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Evaluating the Results of PISA Assessment: Are There Gaps Between the Teaching of Mathematical Literacy at Schools and in PISA Assessment?

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Abstract: The problems in education in the countries of the Organization for Economic Cooperation and Development (OECD) vary from country to country. The differences between "upper class" and "lower class" countries in PISA assessment results have led to a research gap. The purpose of this study was to (a) test students' mathematical literacy skills on the Program for International Student Assessment (PISA) test and compare the results using the sum of means across OECD countries; (b) examine the relationship between students' mathematical competence, precision, and self-perception of mathematical literacy skills in the PISA test; and (c) analyze the gaps that exist between the implementation of mathematics instruction in school and the mathematical literacy as measured on the PISA test. This study was designed as a mixed method with an explanatory sequential design. The data collection methods included test procedures, questionnaires, and interviews. The result of this study showed that the overall mean score obtained was below the OECD average. In general, the respondents achieved only level 2 mathematics proficiency. A significant relationship was found between mathematical competence, precision, and self-perception in mathematical skills. On the other hand, there was a gap, namely the difference at the implementation level, where mathematical literacy measured by PISA differed from the measurement of mathematical learning achievement by teachers in school. The results showed that teaching that emphasizes only problem-solving procedures affects low mathematical competence and is not useful enough for students to deal with the PISA mathematics test.

Keywords: *Education gaps, mathematical competence, mathematical literacy, PISA assessment.*

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Introduction

Initiated by the Organization for Economic Co-operation and Development (OECD), the Program for International Student Assessment (PISA) is an educational system assessment study involving more than 70 countries worldwide. This diagnostic test is one of the measures to improve the education system in OECD member countries. PISA tests students' literacy, mathematics, and science achievement from age 15 toward the end of compulsory education.

The PISA test results state that students' mathematical literacy in all OECD countries is 76% at level 2. Level 6, the highest level of mathematical proficiency, was achieved by China (16.5%) and Singapore (13.8%). However, more than 50% of students in 24 countries are still below this proficiency level (OECD, 2018a). These factual data reveal that all countries must work harder to achieve quality education in line with the United Nations 2030 Continuing Education Mission (Möbus et al., 2018). PISA notes that low student proficiency in mathematical skills across OECD countries is inextricably linked to teacher quality and inequality or gaps in the quality of education (OECD, 2017; Schleicher, 2019).

Observational studies of mathematics instruction suggest that, in at least some schools, much teaching and learning has occurred in mathematics classrooms with relatively little emphasis on explaining concepts while retaining key content and providing little opportunity for teachers to engage students in problem-solving (Johnston-Wilder et al., 2020; Prendergast et al., 2014). Some teachers conduct their teaching in a distinctly uncooperative manner. This manner of teaching causes students to become afraid of mathematics. Students may perceive mathematics instruction negatively in the school (Kusmaryono, Ubaidah, et al., 2022; Ulia & Kusmaryono, 2021). These negative perceptions are one factor that led to the failure of the school-based literacy movement to improve the quality of students' literacy skills.

Students need mathematical literacy skills to solve problems in new situations and interpret mathematics in various

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contexts (OECD, 2017). Therefore, factors strongly influencing mathematical literacy skills, such as mathematical competence, self-perception, and accuracy, must also be analyzed in depth (Aksu et al., 2022; Lara-Porras et al., 2019).

In the last decade, researchers have reviewed the result of PISA assessments, including measurement and large-scale assessments (Ehmke et al., 2020), students' mathematical literacy skills in the PISA test (Ahyan et al., 2019; Harju-Luukkainen et al., 2016), lessons learned from PISA (Hopfenbeck et al., 2018), students' mathematics proficiency levels on PISA (Kandeel, 2021), investigation on reading literacy in PISA 2018 assessment (Koyuncu & Fırat, 2020), development of test items similar to the PISA test (Hasibuan et al., 2020; Mouli et al., 2023), and the correspondence between PISA performance and school achievement (Pulkkinen & Rautopuro, 2022). The weaknesses in the research findings of previous researchers include: (a) the study findings still focus on comparing students' achievement levels in reading literacy, mathematical literacy, and (school) achievement in OECD member countries; (b) the researchers did not analyze aspects of precision and self-perception as factors associated with low PISA test scores; and (c) the researchers did not analyze the gap between the implementation of literacy learning in schools and the assessment of mathematical literacy with PISA. Therefore, we believe it is necessary to have research results that address this issue to add to the existing literature. The results of this study can influence educational policies in a country in schools and the assessment of mathematical literacy with PISA. So, it is necessary to have research results that address this issue to complement the existing literature. Thus, the results of this study can impact education policies in a country.

The strengths of this study are (a) this literature analyzes the relationship between mathematical competence, self-perception, and students' precision as factors that influence mathematical literacy skills, and (b) the existence of literature in raising the problem of tension between the implementation of mathematics literacy learning in schools and the PISA assessment, where these two problems have not been analyzed in depth by previous researchers.

The results of the PISA tests are important as a benchmark for the readiness of human resources in OECD countries to meet the challenges of the 21st century. The PISA test score can also be used to (a) indicate students' readiness to study after school; (b) identify areas that need improvement for schools, the education system, and the government; and (c) allow comparison of student achievement and learning environments in different countries.

The purpose of this study was to (a) test students' mathematical literacy skills on the Program for International Student Assessment (PISA) test and compare the results using the sum of means across OECD countries; (b) examine the relationship between students' mathematical competence, precision, and self-perception of mathematical literacy skills in the PISA test; and (c) analyze the gaps that exist between the implementation of mathematics instruction in school and the mathematical literacy as measured on the PISA test.

It is expected that the results of this study will benefit teachers, students, and the government. The results will help teachers improve mathematics instruction by providing students with helpful reasoning skills for living in a society. For students, the results will demonstrate students' readiness for career choices in the future. The results for the government and stakeholders will help improve the national education system and the quality of education according to the standards demanded by the global market.

Literature Review

PISA measures three areas of literacy: reading literacy (language), mathematical literacy, and scientific literacy. Mathematical literacy is a person's skill to formulate, apply, and interpret mathematics in various contexts (OECD, 2017). The competencies that PISA develops in mathematical literacy include reasoning, decision-making, problem-solving, resource management, information interpretation, organization of activities, and technology usage and implementation skills. In the PISA tests, the mathematical literacy assessment focuses on change and relationships, space and form, quantity and uncertainty (OECD, 2018a). The PISA tests administered in OECD countries aim not to assess mastery of curriculum content but to examine whether students can apply the knowledge they have learned daily. The assessment focuses on the mastery of processes, conceptual understanding, and the ability to function in different situations (Schleicher, 2019; Stacey, 2011). If the country achieves below-average results and occupies the lowest level in the PISA results, the quality of education is considered below the standards required by the global market, and the country must improve its national education system without delay.

Mathematical competence is reasoning and problem-solving with a mathematical approach, including students' skills and abilities in drawing conclusions or making a statement (Albaladejo et al., 2015). According to a study by Michener (1978), a person is said to understand mathematics (a mathematical topic) if he or she can comprehend examples and heuristics. In addition, the person has an intuitive sense of the mathematical topic, how facts in daily life follow its calculations, and how the mathematical topic is related and connected to other theories. George Polya also stated that a well-organized and stored body of knowledge (structure) is an asset for someone in solving problems (Polya, 1962). Based on Polya's notes, students who understand mathematics should have a structured way of thinking and can solve problems according to their level.

Precision refers to the degree of conformity between the measurement result and the actual price or value (Vostanis et al., 2021). Precision or attention to detail is required in all fields; not everyone has it, but it can be trained (Scandura, 1966). One of the distinguishing characteristics of conscientious people is that they take great responsibility for getting things done and do their best.

In learning mathematics, precision is required when students understand problems, create problem-solving plans, perform calculations, and reflect on or review the results of their work. Precision is required when understanding the content of word problems, including what is known and what is asked in the questions. Precision is related to a person's cognitive demands (Miller, 2020). Cognitive demand is the mental state a person experiences when they are so engaged in a task that they expend all their mental resources ((Miller, 2020; Tekkumru-Kisa et al., 2015).

Perception is the first stage of cognition, such as learning, concept construction, problem-solving, and thinking (Timler et al., 2019). Perception has an important influence on other stages, such as prior learning influences on how we understand something (Stringer & Heath, 2008). Self-perception is an individual's assessment of his or her ability to organize and perform the actions necessary to achieve the desired level of ability (Chamorro-Atalaya et al., 2022; Timler et al., 2019). According to self-perception theory, we base our opinions on our behavior rather than analyzing ourselves in depth (Bem, 1972). Students' self-perceptions about mathematics can influence their behavior and interest in learning (Kusmaryono, Ubaidah, et al., 2022). Self-perception is divided into two areas, namely, positive and negative perception. Positive perceptions promote students' interest in learning. Negative perceptions, on the other hand, have a negative effect (i.e., they decrease students' interest in learning a subject; Gurkaynak & Gulcu, 2012; Kaur & Prendergast, 2022; Mathew, 2017). Thus, researchers hypothesize a significant relationship between self-perception and mathematical literacy skills, given that students' self-perception of their abilities is the basis for action in learning and becomes a motivation that largely determines student performance (achievement) in mathematics.

Methodology

Research Design

This study was designed as a mixed method with an explanatory sequential design (Creswell, 2014). The researchers used quantitative methods in the early stages and qualitative methods in the latter stages of the research activities, as shown in Figure 1 (Castrol et al., 2010).

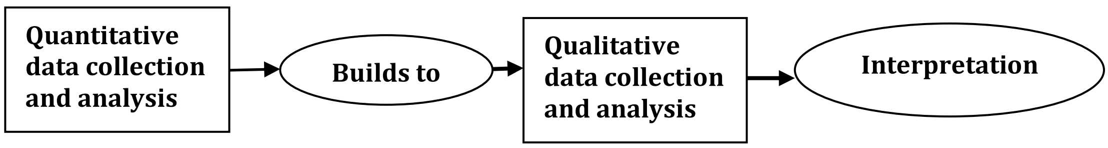


Figure 1. Explanatory Sequential Design

Respondents

The participants were 100 students from two different schools in Semarang City, Indonesia. Fifty participants were from state junior high schools (group A), and the other 50 were students in private junior high schools (group B). The reason for selecting two schools was to maximize the process of selecting a sample (students) that represents a population of students aged 15 years. The samples were selected based on rigorous sampling procedures according to the technical standards of PISA. This procedure was used to select the sample to ensure the results were comparable, reliable, and valid. Respondents were selected as the research sample through a purposive sampling technique. The criteria for respondents are male or female, 15 years old, and a ninth-grade junior high school student. Two mathematics teachers participated in this study. They are the school's senior teachers with more than ten years of experience in mathematics teaching. The selected mathematical competencies of the students based on the mathematics teachers' records are given in Table 1.

Table 1. Data of Respondents Based on Mathematical Competency Scores

Class	N	Mathematical Competence (MC)			Mean Score
		Low (MC $\leq$ 65.0)	Medium (65.0 < MC < 75.0)	High (75.0 $\leq$ MC)	
Class A	50	12	22	16	78.13
Class B	50	16	20	14	76.44
Total Number	100	28	42	30	-

Instruments

The instruments used to collect data included (a) a mathematical literacy competency test containing 24 PISA questions representing proficiency levels from 1 to 6. The test items were obtained from the 2012, 2015, and 2018 PISA tests. The mathematical literacy test had four contents: space and shape, change and relationship, magnitude, and uncertainty. Each content consisted of six questions representing six proficiency levels in the PISA test from 1 to 6. The reason was so that the test takers' ability could be measured according to the level of proficiency of each mathematical literacy content determined by PISA. The determination of test items was determined based on (a) the educational level of junior high school students, (b) the context provided was easy for students to understand, and (c) it was easy to read and did not cause double interpretation. Determination of the test was considered through a group discussion forum (researchers, professors, and mathematics teachers); a questionnaire about self-perception consisted of 20 questions (Likert scale from 1 to 5) (Kusmaryono, Wijayanti, et al., 2022). The self-perception questionnaire in this study referred to the 45 question items of the Self-Perception Profile for Adolescents (SPPA) instrument developed by Harter (1988, as cited in Rose et al., 2012). For this purpose, the SPPA instrument underwent a cross-cultural adaptation process to achieve equivalence between the original and newly adapted instruments. The instrument adaptation steps include (a) translation, (b) expert panels, (c) back translation, (d) pre-testing and cognitive interview, and (e) final version (Ioane, 2017).

The precision checklist sheets were used to examine student performance documents (test answer sheets). Researchers noted the participants' precision levels based on the answers to the PISA test. The level of precision was grouped into three criteria, namely low, medium, and high precision.

Researchers conducted interviews with respondents using interview guide sheets. Respondents who were interviewed were selected through purposive sampling and snowball sampling techniques. Researchers interviewed respondents to obtain in-depth information about the respondents' mathematical competence, self-perception, and precision. The researchers also conducted interviews with mathematics teachers. The interviews with the teachers were completed, and the researcher matched the results with the students' opinions about learning mathematical literacy.

The researcher prepared the interview questions in a semi-structured form which contained questions about students' and teachers' opinions about the PISA test. The interview questions were validated by a team of experts (validators) consisting of two experts in mathematical literacy. The steps for preparing interview questions were (a) aligning the interview questions with the research objectives; (b) building a conversation question; (c) instrument validation (interview questions) by the validator team; and (d) receiving feedback from the validator team to improve interview questions (Yeong et al., 2018). Examples of interview questions are shown in Tables 2 and 3.

Table 2. Examples of Interview Questions for Respondents

No.	Questions
Q-1	How did you prepare to take the PISA test?
Q-2	Is the PISA test a difficult test?
Q-3	Did you pay attention to precision in completing the PISA test?
Q-4	Does your self-perception influence math learning activities?
Q-5	What do you get when you learn math at school?

Table 3. Examples of Interview Questions for Teachers

No.	Questions
Q-1	What is your perception of the Mathematical Literacy Test from PISA?
Q-2	Are you sure that students will successfully complete the Mathematics literacy test from Pisa?
Q-3	How do you respond to the opinion that in school students memorize formulas and many math test exercises?
Q-4	In your opinion, what is the gap between teaching math literacy in schools and PISA assessments?
Q-5	What is your effort to improve mathematics learning in the future?

Data Analysis

The researchers applied the assessment to the mathematical literacy test with the international PISA coding rules (OECD, 2014). Test scores were analyzed with the Rasch fixed item parameter model from the international PISA database (OECD, 2009). The WLE person separation reliability was (.76) for the PISA with a high category (Ehmke et al., 2020).

Initial data analysis (data from Table 1) through the Kolmogorov-Smirnov statistical test obtained a significant value of .078 > .05, meaning that the data from all samples in this study were normally distributed. Furthermore, the F test obtained a significant value of .482 > .05, showing that the data comes from a homogeneous population.

Student performance documents (test answer sheets) were checked to get the precision score. The self-perception questionnaire was measured with the Likert scale, converted into quantitative data, and then analyzed. The questionnaire instrument was tested for the reliability of Cronbach's alpha with a value of .81 (high reliability). The researchers analyzed data from interviews through the stages of reading transcripts, giving coding, making categories, and interpreting the results (Lester et al., 2020). The relationship between mathematical competency, precision, and self-perception variables on mathematical literacy skills was carried out by correlation analysis (Pearson Correlation).

The researchers tested the validity of the qualitative data by testing the data credibility, which included extending observations, increasing persistence, triangulation, negative case analysis, and member checks (Nowell et al., 2017; Stahl & King, 2020). Meanwhile, to ensure the reliability of qualitative data analysis, researchers conducted an objectivity test (confirmability test) through focused group discussion (FGD) (Adler, 2022). The result of this study can be considered objective because several people at the FGDs (researchers), a team of experts (two professors), and mathematics teachers agreed as participants.

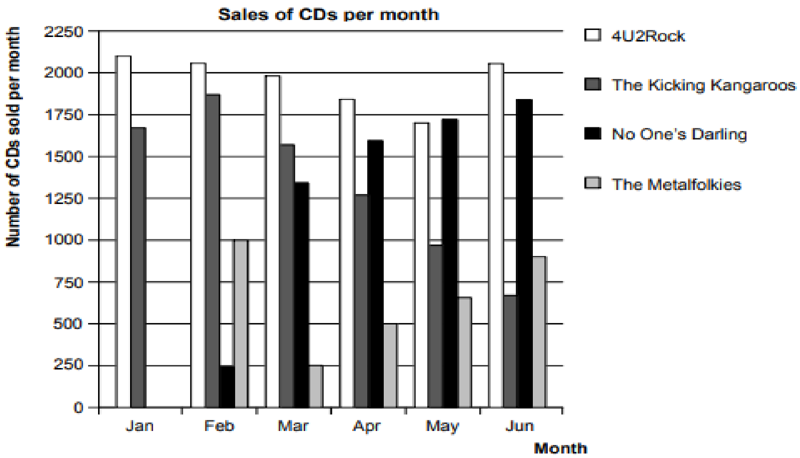
Research Procedure

The first step was to prepare the research instrument. In the second step, the researchers determined the research participants as 100 students. In the third step, students completed the mathematical literacy competency test, which consisted of 24 PISA-based questions. The fourth step was the assessment and analysis of the students' test answers to determine the students' mathematical competence and precision level. Afterward, the researcher interviewed students (four student representatives) who failed to achieve high scores to determine their concerns about the questions. In the sixth step, students filled out a self-perception questionnaire. In the seventh step, the researcher analyzed self-perception questionnaire data. In the eighth step, the researcher conducted interviews with mathematics teachers. In the ninth step, the researchers interpreted the quantitative and qualitative research data to determine the relationship between the two.

Findings

One hundred respondents (students) completed 24 items of the PISA mathematical literacy test. The students' answers were corrected and assessed. This section presents two examples of mathematical literacy test items representing proficiency level 1 and level 6.

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.



Question: How many CDs did the band The Metalfolkies sell in April?

Figure 1. PISA Mathematics Literacy Test Items with Proficiency Level 1

The test item questions (Figure 1) include easy criteria (level 1), and the higher the level (level 6), the higher the level of mathematical proficiency required. To answer test item number 1, students must know and understand tables.

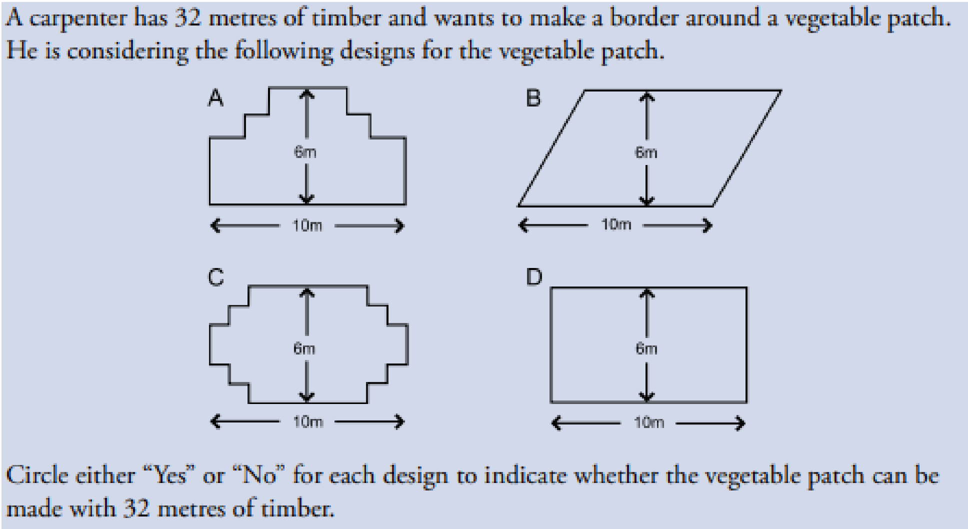


Figure 2. PISA Mathematics Literacy Test Items with Proficiency Level 6

Figure 2 is the PISA mathematics literacy test items with proficiency level 6. Students must have good mathematical analysis and reasoning skills to answer the questions on the level 6 test items. The results of students' work on the mathematics literacy test items were corrected and assessed. The results of the assessments are presented in Table 4.

Table 4. Results of the Mathematical Literacy Test Assessment

Sample	Sample size	Mean score	Standard deviation
Group A	50	58.1	8.39
Group B	50	52.7	7.45
Total	100	55.4	8.62

PISA divides mathematical literacy skills into six levels, from the lowest level 1 to the highest level 6. Items (questions) at level 1 are on the easy level/criteria, and level 6 items are on the difficult level/criteria. Table 5 provides information about the PISA test results in percentage for mathematical literacy in each mathematics content.

Table 5. Percentage of Mathematical Literacy Levels for Each Scale of Mathematical Content

Content	Students	< Level 1	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
Space and Shape	Group A	8.7	22.9	30.7	10.8	17.8	5.6	3.5
	Group B	8.8	24.0	38.8	10.2	10.7	5.5	2.0
	OECD	10.5	14.2	20.4	21.5	17.2	10.4	5.8
Change and Relationships	Group A	11.0	22.1	38.2	12.2	12.0	3.5	1.0
	Group B	15.8	25.0	33.8	10.6	10.2	3.1	1.5
	OECD	10.2	13.0	19.8	22.1	18.5	11.1	5.3
Quantity	Group A	10.7	23.9	25.6	19.5	13.7	3.5	3.1
	Group B	11.9	23.8	27.2	15.2	15.8	3.1	3.0
	OECD	8.8	12.5	20.1	23.7	19,9	11	4.0
Uncertainty	Group A	10.8	24.0	29.8	20.5	10.8	2.6	1.5
	Group B	10.4	25.0	28.2	16.7	10.7	6.0	3.0
	OECD	7.4	13.3	21.5	23.8	19.2	10.6	4.2
Mean Total		11.0	23.8	31.5	14.6	12.7	4.1	2.3
OECD		8.2	13.2	21.1	23.7	19.2	10.6	4.0

Based on the data in Table 5, the average number of respondents reaching levels 1 and 2 can exceed the OECD results. Mathematical literacy proficiency at level 2 recognizes immediate context and interpretation based on relevant data information from one mode. However, the average is below the OECD achievement at levels 3, 4, 5, and 6. Level 6 mathematical literacy skills include students' abilities in advanced reasoning, making models, arguing, and drawing conclusions appropriately (OECD, 2018a). The average student achievement at level 6 is lower than in the OECD.

The results of the self-perception questionnaire about mathematics showed that students in group A had a higher mean score than group B. In general, the mean score of students' self-perception of mathematics was in the middle criteria. The distribution of self-perception data about mathematics is presented in Table 6.

Table 6. Score and Criteria of Students' Self-Perception

Statistics	Self-perception		
	Group A	Group B	Total
Sample size	50	50	100
Maximum score	87.0	86.0	87.0
Minimum score	54.0	57.0	54.0
Mean score	70.1	67.0	69.05
Standard deviation	10.07	9.61	10.25
Criteria	Middle	Middle	Middle

The results of the analysis of the answer test documents from 100 respondents stated that most students had a low level of precision (average score of 41.5). Scores of students' precision in reading, understanding, and completing each test item can be seen in Table 7.

Table 7. The Precision of Students in Answering the Test

Students	Number of respondents	The mean score of precision	Criteria
Group A	50	51.0	Low
Group B	50	32.0	Low
Total	100	41.5	Low

From the data in Tables 6 and 7, it can be concluded that Group A has better precision, and self-perception is higher than Group B. The relationship between self-perception and precision is that students with high self-perception scores also have high perceptions (positive) of mathematics. Students with low self-perception scores also have low (negative) perceptions of mathematics.

To determine the existence of a correlation between research variables, a correlation analysis (Pearson Correlation) was carried out. Variables are correlated when changes in one variable follow changes in other variables. Decision-making with the correlation test can be seen in Table 8.

Table 8. Correlation Between Research Variables

		Math Competency	Precision	Self-Perception	Math Literacy
Math Competency	Pearson Correlation	1	.879**	.791**	.904**
	Sig. (2-tailed)		.012	.003	.022
	N	50	50	50	50
Precision	Pearson Correlation	.879**	1	.856 **	.874 **
	Sig. (2-tailed)	.012		.002	.002
	N	50	50	50	50
Self-Perception	Pearson Correlation	.791**	.856 **	1	.793 **
	Sig. (2-tailed)	.003	.002		.007
	N	50	50	50	50
Math Literacy	Pearson Correlation	.904**	.874 **	.793 **	1
	Sig. (2-tailed)	.022	.002	.007	
	N	50	50	50	50

**Correlation is significant at the .05 level (2-tailed).

The researchers conducted interviews with students and teachers. Interviews with students and teachers were conducted separately by the researchers. The data from the interview transcripts were summarized in a coding table. In addition, the analysis results of the interview data analysis are presented in Tables 9 and 10.

Table 9. Analysis of Data Results of Interviews with Respondents

Questions (Q)	Protocol	Behavior	Coding
Q-1	I studied hard, but I didn't expect the PISA math test to be this difficult.	Students have tried to study hard	Does not support the PISA test
	I memorized a lot of math formulas, but it didn't really support success on the PISA test.	Students learn by memorizing mathematical formulas	Does not support mathematical literacy skills on the PISA test
	I learned from many sources.	Students learn from various sources	Supports mathematical literacy skills on the PISA test
	I study from the school math book but only a small part of the questions are according to the school book.	Students learn from school textbooks	Does not support the mathematical literacy ability of PISA
Q-2	I feel the PISA test is very difficult because not much is studied at school.	Students experience difficulties with the PISA test	Does not support the mathematical literacy ability of PISA
	The PISA test is a difficult test but challenges me to study harder.	Students feel challenged by the PISA test	Supports mathematical literacy skills on the PISA test
	I'm not sure I can complete 25 percent of the PISA test.	Students may only complete some of the PISA tests	Does not support the mathematical literacy ability of PISA
	I was having a hard time understanding the sentences on the PISA test and I missed the hard questions.	Students skip questions on the PISA test	Does not support the mathematical literacy ability of PISA
Q-3	My level of precision is very low in completing the test.	Students are less thorough in working on the PISA test	Does not fit the PISA test
	I wasn't thorough and I felt like I failed the PISA test.	Students are careless while doing the PISA test	Does not support the mathematical literacy ability of PISA
	In some of the questions, I was not thorough and I was careless.	Students do not re-check	Does not support the mathematical literacy ability of PISA
	I do not have enough time to double-check my work.	Students do not understand the PISA test	Does not support the mathematical literacy ability of PISA
Q-4	I love math but I need to study if I'm going to take a competency test.	Students love math lessons	Supports mathematical literacy skills on the PISA test
	I study mathematics because I like a challenge and it is beneficial for my future career.	Students love math challenges	Supports mathematical literacy skills on the PISA test
	Learning math is a difficult and headache-inducing job.	Students think mathematics is a difficult thing	Does not support mathematical literacy skills on the PISA test
	I don't understand math so I feel lazy to learn math.	Students feel lazy to learn mathematics	Does not support mathematical literacy skills on the PISA test
Q-5	We get useful knowledge for future careers.	Students benefit from future careers	Matches with literacy skills on the PISA test
	We know the steps (procedures) to solve the problem.	Students only get procedural knowledge	Does not match with literacy skills on the PISA test
	We got a lot of tasks for problem solving.	Students are good at solving problems	Matches with literacy skills on the PISA test
	We got a bit of use for math to solve problems in new situations.	Students get a little problem-solving ability	Matches with literacy skills on the PISA test

Table 10. Analysis of Data Results of Interviews with Mathematics Teachers

Questions (Q)	Protocol	Behavior	Coding
Q-1	I never understood the PISA test before, it turns out that the PISA test requires high reasoning ability.	The teacher does not understand the PISA test	Does not support the PISA test
	The Pisa test made me think about the importance of equipping students with higher order thinking skills.	Teachers do not equip students with higher-order thinking skills.	Does not support the mathematical literacy ability of PISA
Q-2	I'm not sure students can complete the PISA test by more than 50 percent because students are not used to doing the PISA model test.	Teachers are not sure their students can complete the PISA test	Does not support the mathematical literacy ability of PISA
	I doubt that students will be able to complete the difficult PISA test because I do not train students to complete the PISA test.	The teacher does not challenge the students with the PISA test	Does not support the mathematical literacy ability of PISA
Q-3	I have only focused on preparing for final semester exams, which are different from the PISA test.	The teacher only prepares students for the final exams of the semester	Does not fit the PISA test
	I have realized that students memorized mathematical formulas, but it didn't really help students complete the PISA test.	Teachers only equip students to memorize mathematical formulas	Does not support the mathematical literacy ability of PISA
Q-4	The material in the textbooks that students study is not in accordance with the demands and standards of the PISA literacy assessment.	School textbooks do not meet the demands of the PISA Test	Does not comply with the PISA test
	I haven't coached students on the PISA test in math class	Teachers have not attended training in compiling PISA tests	Lacks support for the PISA test
Q-5	I will focus on solving problems in learning mathematics and equip students with high-thinking skills.	Teachers will equip students with higher-order thinking skills	Matches literacy skills on the PISA test
	I will apply mathematics to solve problems in everyday life so that mathematics becomes part of daily human activities.	The teacher will teach mathematics according to everyday problems	Matches literacy skills on the PISA test

Discussion

Students' Mathematical Literacy Ability

The mathematical literacy skills of students in groups A and B, taken from the PISA test, have a low mean score (Table 4). This mean score is still below the minimum standard set by the school as a criterion. Thus, there is no significant difference in the mathematical literacy abilities of students in groups A and B. When analyzing the test answers, it was found that all respondents made mistakes when filling out the PISA mathematical literacy test. In some cases, for very simple questions (levels 1, 2, and 3), more than half of the respondents could not complete them correctly. For more complicated test items (levels 4, 5, and 6) requiring higher-order thinking skills, the number of respondents who answered correctly was still less than 20% (see Table 5).

The data in Table 3 show that the mean score (overall) on all content tests was achieved only at levels 1 and 2, above the OECD average scores. However, at levels 3, 4, 5, and 6, the mean score is still far below the OECD average. The result of this study is through the 2018 survey report PISA, which is based on the assessment of PISA that only 29% of Indonesian students could achieve level 2 in basic mathematical literacy skills. This result is still low compared to the average of OECD countries, which reaches 76%. Question 6 is a difficult test item that requires level 6 math proficiency. The success rate of students solving level 6 test items is less than 4.0%, even among students in all OECD countries; only 20% of answers are correct (OECD, 2018a).

Relationship Between Mathematical Competence, Precision, Self-Perception, and Mathematical Literacy Skill

The statistical results (Table 8) indicate a significant relationship between the research variables (mathematical competence, precision, self-perception, and mathematical literacy skill). Changes follow the change in one variable in other variables. Self-perception (Table 6) and precision (Table 7) can be related to mathematical literacy skills in the

PISA test (Table 4). High levels of test-taking accuracy and positive self-perception of mathematics can increase self-confidence, leading to higher mathematical literacy skills (Kaur & Prendergast, 2022). Meanwhile, low accuracy and students' negative self-perceptions about mathematics lead to unsatisfactory PISA test scores in mathematical literacy.

Excerpts from interviews with students (Table 9; Q-2; Q-3) show that obtaining information from the PISA test items was difficult, so they could not apply calculations to complete the test. This condition is due to the negative perception that mathematics is difficult and students' low precision in reading the test questions (Acharya, 2017). Completing the PISA test items in story form requires greater precision. If students are not paying attention, they will have difficulty completing the test because they do not understand the information in the test items (Krawitz et al., 2022).

The researchers argue that the participants in this study have low basic mathematics competence. Basic knowledge (competence) in mathematics is required to complete the PISA mathematical literacy test (Almarashdi & Jarrah, 2023). Thus, a student who begins learning with a low level of basic mathematical competence is unlikely to achieve it (Le Hebel et al., 2017). Students with the highest literacy skills (Level 6) are most proficient in mathematics. They perceive mathematics as useful for their future careers (Kusmaryono, Ubaidah, et al., 2022). They specifically prepare to study mathematics optimally to achieve the best results (Perales & Ruiz, 2021).

One of the central aspects of the frame of reference in teaching mathematical literacy is identifying and reflecting on their mathematical competencies and beliefs about mathematics (Ahyan et al., 2019). Students who do not have confidence (Table 9; Q-2), lack control over their work (Table 9; Q-3), and have a negative perception of mathematics (Table 9; Q-2) are more likely to give up rather than try harder. They even skipped several difficult questions (see Table 9; Q-2). Previous research suggests that this small number of skipped or poorly worked questions greatly affects estimates of the average performance (Wise & DeMars, 2005).

Based on data in Tables 6 and 7 supported by interview results (Table 9), it can be explained that the respondents' self-perception of mathematics is at the middle level, and the respondents have a low level of precision. They did not reflect on their performance because the time was short (see Table 9; Q-3). Only respondents identified the problem correctly and rechecked their calculations, but they were not sure the answer was correct. On the other hand, low mathematical competence and lack of understanding of content cause students only to memorize a series of procedures or algorithms and experience difficulties when solving problems (Albaladejo et al., 2015; Melgar et al., 2022).

Students with high mathematical competence and positive self-perception complete various tasks (thinking mathematically) with precision and effort. Meanwhile, students with low mathematical competence and negative self-perception tend to avoid tasks (thinking mathematically) requiring high precision (Mathew, 2017; Wisniewski et al., 2022). They think tasks with high cognitive demands are often considered less valuable and do not affect them (Miller, 2020). This finding indicates that students believe success or failure in learning mathematics is within their control.

The Gap Between the Implementation of Mathematics Learning and the PISA Assessment

PISA results can be a benchmark for students' readiness to face challenges in the 21st century. When students can work on questions at levels five and six, their competence is close to what is expected to survive. From the PISA score, we get a portrait of the extent to which students are ready to face life in the 21st century and apply what they learn at school to survive in the 21st century.

Regarding the focus of presenting the instrument in PISA, which is a common correction that the math problems in the PISA measure more reasoning abilities, problem-solving, and argumentation than measuring memory and calculation abilities (OECD, 2018b; Zaim et al., 2021). Meanwhile, several studies conducted in several Indonesian schools show that students' abilities are still unfamiliar with problems that require logical and applicable thinking (Stacey, 2011). Students still like and are used to theoretical and procedural answers. Students' mathematical competence is only at low-level thinking skills, while the PISA assessment has reached higher-order thinking skills.

Achievement of low and unsatisfactory PISA test results is not separated from teachers' performance in learning mathematics in schools. The interview results with the teacher (see Table 10) indicate that the teacher did not train students to face the PISA test. Teachers are unaware that their students will successfully complete the PISA test because they focus on mathematical formulas. However, this situation does not help students complete the PISA test. The teacher realizes the importance of equipping students with higher-order thinking skills. However, mathematics learning conducted by school teachers is still focused on explaining mathematical formulas, giving examples, and students doing many exercises facing the final semester exams. Teaching like this kind of learning produces low-level mathematical capabilities (Abramovich et al., 2019).

Based on the results in Tables 9 and 10, a gap between the application of mathematics learning methods in schools and PISA assessments was found in this research. Mathematical learning models implemented by teachers in schools are not in line with the purpose of the PISA test. The mathematical literacy test PISA requires students to apply their mathematical knowledge to solve real-world problems (Almarashdi & Jarrah, 2023), while the teacher does not train students for these abilities.

Teachers' mathematics learning models in the classroom focused only on mathematical formulas and many test questions. This finding affects the self-perception of students who are adverse (low) to mathematics (Mathew, 2017). Students are bored and uninterested in learning (Abramovich et al., 2019). On the other hand, if the teacher does not teach students high-level thinking skills (a kind of PISA test), students' analysis skills and precision are also low. From this research, it can be understood that students' self-perception and precision affect the ability of mathematical literacy as in PISA test scores as a statistical test in Table 8.

In this case, the school has not provided our students with survival support. As for some students who can survive, it is not because of the school, but perhaps because of the environment or the family that supports them. Therefore, the learning of mathematics in school needs to be refocused. The teacher must create interactive learning innovations based on real-life problem-solving.

Educational Gaps in OECD Countries

The education gap is an important factor causing the poor ranking of Indonesia and several other countries in PISA. However, random sampling in PISA tests does not fully represent the portrait of education in a country. The educational problems faced by each OECD country are also different. Not all regions in a country have adequate educational facilities. The number of teachers in urban and remote areas is also very different. When given a test by PISA, the results are very different. Educational assessment cannot be carried out uniformly but must be considered one problem in various practical educational contexts.

The rationale for PISA is a clear illustration of the linkages between education and neoliberalism, which has the potential for a gap between "upper class" and "lower class" countries (Bøyum, 2014). The educational conditions in Singapore, Finland, Germany, the United States, and China are very different from those in Indonesia, the Philippines, Bosnia, and Kosovo. Researchers can imagine how our students will survive with low PISA scores. Whether we are aware of it or not, the growth and development of digital technology in today's global age have put tremendous pressure on the education system. The technology measures the educational progress of a country to promote strong knowledge and skills.

We agree with the research findings of Hwang and Ham (Hwang & Ham, 2021) who criticize that a review of the assessment instrument PISA should be considered using other assessment instruments or in other educational contexts. It is important to keep in mind that conditions vary across OECD countries and that mathematical literacy as measured by PISA differs from the measurement of mathematical learning achievement in schools, especially in OECD countries where scores are lower than the average score on the PISA assessment.

Mathematics teaching must improve students' mathematical competence by emphasizing conceptual knowledge and logical reasoning to solve contextual problems. Teachers must also guide students in precision skills to change students' self-perception in a positive direction. In addition, the assessment system and curriculum that have primarily guided teachers must be revised so that they do not become teachers who impede learning. It will take commitment from all stakeholders to make government programs, such as the "school literacy movement," successful so that they do not become mere slogans.

Conclusion

The results showed that the students' mathematical literacy was still low, while the students' mathematical ability was still at level 2 of the PISA assessment. The results of this test are inextricably linked to the factors of students' mathematical competence, precision, and self-perception of mathematics. Statistical analysis showed a significant relationship between mathematical competence, accuracy, and self-perception of mathematical literacy skills. On the other hand, the results of the PISA survey are very important, especially as a measure of the readiness of human resources in OECD countries to meet the challenges of the 21st century. However, this PISA assessment may lead to gaps at the implementation level, as mathematical literacy as measured by PISA differs from the measurement of mathematical learning achievement in schools. Teachers' mathematics instruction emphasizes only problem-solving procedures, which translates into low mathematical competence. At the same time, the PISA test emphasizes reasoning to solve problems and survive in society. Educational conditions in OECD countries are also very different. Therefore, further research studies must consider reviewing the PISA assessment instruments using other instruments or educational contexts.

Recommendations

Strengthening mathematical literacy is needed by students to be able to solve PISA test questions. Students need to get used to reading mathematics literature and improve computational thinking for mathematical concepts (the mathematics itself). Students need to achieve a high level of accuracy when learning mathematics. Students also need to have a positive disposition toward mathematics so that their interest in learning mathematics increases. In addition, students need to promote their mathematical skills appropriately. For future research, researchers can analyze the psychological factors of teachers and students and the impact of facing the PISA test.

Limitations

The participants were 100 students. They were selected from only one city in Indonesia. The results may differ from those of cities in other OECD countries, so future researchers may conduct the same study with a larger sample as a follow-up to supplement the results in this article.

Authorship Contribution Statement

Kusmaryono: Research concept and design, preparing instruments, data analysis, interpretation of research results, and final approval, Kusumaningsih: Collecting and data analysis, critical revision of manuscripts, correction of manuscript grammar, and verification of literature.

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