Development Of The PISA-Like Mathematical Literacy Test Based On Yogyakarta Socio-Culture

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ABSTRACT

This research aims to develop a PISA-Like mathematical literacy test based on Yogyakarta socio-culture that is valid, practical and effective. The research method used is Research and Development (R&D) with the Plomp development model. The subjects of this study were 18 students of class VIII of SMP Teladan Yogyakarta. The instruments used included validation sheets, teacher response questionnaires, student response questionnaires, and test instruments. The results of the study showed: (1) the expert validation results obtained a V-Aiken value of 0.75 with a fairly valid category, (2) There were 7 valid and reliable questions, (3) The teacher's response was very good with a score of 50.67, (4) Student responses to test questions obtained 78% of students obtained a score of 38.1 with a good to excellent category, and (5) 72% of students obtained a mathematical literacy test score with a sufficient to good category. Based on the overall data analysis, it can be concluded that the development of a mathematical literacy test instrument based on PISA-Like with the socio-cultural context of Yogyakarta is declared valid, practical, and effective for measuring the mathematical literacy of class VIII students of SMP Teladan Yogyakarta at the prediction level 3.

1. Introduction

Mathematics is learning that involves the ability to reason and think critically, logically, systematically, and creatively. Students need to possess these abilities. According to NCTM (in Tupamahu et al., 2023), the objectives of mathematics learning include five competencies, namely mathematical problem solving, mathematical communication, mathematical reasoning, mathematical connections, and mathematical representation. Mastery of these five competencies is expected to help students solve various mathematical problems and be reflected in their mathematical literacy abilities. Mathematical literacy is a person's ability to reason mathematically and to formulate, apply, and interpret mathematics in solving problems in various real-life contexts (PISA, 2020). In PISA 2018 it is explained that the definition of mathematical literacy emphasizes active involvement in mathematics. This focus includes mathematical reasoning as well as the use of concepts, procedures, facts, and mathematical tools in describing, explaining, and predicting phenomena. Specifically, the verbs "formulate", "employ", and "interpret" refer to three processes that involve students as active problem solvers (OECD, 2019a).

The importance of mathematical literacy is not yet in line with the PISA results in Indonesia. This can be seen from the various international assessments that Indonesia has participated in, such as the Program for International Student Assessment (PISA) which is still ongoing today. PISA measures the reading, mathematics, and science literacy skills of students aged 15 years or equivalent to junior high school education level (Madyaratria et al., 2019). Mathematical literacy

can encourage someone to understand and consider the application of mathematics in everyday life, not just memorizing mathematical formulas (Hidayati et al., 2020; Nurjanah & Saputra, 2023). PISA measures students' mathematical literacy abilities by presenting mathematical problems that include Content, Contexts, and Competencies (Gradini et al., 2021). These problems are presented in the form of real-world situations that provide a context for the application of mathematics. To solve these problems, students must have a level of ability that includes relevant mathematical content.

However, in reality, several studies report that the mathematical literacy of Indonesian students is still low (Maysarah et al., 2024; Muslimah & Pujiastuti, 2020). According to Tohir, the 2018 PISA results report shows that Indonesia's performance has decreased compared to the 2015 PISA (Tohir, 2019). According to (Efriani & Wachyuni, 2024), the low mathematical literacy abilities of students in Indonesia are caused by students' habits of acquiring and using mathematical knowledge more often in formal form. Judging from the average PISA results, in 2012 it was 384. Meanwhile, in 2015 it increased, so the average result was 395, and in 2018 it decreased to a score of 382. Then, in 2022 it decreased with an average score of 369.

Mathematics teaching in schools is generally more formal and theoretical, lacking variations that influence students' interest in the subject. Students often feel bored and less interested in studying mathematics because they consider it a boring, abstract subject and not related to their daily lives. Apart from that, mathematics learning is still dominated by practice questions and depends on textbooks, thus hampering teacher creativity and not honing students' mathematical literacy as measured by PISA questions. Therefore, it is necessary to integrate mathematical problems or problems with the cultural context close to where the students live.

According to (Khatimah et al., 2022) mathematics learning will be more effective if the material is relevant to students' cultural schemes. This is in line with the opinion of Rosa and Orey, who emphasize that when practical or socio-culture-based problems are studied in an appropriate social context, then the practical mathematics of that social group has important value because it reflects themes related to everyday life (Rawani & Fitra, 2022). Therefore, mathematics teaching methods are needed that can link individuals with their socio-culture to facilitate students' understanding. According to Soedjadi (in Daton et al., 2019) , this requires an abstraction process from mathematical objects so that they can be applied concretely. Thus, there is a significant connection between mathematics and socio-culture.

Socio-Culture-based mathematics problems combine elements from regional social and cultural riches to illustrate mathematical concepts. The model utilizes a multicultural context in illustrating mathematical concepts or principles. For example, the use of cultural arts artifacts such as batik or fractals, as well as the history of mathematics which can be used to teach geometry or algebra concepts. Apart from that, contextual problems related to multicultural reality can also be used in the form of contextual questions that are free from elements of racism, as well as factual statistical data such as the socio-economic conditions of the community around the students. Mathematics experts are currently developing new approaches that connect mathematics with aspects of social life, one of which is through ethnomathematics models (Putra & Prasetyo, 2022). In mathematical problems with ethnomathematics, mathematical concepts can be linked to social and cultural elements of a community or region. One example of applying this approach is linking mathematical concepts with Yogyakarta socio-culture.

Yogyakarta is a province in Indonesia. The local context of Yogyakarta has diverse potential. This diversity can be an important reference source in learning mathematics at school by utilizing the cultural context of Yogyakarta. Within the scope of Yogyakarta socio-culture, various elements cover mathematical concepts including mathematical content in PISA-Like. Based on the 2015 PISA mathematics framework, the mathematical content in PISA includes changes and relationships, space and shape, numbers, as well as uncertainty, and data (Nasution et al., 2020). Various specific concepts such as number patterns, algebra, as well as uncertainty, and data can be found in the cultural context of Yogyakarta. Moreover, according to (OECD, 2019b) students in the city of Yogyakarta are at Level 2 with an average mathematical literacy of 430.

Several studies show that developing PISA-like questions in local cultural contexts produces valid and reliable test criteria (Gradini et al., 2021). Furthermore, research by (Prayitno et al., 2023)

regarding the cultural numeracy literacy ability test instrument in Kuningan Regency, West Java, states that it has a positive potential effect on students' numeracy literacy ability in the good, valid, and practical categories. Apart from that, developing PISA-type mathematics questions in the context of Tugu Yogyakarta states that it produces valid and practical questions and students can involve communication, reasoning, argumentation, and mathematization skills in solving problems (Rokhima et al., 2023). This shows that many researchers are interested and consider it very necessary to develop Pisa-like questions. However, no one has developed PISA-like mathematical literacy questions using the local cultural context of Yogyakarta apart from Tugu Yogyakarta. This can be found in the natural and social environment, historical heritage, and tourist destinations in Yogyakarta to this day. Among them are Kawung batik motifs, typical Yogyakarta food, Taman Sari, Ngayogyakarta Hadiningrat Palace, and so on. A cultural context may be familiar to some students but not to others. This causes the use of context that is not yet known to students in learning and assessment instruments can eliminate the function of the context itself. Thus, it is important to integrate the context in the surrounding environment where learning takes place into learning, including in assessment activities.

Based on the description above, it appears that there is a need to develop a question instrument that can provide space for students to be able to train and test their abilities and skills in working on mathematical literacy questions that are appropriate to the socio-culture, one of which is Yogyakarta socio-culture. Therefore, this research aims to develop PISA-like mathematical literacy questions using the cultural context of Yogyakarta at the junior high school level that are valid, practical, and effective.

2. Method

This research is a Research and Development (R&D) research using the Plomp development model. The Plomp model is also called design research. According to Plomp (Fernandes & Syarifuddin, 2020), states that the stages in this research consist of three stages, namely: preliminary research, prototyping stage, and assessment phase. The research was conducted at Teladan Middle School, Yogyakarta. The subjects in this research were 18 class VIII students and the object of this research was the PISA-like mathematical literacy test instrument based on Yogyakarta socio-culture. The data collection instruments used were the PISA-like mathematical literacy test instrument for the Yogyakarta cultural context, validation sheets, teacher response questionnaire sheets, and student response questionnaire sheets. Student and teacher response questionnaire sheets were used to test the practicality of mathematical literacy skills based on PISA-like based on Yogyakarta socio-culture. Meanwhile, the students' mathematical literacy test instrument was used to determine the effectiveness of the Yogyakarta socio-culture-based PISA-like mathematical literacy test instrument that had been developed. Before the mathematical literacy test instrument is used, it is validated by an expert/validator.

Meanwhile, the PISA-like mathematical literacy test sheet consists of multiple-choice questions, true-false statements, and descriptions. This research involved two validators as experts to validate the PISA-like mathematical literacy test instrument. The development of the PISA-like test instrument has proven its validity and demonstrated the practicality and effectiveness of the test. The expert assessment questionnaire data and student and teacher responses were collected in the form of qualitative data and then converted into quantitative data (both validity and practicality data).

Analysis of expert validity test data is carried out to assess whether or not the questions that have been developed are suitable as learning tools. Researchers will carry out revisions if the experts provide appropriate suggestions and input that have been given. The experts will provide a decision in the form of test questions that can be used without improvement or if there are improvements. Proving content validity using the V-Aiken formula. The formula applied for validation is the V-Aiken index (1985), which calculates the content validity coefficient based on the results of item evaluation by a group of experts (n-people) and the extent to which the item represents the construct being measured. Expert test data analysis was carried out using the V-Aiken formula according to the explanation (Retnawati, 2016).

$$V = \frac{\Sigma s}{n(c-1)}$$

V: Respondent agreement index regarding item validity

s: the score determined by the respondent minus the lowest score (s = r-1)

r: score of the selected category for the respondent

n: number of respondents

c: number of selected categories filled in by respondents

The following **Table 1** shows the assessment criteria for the expert validity test and the V-Aiken index carried out at the initial testing stage.

Table 1. Expert Test Validity Criteria

Average Score	Validity Level
0,8 < V ≤ 1,0	Very Valid
0,4 < V ≤ 0,8	Fairly Valid
0 < V ≤ 0,4	Less Valid

Next, a validation analysis of the PISA-Like mathematical literacy test instrument items was carried out in the Yogyakarta Social-Cultural context. According to Ghozali, the validity test functions to determine whether the test instrument is valid or not (Ghozali, 2021). A test instrument is considered valid if the questions can describe the thing you want to measure. To determine the validity of this question item, the Product Moment correlation formula is used. If $r_{count} > r_{table}$ with sig. 0.05 then the question item is declared valid, otherwise if $r_{count} < r_{table}$ with $\alpha = 0,05$ then the question item is declared invalid (Slamet & Wahyuningsih, 2022).

Meanwhile, test reliability estimates are used to determine the accuracy of the test, namely, the extent to which the test can be trusted to obtain relatively unchanged scores even though it is tested under different conditions (Imania & Bariah, 2019). The formula used in testing instrument reliability uses Cronbach's Alpha for essay test and KR-20 for multiple choices. The test instrument is said to be reliable if it has a reliability coefficient of $r_{11} > 0,5$ (Ary et al., 2014).

Practicality test data analysis serves to determine students' and teachers' responses to the questions being developed, including ease and difficulty according to PISA level predictions. The practicality test involved 18 students and 3 teachers' responses regarding questions developed by researchers. In the practicality test, the data used were student and teacher response questionnaires. Then this practicality analysis uses the assessment criteria according to Meltzer (2002) (in Maharani et al., 2023) in **Table 2** where the instrument is said to be practical if the minimum practicality assessment is in the good category.

Table 2. Practicality and Effectiveness Assessment Criteria

Average Score	Category
$X_1 > Mi + 1.5Sdi$	Excellent
$Mi + 0.5Sdi < X_1 \leq Mi + 1.5Sdi$	Good
$Mi - 0.5Sdi < X_1 \leq Mi + 0.5Sdi$	Quite Good
$Mi - 1.5Sdi < X_1 \leq Mi - 0.5Sdi$	Bad
$X_1 \leq Mi - 1.5Sdi$	Very Bad

Note: X_i: Mean score

M_i: Mean ideal score $= \frac{1}{2}$(maximum score + minimum score)

Sd_i: Ideal Standard Deviation $= \frac{1}{6}$(maximum score – minimum score)

After the PISA-Like mathematical literacy test instrument was declared valid and reliable, we used it to collect data and analyze the results of the mathematical literacy test. After obtaining the data, we analyzed it using effectiveness assessment criteria to Meltzer (2002) (in Maharani et al., 2023). The effectiveness test involved 18 students as samples with 10 questions developed. In **Table 2**, the instrument is said to be effective if the effectiveness assessment is at least 70% of students get a mathematics literacy score in the quite good to excellent category.

3. Results and Discussion

First, the initial investigation stage (preliminary research). This stage begins with collecting various references related to research, especially regarding the development of test instruments to measure students' mathematical literacy abilities. After that, the location and research subject are selected. The research location was Teladan Middle School, Yogyakarta, and the subjects were class VIII students. At this initial research stage, analysis was carried out consisting of material analysis and question analysis. Material analysis is an activity to identify the main concepts that will be used in creating questions. In the analysis of this material, several things were identified, such as the content of the LKS used often did not match the indicators listed in the teaching module/RPP as well as analysis regarding the relevance of junior high school material. Mathematics material in junior high school such as Systems of Linear Equations in Two Variables, geometry, ratios, algebra, and so on is very relevant to mathematical literacy content, namely change and relationship, quantity, uncertainty of data, and shape and space because it provides students with the basic knowledge and skills needed to understand and apply mathematics. in everyday life. Therefore, this relevance shows that the material taught in junior high school does not only focus on understanding abstract concepts but also on developing critical thinking and problem-solving skills that are essential for mathematical literacy.

Meanwhile, question analysis aims to improve the test by revising or deleting ineffective questions. In the analysis of this question, the questions in the worksheets are often abstract and not related to the local cultural context that is familiar to students. As a result, students are not used to working on questions in a cultural context that involves real-world activities. Students will only stick to the formulas they have memorized without understanding the context that has been presented. Therefore, these questions need to be improved by adding cultural context to each question to improve students' mathematical literacy skills. Furthermore, the analysis of the abilities of students at Middle Schools or Madrasah Tsanawiyah Yogyakarta, swhere the results of the study at Mts Muallimat Muhammadiyah Yogyakarta showed that each student's mathematical literacy ability was in the very low category (Nurutami & Setyawan, 2019). Moreover, according to (OECD, 2019b) students in the city of Yogyakarta are at Level 2 with an average mathematical literacy of 430.

The second is the prototype stage. At this stage, the product in the form of PISA-like mathematics literacy test questions based on Yogyakarta socio-culture was designed according to the PISA domain. Activities carried out include designing question grids, creating tests to measure mathematical literacy abilities that are adjusted to PISA level predictions, as well as preparing question answer keys. The components that have been prepared are used as a guide in making the prototype. Next, the third stage of the Plomp stage is the assessment phase. At this stage, a validity test is carried out which aims to find deficiencies to make improvements. The aspects assessed include the appropriateness and linguistic aspects of the test instrument. The assessment phase guidelines are used to assess the design of the PISA-like mathematics literacy test questions based on Yogyakarta socio-culture. Test instruments that have undergone the assessment phase are then validated.

Validation of test instruments is carried out by providing the developed test instruments and validation sheets to the validator. The test instrument validators consisted of two mathematics lecturers from IAIN Kudus. The validator believes that the prototype can be used but some items need to be revised. Several things need to be corrected, such as adjusting the data to the reality of the local context, correcting writing errors, grouping several questions that have the same form as multiple choice questions, true-false statements, and descriptions, as well as providing the data source. The results of validation by experts can be seen in **Table 3**.

Table 3. Validation Results

Indicators	V-Aiken	Category
Content (Mathematics)	0,75	Fairly Valid
Construction	0,734375	Fairly Valid
Language	0,75	Fairly Valid
Mean score	0,74264706	Fairly Valid

The validation results show that the PISA-Like mathematical literacy test instrument in the Yogyakarta cultural context is in the quite valid category with an average V-Aiken score obtained of

0.75. The construction aspect obtained a value of 0.734375, which means that the test instrument developed is valid enough to be used. Furthermore, the content aspect of the material received a value of 0.8875, which means that the test instrument is appropriate to the students' conditions involving elements of local socio-culture. After that, the language aspect received a score of 0.75, which means that the test instrument has the correct concept of the material and uses language that is easy to understand.

Next, a test of the validity of the test instrument items was carried out. The results of the test validity calculations were processed using SPSS. The results of the test validity calculation were then consulted with the r_table at a significance level of 5% with N= 18 so that the r_{table} showed a value of 0.4683. The following are the results of the validity test of multiple choice questions items which can be seen in **Table 4**.

Table 4. Results of Question Item Validity Analysis

Valid Category	Invalid Category
Question: 1, 2, and 3	-

This shows that the validity of the Yogyakarta socio-culture PISA-Like mathematical literacy ability test is quite good, with 5 valid questions. Each question is adjusted to the predicted PISA level at levels 1-6. For question number 1, prediction is level 1, question number 2 is prediction level 2, and numbers 3. Meanwhile, there are not invalid multiple choise questions. The following are the results of the validity test of essay question items, which can be seen in **Table 5**.

Table 5. Results of Question Item Validity Analysis

Valid Category	Invalid Category
Question: 4a, 4c, 5a, 5b, 5c, and 6	Question: 4b, 4d, 5d, 7, 8, 9, and 10

This shows that the validity of the Yogyakarta socio-culture PISA-Like mathematical literacy ability test is quite good, which has 6 valid and 7 invalid essay questions. Each essay is adjusted to PISA Level predictions at levels 1-6. Question number 4 includes a Level 4 prediction, question number 5 is a Level 5 prediction, and numbers 6 is prediction level 3.

After that, a reliability test was carried out using KR-20 with the help of SPSS 26. Reliability of a question is necessary because it supports the formation of the validity of the question items so that a valid question is usually reliable. The results of the reliability test on multiple choice questions show that the test instrument is reliable. The following **Table 6** shows the results of the KR-20 reliability test.

Table 6. Reliability Analysis Results

KR-20	N of Items
0,536748	3

In analyzing this data, the result was that the Reliability Index $= 0.536748$. Based on the criteria (Ary et al., 2014) it can be concluded that the test instrument is reliable. Furthermore, for the essay questions, a reliability test was also carried out using Cronbach's Alpha assisted by SPSS 26. The following results of the reliability test are shown in **Table 7**.

Table 7. Reliability Analysis Results

Cronbach's Alpha	N of Items
0,840574	6

In analyzing this data, the result was that the Reliability Index = 0.840574. Based on the criteria (Ary et al., 2014) it can be concluded that the test instrument is reliable. Test instruments that are valid and reliable are then carried out in one-on-one evaluations which aim to obtain assessments from teachers and students as users of the product being developed. The purpose of this one-on-one evaluation is to see the practicality of the test instrument developed.

The one-on-one evaluation involved 3 teachers and 18 class VIII students at Teladan Yogyakarta Middle School. Teachers were given a Yogyakarta socio-culture-based PISA-Like mathematical literacy ability test instrument, then teachers were asked to fill out a questionnaire regarding the practicality of the instrument. After that, 18 students were asked to answer problem-solving ability test questions, after which they were given a questionnaire on the practicality of the test questions.

The results of the teacher questionnaire analysis showed that 100% of teachers' responses to the Yogyakarta socio-culture-based PISA-Like mathematical literacy ability test instrument were in the good to very good category with a mean of 50.67. This shows that the test instrument can be used to measure students' literacy skills with elements of Yogyakarta socio-culture. To find out whether the test instrument that has been developed can be applied, the assessment criteria refer to **Table 8**.

Table 8. Practicality Criteria for Teacher Response Test Instruments

Average Score	Category	Frequency	Percentage (%)
$X_1 > 48,75$	Excellent	1	33
$41,25 < X_1 \leq 48,75$	Good	2	67
$33,75 < X_1 \leq 41,25$	Quite Good	0	0
$26,25 < X_1 \leq 33,75$	Bad	0	0
$X_1 \leq 26,25$	Very Bad	0	0

In the students' response questionnaire, students have 4 answer choices with a maximum score of 52 and a minimum score of 13. The results of the student questionnaire show that 78% of students' responses to the Yogyakarta socio-culture-based PISA-Like mathematical literacy ability test instrument are in the good to excellent category with an average score of 38.1 (good category). This shows that the Yogyakarta socio-culture-based PISA-like mathematical literacy ability test instrument that was developed was deemed feasible and easy to understand by students. To find out whether the test instrument that has been developed can be applied, the minimum assessment is in the good category referring to **Table 9**.

Table 9. Practicality Criteria for Student Response Test Instruments

Average Score	Category	Frequency	Percentage (%)
$X_1 > 42,25$	Excellent	2	11
$35,75 < X_1 \leq 42,25$	Good	12	67
$29,25 < X_1 \leq 35,75$	Quite Good	3	17
$22,75 < X_1 \leq 29,25$	Bad	1	5
$X_1 \leq 22,75$	Very Bad	0	0

Furthermore, the PISA-Like mathematical literacy ability test instrument based on Yogyakarta socio-culture has been validated and improved so that it is in a good category and then tested on students. The test instrument was tested offline on 18 students at Teladan Yogyakarta Middle School class VIII for the 2024/2025 academic year. This instrument was used to determine the effectiveness of the Yogyakarta socio-culture PISA-like mathematical literacy ability test questions that had been developed. The effectiveness assessment criteria are seen in **Table 10**.

Table 10. Test Instrument Effectiveness Criteria

Average Score	Category	Frequency	Percentage (%)
$X_1 > 75$	Excellent	0	0
$58 < X_1 \leq 75$	Good	7	39
$42 < X_1 \leq 58$	Quite Good	6	33
$25 < X_1 \leq 42$	Bad	3	17
$X_1 \leq 25$	Very Bad	2	11

The results of the Yogyakarta socio-culture PISA-Like mathematical literacy ability test instrument showed that 72% of students had obtained mathematical literacy test scores in the fair to good category. This shows that the Yogyakarta socio-culture PISA-Like mathematical literacy ability test instrument questions are used quite well by students.

The question package developed can also be used as a medium for assessing students' mathematical literacy abilities. In this research, mathematical literacy abilities are measured based on the level of difficulty of the questions that have been created. If students can solve level 1 prediction questions, then their mathematical literacy abilities are at level 1. In PISA, mathematical literacy abilities are divided into 6 levels, starting from level 1 to level 6 as the highest level. The

level of students' mathematical literacy skills developed in this research reached level 6, with a total of 10 questions based on Yogyakarta socio-culture. Based on the research conducted, the following data was obtained on the mathematical literacy abilities of class VIII students at Teladan Middle School in Yogyakarta.
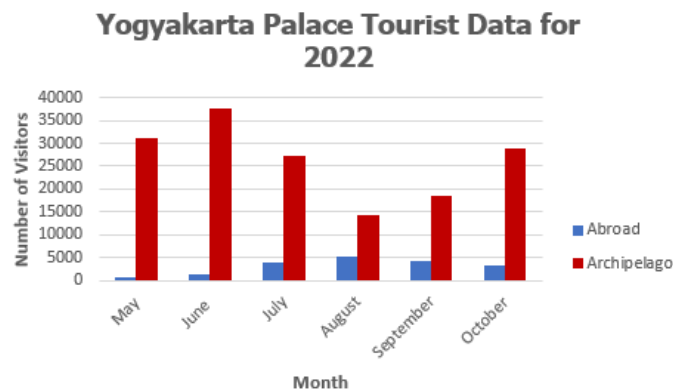
Table 11. Field Trial Results

No	Description	The Number of Students
1	Students can solve questions with level 1 predictions	13
2	Students can solve questions with level 2 predictions	14
3	Students can solve questions with level 3 predictions	17
4	Students can solve questions with level 4 predictions	0
5	Students can solve questions with level 5 predictions	1
6	Students can solve questions with level 6 predictions	0

Based on the **Table 11**, the majority of students are only able to solve mathematical literacy questions at predicted level 3. This is due to the varying levels of difficulty of the questions developed in this research. Students generally can only answer questions with a low level of difficulty. The following is an example of a question that has been developed and tested on grade VIII students at Teladan Middle School Yogyakarta.

English Version

1. Ngayogyakarta Hadiningrat Palace is one of the tourist destinations in Yogyakarta which attracts both foreign and Indonesian tourists. The following is a graph of the number of tourists from May to October 2022.

(Source : https://www.slideshare.net/slideshow/r2analisis-jumlah-kunjungan-wisatawan-kota-yogyakarta-tahun-2022pptx/255118861)

How many Indonesian tourists will there be in October 2022?

a. 14.185 visitors   c. 27.352 visitors
b. 28.976 visitors   d. 31.287 visitors

Figure 1. Question about the theme of the Yogyakarta Palace

The questions in Figure 1 are level 1 predictions. These questions are adapted to the PISA domain with uncertainty and data content, general context, reproductive competence, and employment processes. In this problem, students are required to be able to use their knowledge in solving general context problems with the relevant information provided in the diagram. Based on the indicators of mathematical literacy skills in PISA, students can answer by applying and looking at the graph of the number of Indonesian tourists in October 2022.

The questions in Figure 2 are level 2 predictions. These questions are adapted to the PISA domain with change and relationship content, personal context, connection competence, and formulating process. In this problem, students are required to be able to interpret the problem and solve it using a formula. Based on the indicators of mathematical literacy ability in PISA, students can answer by formulating and calculating income disputes.

English Version

2. Ngayogyakarta Hadiningrat Palace is one of the cultural tourism destinations in Yogyakarta. Some places that tourists can visit include the palace grounds, museums, performances, Wayang Wong, and others. Here are the ticket prices below!
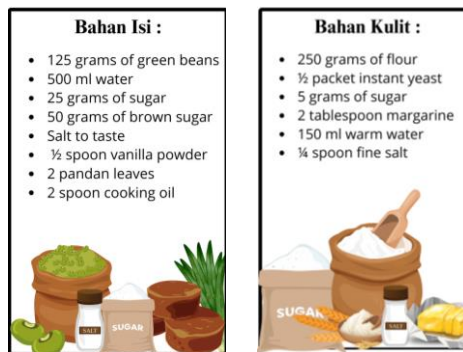

(Source: Personal documentation)

In May 2022 there will be around 618 foreign tourists. Then, there was an increase in June 2022 to around 1.161 people. What is the difference in income in May and June 2022?

a. Rp. 13.500.000,00   c. Rp. 13.575.000,00
b. Rp. 12.575.000,00   d. Rp. 12.500.000,00

Figure 2. Question about the Yogyakarta Palace theme

English Version

3. Fafa wants to make Bakpia Pathok based on the recipe in the discourse. Stock up on ingredients at home as follows:

Table of General Information about the Context of Bakpia Pathok

Material	Supply
Mung beans	750 grams
Sugar	200 grams
Brown sugar	250 grams
Flour	2.000 grams

Based on existing supplies, Fafa can make a maximum of... Bakpia

a. 75 pieces   c. 100 pieces
b. 90 pieces   d. 120 pieces

Figure 3. Bakpia Pathok Theme Questions

The questions in Figure 3 are level 3 predictions. These questions are adapted to the PISA domain with quantity content, personal context, connection competence, and formulating process. In these questions, students are required to be able to solve problems and relate them to the real world. Based on the indicators of mathematical literacy ability in PISA, students can answer by formulating and calculating the maximum number of Bakpia according to the inventory in the table.

Based on the developments that have been carried out in the research, 6 mathematical literacy questions obtained from the Yogyakarta cultural context were valid, practical and effective. This is in line with what was stated by (Hamzah, 2019; Nindiawati et al., 2021) that good questions that can

be used to evaluate students are questions that meet the criteria for validity, practicality and effectiveness.

Using the context of local wisdom, especially Yogyakarta socio-culture, in developing mathematical literacy questions has its appeal for students. Integrating Yogyakarta's socio-culture into mathematics learning is something new and unusual for students. Apart from that, Yogyakarta's socio-culture is an integral part of students' lives because it is their socio-culture. Based on students' responses, the application of the Yogyakarta cultural context was able to increase their interest and motivation in learning mathematics

Meanwhile, the application of Yogyakarta socio-culture as a context in mathematics problems is very crucial in mathematical literacy. This is in line with the fact that mathematization or literacy activities will take place optimally if the questions use a cultural context (Lestariningsih & Lutfianto, 2021). Based on this opinion, it is very clear that the application of the Yogyakarta cultural context has an important role in matters of mathematical literacy. The use of this context makes it possible to evaluate students' ability to transform real-world problems into mathematical symbolic forms.

The mathematical literacy questions developed in the Yogyakarta cultural context were proven to be able to increase students' mathematical literacy. This can be seen from the results of students' mathematical literacy which shows that the level of student effectiveness in solving questions is in the quite good category. Apart from that, questions are also useful in increasing students' interest and motivation to learn. This research supports previous findings which state that mathematics questions with a cultural context can motivate students to learn (Imamuddin et al., 2022; Rizky & Nasution, 2024). The use of cultural context has been proven to attract and motivate students (Isnaniah & Imamuddin, 2022; Yanti, 2024). Mathematics learning that integrates students' local culture makes it easier to understand the material and increases students' mathematical literacy (Idris, 2019; Putri et al., 2024).

The development of Yogyakarta socio-culture-based mathematics literacy questions did not run completely smoothly, several obstacles occurred at the stages of the activity. These obstacles occurred at the prototype stage. At this stage, the obstacles encountered were in developing mathematical literacy questions, the questions created had to meet the indicators of mathematical literacy ability in PISA, the questions created had to be based on Yogyakarta socio-culture, and also the content of the questions had to be by the material the students had studied. In addition, the choice of language must be clear, not give rise to double meanings, and be easy for students to understand.

Based on the researcher's analysis, several reasons why students have not been optimal in solving PISA-like mathematical literacy questions in the Yogyakarta cultural context include students not being thorough enough, not being able to evaluate solutions, and not being able to apply the results and mathematical reasoning. Students tend to answer questions directly without writing down the information they see about the question and without making mathematical models. As a result, their ability to interpret and analyze questions is still lacking.

Therefore, the researcher hopes that this research can be further developed by future researchers. This research can help students learn about various very important local cultural values. It is also hoped that the results of this research will encourage teachers to continue to strive to develop mathematical literacy questions using cultural contexts.

4. Conclusion

Based on the results of research and discussion regarding the development of a PISA-Like-based mathematical literacy ability test instrument in the cultural context of Yogyakarta, it can be concluded that the feasibility of the questions developed is supported by validation results from expert validators. The expert validation results show that these questions have an average value of 0.75 and are included in the quite valid category. Of the question items tested, 7 questions were declared valid and reliable. Based on the results of a questionnaire filled out by class VIII students at SMP Teladan Yogyakarta for the 2024/2025 academic year, the average student response to the questions developed reached a score of 38.1, which is in the good to excellent category with a percentage of 78%. Apart from that, the results of the teacher questionnaire showed that the average

teacher response to the questions reached a score of 50.67, which is included in the good to very good category with a percentage of 100%. The results of the Yogyakarta socio-culture PISA-Like mathematical literacy ability test instrument showed that 72% of students had obtained mathematical literacy test scores in the fair to good category. However, students' mathematical literacy abilities are at predicted level 3. Thus, this research succeeded in developing a PISA-Like-based mathematical literacy ability test instrument with a valid, practical, and effective Yogyakarta cultural context.

Based on the research results and conclusions that have been outlined, there are several suggestions that researchers can give to students: they should study harder and try to practice more mathematical literacy questions. Students must be able to recognize the environment well, especially the local socio-culture around them, and integrate it into the real world.

Meanwhile, future researchers, to be able to choose research subjects who are used to working on problems with context so that students' mathematical literacy abilities are more clearly visible and take into account the students' situation and conditions so that the time used is maximized.

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References

Ary, D., Jacobs, L. C., Sorensen, C. K., & Walker, D. A. (2014). *Introduction to Research in Education, Ninth Edition*. Wadsworth, Cengage Learning.

Daton, Y. L., Hariyani, S., & Suwanti, V. (2019). PENERAPAN MODEL PEMBELAJARAN REALISTIC MATHEMATIC EDUCATION (RME) UNTUK MENINGKATKAN HASIL BELAJAR SISWA. *Seminar Nasional FST*, 417–425.

Efriani, A., & Wachyuni, D. R. (2024). Pengembangan Soal Matematika Model PISA Konteks Ramadhan dengan Konten Uncertanty and Data. *Jurnal Pendidikan Matematika*, *15*(1), 60–69.

Fernandes, M., & Syarifuddin, H. (2020). PENGEMBANGAN PERANGKAT PEMBELAJARAN PECAHAN BERBASIS MODEL PENEMUAN TERBIMBING UNTUK KELAS IV SD. *ELSE : Elementary School Education Journal*, *4*(1), 20–35.

Ghozali, I. (2021). *Aplikasi Analisis Multivariat (edisi ke-10)*. Badan Penerbit Universitas Diponegoro.

Gradini, E., Firmansyah, & Saputra, E. (2021). Pengembangan Tes Literasi Matematis Menggunakan Soal Pisa-Like Konteks Kultur Lokal. *Jurnal Ilmiah Pendidikan Matematika AL-QALASADI*, *5*(1), 29–43.

Hamzah, A. (2019). *Metode Penelitian & Pengembangan Research & Development*.

Hidayati, V. R., Wulandari, N. P., Maulyda, M. A., Erfan, M., & Rosyidah, A. N. K. (2020). Literasi Matematika Calon Guru Sekolah Dasar dalam Menyelesaikan Masalah PISA Konten Shape And Space. *JPMI: Jurnal Pembelajaran Matematika Inovatif*, *3*(3), 185–194.

Idris, K. (2019). Literasi Statistik Berbasis Konteks Budaya dan Keislaman: Perspektif Dosen dan Mahasiswa PTKI. *Prosiding Seminar Nasional IItegrasi Matematika Dan Nilai Islami*, *3*(1), 357–362.

Imamuddin, M., Musril, H. A., & Isnaniah. (2022). Pengembangan Soal Literasi Matematika Terintegrasi Islam Untuk Siswa Madrasah. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *11*(2), 1355–1371.

Imania, K. A., & Bariah, S. K. (2019). Rancangan Pengembangan Instrumen Penilaian Pembelajaran Berbasis Daring. *Jurnal Petik*, *22*(1), 12–23.

Isnaniah, & Imamuddin, M. (2022). PENGEMBANGAN SOAL LITERASI MATEMATIKA KONTEKS BUDAYA MINANGKABAU UNTUK MENINGKATKAN LITERASI MATEMATIKA SISWA. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *11*(4), 3716–3726.

Khatimah, H., Mania, S., Majid, A. F., & Yuliany, N. (2022). Development of Ethnomatematics-Based Mathematics Learning Module (Bugis Cultural Tradition). *Alauddin Journal of Mathematics Education*, *4*(2), 161–171.

Lestariningsih, L., & Lutfianto, M. (2021). Pengembangan Soal Literasi Matematis untuk Mendukung Matematisasi Mahasiswa Calon Guru. *Jurnal Elemen*, *7*(1), 195–208.

Madyaratria, D. Y., Wardono, W., & Prasetyo, A. P. B. (2019). Kemampuan Literasi Matematika Siswa pada Pembelajaran Problem Based Learning dengan Tinjauan Gaya Belajar. *PRISMA: Prosiding Seminar Nasional Matematika*, *2*, 648–658.

Maharani, R., Lestari, M., Rauf, R. A. A., Hargrove, B. M., Chong, S. T., Listiani, T., & Exacta, A. P. (2023). The Effectiveness of Learning Media Exhibitions Through Project-Based Learning (PjBl) to Improve the Creativity Skills of Prospective Mathematics Teachers. *Jurnal Pendidikan Matematika*, *6*(2), 217–234.

Mardiyah. (2024). *EFEKTIVITAS MODEL PROBLEM BASED LEARNING DENGAN PENDEKATAN CONCRETE PICTORIAL ABSTRACK (CPA) UNTUK MENINGKATKAN LITERASI MATEMATIKA SISWA PADA MATERI TEOREMA PYTHAGORAS KELAS VIII DI MTS NEGERI 2 JEPARA*. Institut Agama Islam Negeri Kudus.

Maysarah, S., Saragih, S., Armanto, D., & Siregar, H. (2024). Kemampuan literasi matematis dan keterampilan sosial melalui model project based learning. *Delta-Pi: Jurnal Matematika Dan Pendidikan Matematika*, *13*(1), 68–81.

Muslimah, H., & Pujiastuti, H. (2020). Analisis Kemampuan Literasi Matematis Siswa dalam Memecahkan Masalah Matematika Berbentuk Soal Cerita. *Jurnal Pendidikan Matematika Dan Sains*, *8*(1), 36–43.

Nasution, R. S., Fauzi, K. M. A., & Syahputra, E. (2020). PENGEMBANGAN SOAL MATEMATIKA MODEL PISA PADA KONTENSPACE AND SHAPE UNTUK MENGUKUR KEMAMPUAN PENALARAN MATEMATIS. *Paradikma Jurnal Pendidikan Matematika*, *13*(1), 1–10.

Nindiawati, D., Subandowo, M., & Rusmawati, R. D. (2021). Pengembangan Bahan Ajar Matematika untuk Siswa Kelas V Sekolah Dasar. *Edcomtech*, *6*(1), 140–150.

Nurjanah, A., & Saputra, D. C. (2023). Mathematical Literacy Skills: A Survey in Secondary Schools. *JAMBURA Journal Of Mathematics Education*, *4*(1), 35–49.

Nurutami, A., & Setyawan, F. (2019). Kemampuan Literasi Matematika Siswa Berdasarkan Konten PISA. *Wacana Akdemika: Majalah Ilmiah Kependidikan*, *3*(1), 11–20.

OECD. (2019a). *Chapter 3 PISA 2018 Mathematics Framework*. PISA 2018 assesment and analytical framework.

OECD. (2019b). *PISA 2018 Resultss (Volume I): What Students Know and Can Do*. PISA, OECD Publishing.

PISA. (2020). *KERANGKA MATEMATIKA PISA 2021*.

Prayitno, A. T., Sumarni, Syafari, R., Basir, M. A., Febrianti, D., & Putri, A. (2023). Instrumen Tes Kemampuan Literasi Numerasi Berbasis Budaya Lokal Kabupaten Kuningan Jawa Barat. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *12*(1), 789–801.

Putra, A. P., & Prasetyo, D. (2022). PERAN ETNOMATEMATIKA DALAM KONSEP DASAR PEMBELAJARAN MATEMATIKA. *Jurnal Intersection*, *7*(2), 1–8.

Putri, Y. W., Kusumaningtyas, W., Nur, D. R., & Amanda, M. (2024). PERAN

ETNOMATEMATIKA DALAM MENDUKUNG LITERASI MATEMATIKA DI ERA SOCIETY 5.0. *Jurnal Sains*, *3*(1), 24–32.

Rawani, D., & Fitra, D. (2022). Etnomatematika: Keterkaitan Budaya dan Matematika. *Jurnal Inovasi Edukasi*, *5*(2), 19–26.

Retnawati, H. (2016). *Analisis Kuantitatif Instrumen Penelitian*. Parama Publishing. https://doi.org/10.1088/1742-6596/1155/1/012019

Rizky, V. B., & Nasution, A. T. (2024). Model Pembelajaran Etnomatematika dalam Menumbuhkan Motivasi Belajar Siswa di Sekolah Dasar. *EDUCOFA: Jurnal Pendidikan Matematika*, *1*(1), 57–70.

Rokhima, N., Pamungkas, D., & Prahmana, R. C. I. (2023). Pengembangan Soal Matematika Tipe Pisa Menggunakan Konteks Tugu Yogyakarta. *Jurnal Pendidikan Dan Pembelajaran Matematika Indonesia*, *12*(1), 49–59.

Slamet, R., & Wahyuningsih, S. (2022). Validitas Dan Reliabilitas Terhadap Instrumen Kepuasan Ker. *Aliansi : Jurnal Manajemen Dan Bisnis*, *17*(2), 51–58. https://doi.org/10.46975/aliansi.v17i2.428

Tohir, M. (2019). *Hasil PISA Indonesia Tahun 2018 Turun Dibanding Tahun 2015*. 3 Desember 2019.

Tupamahu, P. Z., Ratumanan, T. G., & Laamena, C. M. (2023). Students' Mathematical Representation and Communication Ability in Mahematics Problem Solving. *Jurnal Didaktik Matematika*, *10*(1), 111–130.

Yanti, S. (2024). PENGEMBANGAN MATERI AJAR MATEMATIKA BERBASIS KONTEKS LINGKUNGAN SEKITAR. *JRPP: Jurnal Review Pendidikan Dan Pengajaran*, *7*(3), 11111–11115.