | 2012 | 2015 | 2018 | 2022 | 2025 |
|---|---|---|---|---|---|---|---|---|---|
| Participated | 32 | 42 | 57 | 65 | 64 | 71 | 78 | 80 | 91 |

https://www.oecd.org/en/about/programmes/pisa/pisa-participants.html

It is noteworthy that they do not target competencies within school subjects, such as language, mathematics and science. Instead, they target the competencies expected to be demonstrated in society as a result of school education. This nuanced difference is important. For example, in mathematics literacy, there is no direct reference to mathematical concepts, such as equations, or mathematical procedures, such as addition and square roots.

Analysis of the three main OECD literacies

To identify the characteristics of mathematical literacy, its definition is reviewed. OECD-PISA defines mathematical literacy as follows:

> [Mathematical literacy] is an individual's capacity to reason mathematically and to formulate, employ, and interpret mathematics to solve problems in a variety of real-world contexts. It includes concepts, procedures, facts and tools to describe, explain and predict phenomena. It helps individuals to make informed decisions and judgements which are essential for being constructive and engaged citizens in the 21st Century. (OECD, 2024 a)

This definition contains both the activity by the person who immediately works on the situation (action and objects to act on) and the image of the person who lives in the society using mathematics-related competences (final goal). Here, the action and objects are 'formulate, employ, and interpret mathematics', 'solve problems in a variety of real-world contexts' and 'describe, explain and predict phenomena'. The final goals are 'make informed decision' and 'being engaged citizen'. Hence, it can be summarised as the first row of Table 2.
The same analysis process is followed with scientific and reading literacies. There are different versions of the definitions. The below ones are extracted from the OECD website by 'science literacy' and 'reading literacy'. The results are presented in the second and third rows (Table 2).

> [Science literacy] involves actively participating in informed discussions about science, sustainability and technology to guide decision-making and action. This requires the ability to explain phenomena scientifically, design and assess scientific enquiry, and research and interpret data and evidence critically. (OECD, 2024b)
> [Reading literacy] is understanding, using, evaluating, reflecting on and engaging with texts in order to achieve personal objectives, enhance knowledge and capabilities, and contribute to society. In the 21st century, reading extends to digital platforms, and requires triangulating different sources, navigating through ambiguity, distinguishing between fact and opinion, and constructing knowledge. (OECD, 2024c)

Table 2. Three main OECD literacies

| | Action | Objects | Final Goal |
|---|---|---|---|
| Mathematical literacy | Interpret<br>Solve<br>Explain | Mathematics<br>Problem in real-world context<br>Phenomenon | Informed decision<br>Engaged citizen |
| Science literacy | Explain<br>Assess<br>Interpret | Phenomenon<br>Science<br>Data, evidence | Informed discussion<br>Decision making |
| Reading literacy | Evaluate<br>Reflect | Texts<br>Digital platform | Achieve personal objectives<br>Contribute to society |

Source: Author

Analysis of released items

To confirm the validity of this analysis, some released items were analysed for each PISA literacy. The chosen items were 'Continent area' for mathematical literacy (OECD, 2006a), 'Tooth decay' for science literacy (OECD, 2006 b) and 'Lake Chad' for reading literacy (OECD, 2006 c). These items were chosen because they involved quantitative data.

'Continent area' estimates the area of Antarctica using the map scale. This requires utilising the map and dividing the area into measurable sections. A person needs a real context for reading Antarctica's map and a foundational idea of the area. Antarctica is not a regular geometrical shape; hence, it requires active map reading (interpret the data) and finding approximated sections to find the area (solve the problem in a real-world context). Such active reading requires engagement and explanation.

'Tooth decay' makes sense of the problem of tooth decay. Personally, the respondents know and experience this phenomenon. However, they have to make sense of the information (interpret the data), which represents the relationship between the amount of sugar consumed and the number of tooth decay. They are expected to read the graph (data) and verify the statements. Some statements are correct based on common sense. This is related to evaluating evidence rather than opinion. Informed decision-making and explanation of the phenomenon are related to this item.

'Lake Chad' reads the figures (data) of changing levels of the lake and changing art patterns. The information is embedded within the figures. Therefore, people are required to carefully select appropriate information. This requires understanding the information quantitatively and relationally and selecting the necessary ones. Reading texts and evaluating them are for personal purposes or society, which depends on your work and purpose. These analyses for each literacy confirmed that at least some items contain the characteristics presented the Table 2.

## REALITY OF MATHEMATICAL LITERACY IN INDONESIA

An analysis of the OECD-PISA literacies in the current context highlights that an active and critical reading of the data is required in today's society. The definitions of PISA literacies support the acquisition of such abilities. In this section, Indonesian education at large and mathematics education are reviewed and discussed based on PISA's mathematical literacy. The data is provided by a doctoral student at Hiroshima University, Ms. Yoga Dwi Windy Kusuma Ningtyas.

What is intended: development agendas

According to Rencana Pembangunan Jangka Menengah Nasional (RPJMN) 2025–2029, the Indonesian government set eight development agendas in 2019. One of them was social transformation, which meant building a high-quality, equal education system. The key requirements for this transformation were as follows:

- Expanding 13 years of mandatory education: 1 year of preschool + 12 years of primary and secondary school
- Increasing participation in higher education and producing more qualified STEAM graduates
- Using the education endowment fund effectively
- Enhancing the teaching and learning quality
- Restructuring the teachers and the education staff management

These would ensure that 75% of workers would complete secondary or higher education and work in skilled jobs. This was a preliminary condition for Indonesia to develop economically and socially.

What is intended: aims of mathematics education

To achieve the above agendas and social transformation, the curriculum (Minister of Education, Culture, Research, and Technology of Indonesia, 2024) states the following aims for school mathematics. Each aim is provided with a short phrase by the author to characterize specific mathematical ability.

- Understand mathematical content … (mathematical understanding and procedural skills)
- Solve problems by understanding the problem, designing a mathematical model, solving the model and interpreting the solution obtained (mathematical problem solving)
- Use reasoning about patterns and properties… or explain mathematical ideas and statements (mathematical reasoning and proof)
- Communicate ideas … and represent a situation in mathematical symbols or models (mathematical communication and representation)
- Connect mathematical contents… within a discipline, across disciplines, across science and to life (mathematical connections)
- Have an attitude … of curiosity, attention and interest in learning mathematics… (mathematical disposition)

These aims include cognitive, procedural and affective abilities. Furthermore, application-oriented abilities, such as problem solving, communication and mathematical connections are included. They almost cover PISA's mathematical literacy. However, it is noteworthy that PISA aims for competences in society and the above aims are acquired through mathematics education.

What is achieved or not achieved

In light of the above-mentioned intentions of the Indonesian government, students' achievements are examined, considering OECD-PISA results. In Table 3, the data is collected and edited using the PISA report (reference). The table lists all ASEAN countries, which participated in PISA 2023, alphabetically. Indonesia tops the list while Laos, Myanmar and Timor-Leste did not participate. This table presents the distribution of students' achievement according to PISA levels.

PISA set these levels and introduced demarcations for level 1 as 1a, 1b, 1c and below 1c due to the increasing number of non-OECD countries in the study. This demarcation accommodates detailed descriptions of the lower achievements. The number under each level name in parentheses indicates standardised figures, where 500 represents an international mean score and 100 represents one standard deviation. For example, level 1b (295) is two standard deviations below the international mean and 36.0% belong to this level.

Table 3. Distribution of students' achievement for ASEAN countries in PISA 2022

| Level (lowest score) | below 1c | 1c (233) | 1b (295) | 1a (358) | 2 (420) | 3 (482) | 4 (545) | 5 (607) | 6 (669) |
|---|---|---|---|---|---|---|---|---|---|
| Indonesia | 1.0 | 10.9 | 36.0 | 33.8 | 14.1 | 3.8 | 0.5 | 0 | 0 |
| Brunei | 0.2 | 2.8 | 12.9 | 26.0 | 27.3 | 18.6 | 9.2 | 2.8 | 0.3 |
| Cambodia | 7.6 | 20.6 | 33.7 | 26.1 | 9.5 | 2.2 | 0.3 | 0 | 0 |
| Malaysia | 0.2 | 4.7 | 21.6 | 32.5 | 24.8 | 11.4 | 3.7 | 0.9 | 0.2 |
| Philippines | 1.1 | 16.7 | 38.6 | 27.7 | 12.2 | 3.2 | 0.5 | 0.1 | 0 |
| Singapore | 0 | 0.3 | 1.9 | 5.9 | 11.2 | 17.6 | 22.6 | 22.0 | 18.6 |
| Thailand | 0.5 | 6.6 | 27 | 34.2 | 19.4 | 8.1 | 3.2 | 0.8 | 0.2 |
| Viet Nam | 0.3 | 1.9 | 7.3 | 18.6 | 28.1 | 24.7 | 13.6 | 4.5 | 0.9 |

Source: Author developed based on OECD (2023)

Table 3 indicates that the majority of Indonesian students (81.7%) belong to level 1s. This represents a serious condition. To understand their difficulties, level 2 was analyzed. The description of level 2 is as follows:

> At Level 2, students can recognise situations where they need to design simple strategies to solve problems, including running straightforward simulations involving one variable as part of their solution strategy. They can extract relevant information from one or more sources that use slightly more complex modes of representation, such as two-way tables, charts or two-dimensional representations of three-dimensional objects. Students at this level demonstrate a basic understanding of functional relationships and can solve problems involving simple ratios. They are capable of making literal interpretations of the results. (OECD 2023, p.92)

Hence, level 2 includes problem-solving with a one-variable, straightforward solution. It contains one or more sources, two-way tables, charts and two-dimensional representations. They are neither extremely simple nor very complicated. Therefore, it is important to go back to the original meaning of 'problem solving' and 'reading the context of the problem'.

## MATHEMATICAL LITERACY AND CONTEXT

To fundamentally reflect on this situation, literatures were reviewed in terms of mathematics problem solving and context since PISA problems notably contain a rich context. This context may contain some clues for improvement.

Different levels of understanding

Zambian students have consistently marked low scores in the national assessment and regional transnational assessment, Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ). Against this condition, Uchida (2009) conducted a survey to identify the difficulties of Zambian children (grades 3 to 7). The problem used for the survey was four fundamental operations. The results are presented in Table 4.

Table 4. The result of Zambian students' achievement levels (Uchida, 2009)

| | | G3 | G4 | G5 | G6 | G7 |
|---|---|---|---|---|---|---|
| Correct | Calculation in column | - | 42 | 13 | 48 | 23 |
| | Bar counting | 63 | - | - | 4 | 41 |
| | No explanation | 17 | 51 | 76 | 44 | 33 |
| Incorrect | Wrong operation | - | 6 | 3 | - | - |
| | Other errors | 20 | - | 7 | - | 3 |
| | Blank | - | - | - | 4 | - |

Note: Figures are in the percentage

This shows that there are different understanding levels even among correct and incorrect answers. Correct answers employed addition and multiplication. Incorrect answers are not simply wrong. Some incorrect answers are almost correct and are correct when answered orally. Hence, the author presented these different understanding levels figuratively below (Figure 1).

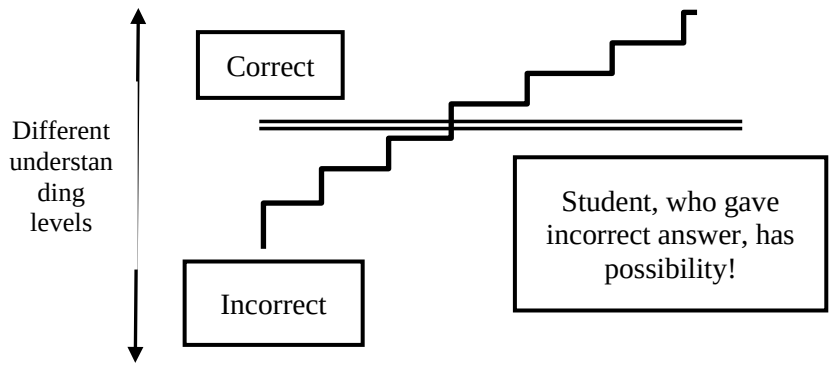



Figure 1 Different understanding levels (by the author)

Identification of different stages of errors

Prakitipong and Nakamura (2006) employed interviews more systematically using the Newman procedure (Clements, 1980) in Thailand. They targeted the incorrect answers in the problem-solving stages. The study differentiated I Reading Errors, II Comprehension Errors, III Transformation Errors, IV Process Skills Errors and V Encoding Errors.

I Reading Errors referred to students being unable to read or pronounce the problem. This can happen especially in countries or areas where the language of instruction differs from students' language at home. II Comprehension Errors meant students could read the problem but were unable to explain its meaning. III Transformation Errors indicated that students could read and explain the problem but could not determine the operation to be used for the solution. For example, in the problem with mathematical relation 'a + b = c', the value of 'c' or 'a' is to be found. Depending upon the case, the operation can be addition or subtraction. This becomes confusing for the students. IV Process Skills Errors indicated errors in the calculation, which is frequently focused upon. V Encoding Errors represented writing the answer after the calculation.

Prakitipong and Nakamura (2006) employed the following problem with the Thai students: 'Dad bought 7 oranges and gave 3 oranges to a neighbour; mom also bought 5 apples and gave 2 apples to the neighbour; their son 'Fred' bought 16 pears and gave half of them to his friends. How many fruits do they have left?' According to the survey, the percentages of students belonging to levels I, II, III, IV and V were 7.5, 32.5, 0, 5.0 and 0, respectively. The remaining 55.0% solved the problem correctly. A total of 32.5% of students made a mistake because they could not understand the phrase 'half of sixteen' and were unable to proceed further, while 5 % of students committed mistakes due to incorrect addition at the process skills level. This study revealed that errors could be made at various stages of problem solving.

Peculiar understanding in mathematical context

Mellone, Vershaffel, and Dooren (2014) conducted research in Belgium. They introduced the idea of 'P-Problem (problematic problem)', in which students did not use common knowledge in solving mathematical problems. One such problem was as follows: 'A man wants to have a rope long enough to stretch between two poles 12 m apart, but he has only pieces of rope 1.5 m long. How many of these pieces would he need to tie together to stretch between two poles?'

In this problem, students simply divide 12 by 1.5 and get 8 as the answer. In other words, they do not use the common knowledge that we need a certain length to tie the ropes. The research focused on this phenomenon and tested if they could improve this phenomenon through group work. Mellone, Vershaffel, and Dooren (2014) found that group work impacted students' interpretation of the problem context and added some details to it. Simultaneously, such addition contained details close to their life. This research indicated that students paid attention to mathematical components and trivial daily details, which were important for them to make sense of the problem.

PISA's mathematics literacy and context

PISA defines the context as follows: 'The context is the aspect of an individual's world in which the problems are placed. The choice of appropriate mathematical strategies and representations is often dependent on the context in which a problem arises'. The contexts are classified into personal, occupational, societal and scientific. However, such a simple classification may confuse the mathematical meaning and underestimate it. The following examples explain such situations.

Personal: I have 10 dollars and am given 20 dollars by my mother. How much do I have in all now?
Occupational: I make 10 jackets and 20 pants. How many sets of jackets and pants do I have in all?
Societal: 100,000 people live in city A. The population increased by 10% from 1980 to 2000. It increased by 20% from 2000 to date. How much has the population grown since 1980?
Scientific: Put 10% of salt solution and 20% of salt solution together. What is the concentration of the solution?
Source: Author

Mathematically, each example may have different operations.

Personal: 10 + 20 = 30
Occupational: 10 sets of jackets and pants. 10 pants are left without a pair.
Societal: Increment from 1980 to 2000 is 10,000 (10% of 100,000 people). The increment from 2000 to date is 22,000 (20% of 110,000 people). Thus, the increment since 1980 is 32,000, which is 32%.

Scientific: Suppose each salt water weighs 100g. Salt contained in 10% of salt solution is 10g (100 x 0.1) and salt contained in 20% of salt solution is 20g (100 x 0.2). After mixing, 200 g of salt water contains 30g of salt. Its concentration is 15% (30 ÷ 200 x 100 = 15).

Summary of mathematical literacy and context

As stated before, the literature was reviewed in terms of mathematics problem-solving and context. All these literatures are reflected and summarised using the PISA mathematisation cycle.

This mathematisation cycle represents the essence of PISA mathematical literacy, starting from the real-world problem being converted into a mathematical problem, being solved into a mathematical solution and being brought back to the real world as a real solution. The above literature can be located in this cycle, focusing on certain stages. This may indicate the difficulties in Indonesia's current situation.

Previously, teachers and students disregarded the non-mathematical components of mathematics problems and did not pay attention to the context of problem-solving. However, in the PISA literacies, it is important to understand the problem context and extract mathematical relationships. It is important to go beyond simple mathematical calculations or reading the problem. Students must think extensively between 'calculate the problem' and 'reading the math problem'.

## PROPOSAL OF SOCIALLY OPEN-ENDED PROBLEMS IN MATHEMATICS EDUCATION

The above examples are related to 'making a decision using data' in correspondence with the data-driven society in Chapter 1. OECD literacies in Chapter 2 requires mathematical literacy and context, and students to think extensively between 'calculate the problem' and 'reading the math problem' in Chapter 4. Following these, a new approach of 'socially open-ended problem' (Baba, 2007) was proposed to strengthen critical thinking. The author and his team have been engaged with this approach since 2010s (Shimada & Baba, 2015; Hattori et al., 2021; Baba et al. 2024).

The socially open-ended problem (Baba, 2007) allows students to have mathematical and socially open-ended solutions, and nurtures mathematical thinking and judgement based on associated social values. One of the typical problems is 'Hitting a target' (Shimada & Baba, 2015).

Matoate problem: At a school cultural festival, your class offers a game of hitting a target with three balls. If the total score is 13 points or more, you can choose three gifts. If you score 10 to 12 points, you get two prizes, and if you score 3 to 9 points, you get only one prize. A first grader threw a ball three times and hit the target in the 5-point area, the 3-point area and on the border between the 3-point and 1-point areas. How do you score the student?

Students engaged with this problem individually. Table 5 presents the results of students' mathematical models and social values.

Table 5. Mathematical models and social values at the beginning of the class (Shimada & Baba, 2015)

| Mathematical model | Expected value type | Explicit value (%) | Explicit value (%) |
|---|---|---|---|
| a. 5+3+3 | Kindness to the first grader (specific person) | 92.9 (13/14) | 94.4 (17/18) |
| b. 5+3+(3+1) | | 100.0 (1/1) | |
| c. 5+3+3+1+1 | | 100.0 (1/1) | |
| d. 5+3+2 | | 100.0 (2/2) | |
| e. 5+3+2 | Fairness and equality to the whole class (all students) | 0.0 (0/9) | 0.0 (0/20) |
| f. 5+3+1 | | 0.0 (0/10) | |
| g. 5+3+3 | | 0.0 (0/1) | |

After they discussed their models and values in the classroom, they were asked to choose the models and values again. Due to classroom interaction, some of them changed their values. The objective was to encourage discussion among students instead of obtaining a particular solution. Through this problem-solving, students were expected to acquire mathematical thinking and judgment ability.

| | |
|---|---|
| T1 | Please present make a presentation on how you think about this problem. S.J., please. |
| S.J.1 | I gave 3 points to the first grader, so I wrote 5+(3×2)=11, 11 points, because the first grader should be welcomed. |
| T2 | Does anyone have any questions for S.J.? |
| S1 | I think that we do not have to write the parentheses in the expression because we calculate the multiplication before the addition. |
| S.J.2 | Thank you, I understand. I will rewrite it as 5+3×2=11. |
| T3 | And who did you think of, S.J.? |
| S.J.3 | I thought of the first grader. |
| T4 | I will write the words 'kindness to the first grader' next to S.J.'s idea.<br>Next, please present your idea, K.K. |
| K.K.1 | The ball is on the boundary of 3 points and 1 point. I gave 1 point because the 1-point area of the ball is larger than the 3-point area of the ball. So, 5+3+1=9, 9 points. |
| T5 | Does anyone have any questions for K.K.? |
| S2 | What points will you give to the first grader when the ball reaches the middle just above the line? |
| K.K.2 | I will give 2 points. |
| S3 | What points will you give to the first grader when the ball reaches the middle of just above the line of 1 and 0 points? |
| K.K.3 | I will give 0.5 points. |
| T6 | S.J. gave 3 points to the first grader. And who did you think of, K.K.? |
| K.K.4 | I thought about all the people who played the game. I want to be impartial to all the people. |
| T7 | So, I will write the words 'fairness to all people' next to K.K.'s idea. |

Source: Shimada & Baba (2015)
Note: 'T' and number stand for teachers' utterance. Other initials such as S.J., K.K. and number stand for particular students' utterance.

This socially open-ended problem is developed based on the open-ended approach (Shimada eds, 1977; Becker & Shimada, 1997) to cater for values that emerge during problem-solving. Characteristics of each open-ended problem is as presented in Table 6.

Table 6. Comparison between mathematical open-ended and socially open-ended problems (Baba, 2007)

| | Mathematically open-ended problem | Socially open-ended problem |
|---|---|---|
| Objective | To nurture mathematical thinking | To nurture mathematical thinking and judgement based on associated social values |
| Problem | To allow mathematically diverse solutions | To allow mathematically diverse solutions and associated social values |
| Method | Discussion of mathematically diverse solutions and their generalisation and symbolisation | Discussion of mathematically diverse solutions and the associated social values |

Hence, the socially open-ended problem aims to nurture mathematical thinking and judgement based on associated social values. In the given problem, the students discussed mathematical models and values.

## CONCLUSION: FUTURE OF MATHEMATICS LITERACY IN INDONESIA

This paper considered the direction of mathematics education from the perspective of mathematics literacy. It identified the gap between intention and attainment of mathematical education in Indonesia using the PISA result. This result prompted us to think about two issues – reconfirmation of the direction of PISA and confirmation of how to improve PISA result based on such reconfirmation.

Regarding the first issue, the definition of PISA mathematical literacy should be relooked at. PISA's status makes us simply believe and follow its directions. However, we should question if the final image, such as 'make informed decision' and 'being engaged citizen', is the one we aim to achieve. In current mathematics education, attention is paid to correctness of problem-solving. If the above direction is the aim, inquiry of thought and critical discussion of different ideas should be promoted rather than finding the correct answerswith formulas.

This first issue is related to second issue of improving the PISA result. The PISA problem often contains a long context, which the students rarely encounter in school. The context may contain unnecessary detailed information from daily life and require students to read it critically and scoop the mathematical relationship amid data and information. This is more than processing the mathematical calculation. Despite such complication, as seen in the Matoate problem, students are eloquent and discuss their mathematical models and social values.

Whether using a socially open-ended problem or not, it is important that (1) the students make sense of the problem's context and (2) the teachers pay more attention to students' understanding of context. As discussed in Chapter 3, there are various levels of understanding and errors in mathematical problem-solving. Some of them are directly related to mathematical processing, while others are related to the stages before processing. Therefore, the teacher should not impose only the correct answer on the students; instead pay attention to students' understanding and explore discussion and ideas during the lesson.

Two questions can improve the future of mathematics literacy based on the meta-problem (Baba, 2024).

- What kind of problems do we want our children to solve?
- What kind of competencies do we expect them to demonstrate in such problems?

Here, the problem does not lie with the textbook. Instead, we must reconsider what a meaningful mathematical problem is concerning students' expected competence. The required competence in Indonesia will change due to the emergence of AI and other technologies and a large data-driven society. The direction of mathematics education will be based on current competences. What to discuss and how to discuss in future mathematics lesson will depend on expectation towards society and students' competences.

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