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Mathematics PISA Problems Using Local Context for Elementary School Students

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Abstract

Referring to the results of an international survey, one of which is PISA, the achievements of Indonesian students are still below the global average score. The main problem that is the causative factor is that students need to be used to solving similar problems. The issues used in PISA questions are familiar to only some students in Indonesia. This study aimed to develop PISA model mathematical problems with valid and reliable local contexts and potential impacts. The type of research conducted is development research using the ADDIE model with the stages of analysis, design, development, and evaluation. The test subjects were fifth-grade elementary school students in Bengkulu and South Sumatra provinces. The research instruments were product development validity sheets, legibility sheets, and student response questionnaires. Data analysis consisted of validity analysis using the Aiken Index and reliability with Cronbach Alpha. The study results show that PISA model mathematical questions with the regional context meet the validity, reliability, and potential impact criteria. The results of the implementation test showed that 11 students (27.50%) were in the low category, 32 students (55.00%), and 7 students (17.50%) were in the high category.

Keywords: development research; PISA model; mathematic problems, local contexts

I. Introduction

The achievement of mathematics learning outcomes for elementary school students in Indonesia still needs to improve. This is supported by several data, one of which is data on the 2022 minimum competency assessment results at the elementary school level shows that student competency achievement in Indonesia is below 50% (Kemendikbud, 2022). The results of this national assessment show that particular action is needed to improve student learning outcomes in Indonesia. Another example is the research results of Susanto et al. (2023), which show that student mastery in solving minimum competency assessment-type questions is in a low category with a mastery proportion of 48.42%.

The results of interviews conducted with elementary school teachers in preparing minimum competency assessments concluded that the main problem was the availability of learning resources, such as teaching materials and relevant questions. These limitations are one of the factors in the low readiness of students to take part in the national assessment, namely the minimum competency assessment. Research has also been conducted, which shows that student's ability to solve problems requires high thinking skills in a low average category (Susanto & Retnawati, 2016).

The various efforts that the government has made to improve student learning achievement have started with reforming the

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international standard curriculum and assessment. However, in practice, not all schools are ready to apply it. Limited resources in schools and outreach should be a significant concern in improving learning outcomes. According to data from the Directorate of Basic Education (2022), students from rural schools consistently have had low literacy skills in the last six rounds of *the Programme for International Student Assessment* (PISA). This problem indicates that a different approach is needed for schools in the regions.

Efforts to empirically improve students' mathematics learning outcomes have proven the use of media, learning models, teaching material designs, and tests that demand student skills. This follows the opinion of Susanta, Koto, and Susanto (2022), which states that they must carry out innovative learning to develop students' abilities. Another opinion also mentions that guided practice methods can improve students' abilities (Bindas et al., 2010). It believes that in improving students' abilities, teachers must be able to design teaching materials or learning evaluation tools creatively.

Data from international surveys that have been conducted, such as TIMMS and PISA, demand the need for an emphasis on learning that emphasizes students' freedom to explore abilities. This is by Government Regulation 58 of 2013, which changes passive learning patterns to active-seeking learning where students actively build their knowledge which is reinforced by a scientific approach learning model (Kemendikbud, 2014).

Student abilities can be developed with a context approach that is familiar to students. Using contexts close to students can make it easier for students to recognize and understand problems before solving them (Zulkardi, 2013). This shows that in facilitating students' ability to understand the material, they can use real contexts that are familiar to students and regional contexts. Using the local context associated with teaching materials can support students' abilities (Susanta et al., 2022). Ethnomathematics-based teaching materials are effective in improving learning outcomes (Setiana & Nuryadi, 2021); the RME approach with the culture of the village of Kuta (Adilaturahmanh & Suparni, 2021)

Several research studies show that the use of local contexts in questions has an impact on student's abilities. Research conducted by Rauf, Fitriasari, and Septiani (2022) uses the Palembang cultural context, the Jambi context (Charmila et al., 2016); Palembang traditional house context (Susanti, 2016); mathematical problem ability in local contexts problem (Simamora & Saragih, 2019). PISA questions in the Bangka context (Dasaprawira et al., 2019); about the context of the ASEAN Games (Pratiwi et al., 2019); math literacy task with context (Susanta et al., 2023); Ethnomathematics in market snacks in the Cileungsi area (Mulyatna et al., 2022).

Research studies on other problem development using context show an impact on students' thinking abilities. Research conducted by Susanta, Susanto, and Sumardi (2022) shows that using the local context in higher-order thinking skills (HOTS) questions potentially impact supporting students' HOTS abilities. A study by Kadir and Masi (2013) states that using context in questions has a potential impact. Based on some of the research that has been done, it is necessary to emphasize the local and regional context in developing questions. This is the opinion of Stroyer, Nainggolan, and Hutabarat (2018), who states that learning mathematics will always be surrounded by cultural problems. Tasks designed with context can impact student abilities (Susanta et al., 2023).

Based on the problems and data described, it is necessary to emphasize learning mathematics, especially in preparing questions as a vehicle for student practice. This is due to a minimum competency assessment (MCA) which refers to international surveys but still needs more learning resources. One of them is the availability of relevant questions that refer to international-scale tests. So the teacher needs to prepare questions relevant to the assessment held by the government.

In this study, the development of regional context-based PISA mathematical questions was carried out. So that students are facilitated in solving the problems presented in the questions by using familiar contexts. The regional contexts that are the focus are the contexts of Bengkulu and Musi Rawas South Sumatra, Sumatra, Indonesia.

II. Research Method

Types of research

The research conducted is research and development. This study aims to develop PISA model math problems with regional contexts for elementary school students. The regional contexts that are the focus are the Bengkulu and Musi Rawas of South Sumatra, Sumatra, Indonesia.

Research procedure

The development of test items refers to the stages of the ADDIE model consisting of analysis, design, development, implementation, and evaluation. In the analysis stage, an assessment of the material based on basic competence in mathematics was carried out in fifth-grade elementary schools in the 2013 curriculum, and an analysis of the appropriate regional context. An initial draft was carried out at the design stage to prepare PISA model math problems, as shown in Figure 1.

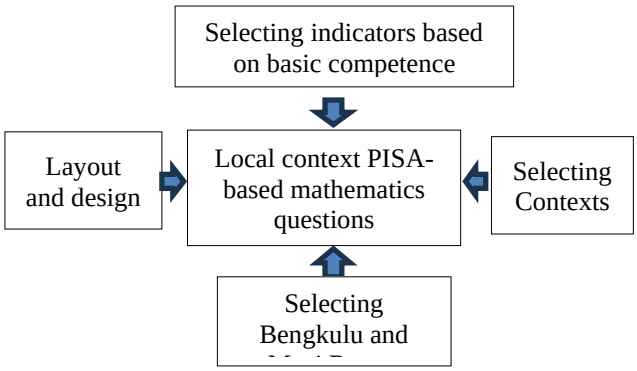

Figure 1. Development design

The development stage is carried out by an expert test by the validator. In this study, the assessment was carried out by two validators who assessed the material, construction, and language of the product being developed. In addition, a limited trial was conducted on 6 students from each trial school, so the number of readability test subjects was 12. At the implementation stage, trials were carried out widely, namely as many as two schools each, from Bengkulu and Musi Rawas Regency South Sumatra, Sumatera Indonesian. The test results were analyzed to measure the reliability of the questions developed. The final stage, namely, evaluation, aims to measure student responses by distributing questionnaires.

Research subject

The test subjects in this study were elementary schools from Bengkulu and Musi Rawas Regency South Sumatra Province. The test subjects in this study were fifth-grade students at Bengkulu public elementary school and Musi Rawas public school. The description of the subjects in this study is shown in the following table.

Table 1.
Research subjects

School	Try Out	Implementation
Bengkulu public elementary school	12 (Low, Medium, high)	21 (7Male, 14Female)
Musi Rawas public elementary school	12 (Low, Medium, High	19 (5Male, 12Female)

Data collection technique

Data collection techniques are divided into two stages: tests and non-tests. Data on students' ability to solve questions are collected by distributing test questions to the trial class. Non-test data is a questionnaire assessing the validity and student responses.

Research Instruments

The test instrument in this study was in the form of regional context PISA mathematics test questions which were development products. The non-test tools in this study consisted of validation sheets, legibility sheets, and response questionnaires. The assessment criteria in the developed validation sheet consist of five rating scales (Linkert scale), namely: very good (5), good (4), enough (3), less (2), and very less. The student response questionnaire refers to five criteria from the Linkert scale, namely: (5)

strongly agree, (4) agree, (3) undecided, (2) disagree, and (1) strongly disagree (Sugiyono, 2016).

Data analysis technique

The validity analysis used the Aiken index $V = \frac{\sum s}{n(c-1)}$, with $s = r - I_0$ (Retnawati, 2014). Furthermore, the analysis of student test results and questionnaires was carried out using descriptive statistics.

III. Results and Discussion

Product Description Development

The research aims to develop PISA model math problems with local contexts. The product resulted from developing two packages of PISA model questions in descriptions from level-1 to level-6. The created questions consisted of 12 questions, 6 questions in the context of Bengkulu and 6 questions in the context of the Musi Rawas. The questions were developed based on the PISA level and the regional context of Bengkulu and Musi Rawas, which consisted of tourism, special food, culture, and historical contexts in Table 2.

Table 2.
Product development

Level	Local Contexts	
	Bengkulu	Musi Rawas
1	Historical [Bubungan Lima]	Culture [Batik musirawas]
2	Tourism [Panjang Beach]	Tourism [Aur Lake]
3	Food [Tat cake]	Food [Pempek]
4	Culture [Tabot]	historical [Turak Dance]
5	historical [Forth Malborough]	Food [Kemang Bread]
6	Tourism [Dendam Lake]	Tourism [Rayo Lake]

The following is an example of product development using the context of the Musi Rawas (level 50).

Roti Kemang is one of Musi Rawas' special culinary snacks. This bread usually has flavors such as coconut, durian, and chocolate with the price for each mold as shown in the following table.

Varian	Price (IDR)
Coconut	15.000
Chocolate	18.000
Durian	20.000

Salma brought Rp. 100,000.00 and wanted to buy kemang bread. What variant of the *roti kemang* flavor did Salma buy, if the remaining money that Salma received was IDR 8,000? Explain your argument!

Figure 2. Sample development products (in english)

Results of Needs Analysis

Needs analysis in the development of PISA model mathematical problem products in the regional context was based on interviews with teachers, distribution of questionnaires to students, and analysis of the appropriate regional context. The results of an interview with one of the elementary school teachers in Bengkulu City, Mrs. Elin Wahyulin, M.Pd. The results of the interviews can be concluded by compiling questions with an emphasis on student practice as well as semester exam questions generally developed from questions in the textbook used. Different numbers usually replace problems with the same pattern in the book.

Based on the results of the interviews, it was concluded that the teacher had yet to use the real context or local context in the questions. Teachers generally use general contexts appropriate to the problems in school textbooks. The book used is a book published by the 2013 curriculum of the Ministry of Education and Culture with a general context and not specific to the student's environment. So it is necessary to emphasize the local context in compiling questions. Using a natural context, the teacher chooses a context appropriate to the problem in the textbook, namely the 2013 Ministry of Education and Culture publication. However, the teacher has yet to use context or local problems as problems in the questions.

Furthermore, this study also explored information from students related to the use of problems in the questions by the teacher. Analysis

of student needs is done by distributing questionnaires to students. The distribution was carried out to fifth-grade elementary school students in an elementary public school in Bengkulu City, namely as many as 12 students with a distribution of low, medium, and high levels of knowledge. The results of student responses that agree with the questionnaire statements are in Table 3.

Table 3.
Student response to questions

No	Question indicator	Percentage (%)
1	The questions given by the teacher are similar to the questions in the textbook	83.33
2	Problems in questions are often encountered in everyday life	41.66
3	In the questions, the teacher uses problems that exist in Bengkulu	25.00

Based on the questionnaire result, the questions compiled by the teacher in class learning tend to use questions similar to the textbooks used. In addition, the use of local or regional problems in collecting questions in class has yet to be widely used. It is still rare for the teacher to emphasize the problem using the regional context. Interviews were also conducted with elementary school teachers in Musi Rawas. The conclusions from the interviews also show that the evaluation tool in the teacher's class uses questions in the textbook and is modified. The analysis results are viewed from the regional context, especially in the Bengkulu and Musi Rawas. The context can be related to material for fifth-grade elementary school students. For example, in Bengkulu: such as the tourism context of Bengkulu, for example, Panjang beach, cultural context such as Batik, historical buildings such as Bung Karno's exile house, the context of special food such as that cake. Likewise, in the Musi Rawas, such as Lake Gegas, Musi Rawas batik, traditional houses, and special food. These contexts are closer to students and familiar to students.

Product Validity Test Results

The product development results were obtained by expert tests by two lecturers in the master of primary education at the Faculty of Teacher Training and Education, Bengkulu University. Validity assessment is based on three aspects, namely material, construction, and language, and the context used. The expert test results were analyzed using the Aiken index with valid criteria if the Aiken index value is more than 0.5. The results of the Aiken product development index analysis are in Table 4.

Table 4.
Aiken index value

Question	Content Aspect	Construction and Language	Context Appropriate
Type A	0.65	0.62	0.55
Type B	0.70	0.65	0.56

The results of the Aiken index test in Table 4 provide information that the question packages compiled as products in this study have met the valid criteria. This can be seen from the index value on each aspect of the question, which is more than 0.5.

The validity analysis results show each development product's good aspects. This means that theoretically, the questions developed have met the suitability aspect. So that the questions can function to measure the goal of measurement that is adjusted to the learning objectives; this is in line with the opinion of Rezeki, Andrian, and Safitri (2021) that a valid learning tool is a way to obtain information about student abilities according to learning objectives.

At this stage, an assessment was also carried out by a fifth-grade elementary school in Bengkulu and an elementary public school in Musi Rawas, South Sumatra, with 12 students each. Assessment is focused on the readability of questions, symbols, and the ease of understanding the language of the questions. The readability questionnaire consists of 10 statement items. The results of distributing readability questionnaires are as follows.

Table 5.
Assessment of the context of bengkulu

Readability items	Score	Criteria
Layout, symbols, and letters	3.86	Good
Ease of use	4.20	Good
language use	4.21	Good
Familiar context	3.76	Good

Table 6.
Assessment of the context musirawas

Readability items	Score	Criteria
Layout, symbols, and letters	3.90	Good
Ease of use	3.96	Good
language use	3.80	good
Familiar context	3.80	Good

Based on the assessment Table 6, it was concluded that in terms of readability according to student assessments, it was in a good category. Students easily understand the symbols, language, and pictures in the questions.

Implementation results

After the questions were revised based on suggestions from expert tests and student readability assessments, test questions were piloted in large-scale classes. The subjects of the wide-scale trial were the fifth-grade elementary school Bengkulu City with 21 students, and fifth-grade students at elementary public school Musi Rawas, with 19 students. Data from test results at one of the schools was used to analyze the reliability of the questions. Reliability test using Croncbach alpha with results as shown in table 7.

Table 7.
Results of the reliability test of questions

Question	Total Questions	Cronbach alpha	Conclusion
Type A	6	0.76	High
Type B	6	0.82	High

Based on the results of the reliability test above, it can be concluded that each question package meets the reliability criteria with high criteria. Furthermore, the results of the response questionnaire as a potential impact on students' work on questions are presented in Table 8.

Table 8.
Results of student responses

Statement items	Response of students
Problems can be understood and solved	30.00%
Understand the problem and solve some	57.50%
Understand the meaning of the problem and can not solve	12.50%
Do not understand the problem	.00%

Based on Table 8, students generally understood and could solve questions by 57.50%, meaning that more than 50% could understand some. Furthermore, the results of the implementation showed that 11 students (27.50%) were in the low category, 32 students (55.00%), and 7 students (17.50%) were in the high category.

The results of the study show that there is an impact on the use of regional contexts on students' ability to solve problems. The results of this study are supported by research conducted by Susanta, Sumardi, and Zulkardi (2022), which states that an emphasis on context issues can help students improve student abilities. According to Wardani, Sulkardi, and Hartono (2017), students must be trained with PISA model questions. Further, according to Ylimaki (2010), Effective learning emphasizes activity, context, and culture as a collaborative effort within groups. The results of this study are also in line with Surya and Saragih's (2017) development of learning materials based on the Aceh Cultural Context that effectively improves students' skills. PISA math problems using the Ogan Ilir cultural context potentially impact students' abilities (Octaria, 2018). The results of other studies show that the Bengkulu context, which is packaged in HOTS questions, impacts the high-level thinking skills of high school students (Susanta et al.., 2022).

IV. Conclusion

Based on the review of the results of the research and discussion, the regional context PISA-type math questions developed meet valid and reliable criteria and have a potential impact. The regional contexts of Bengkulu and Musi

Rawas can be used as problems in compiling questions such as the context of tourism, exceptional food, culture, and history.

This research has implications for the teacher's ability to analyze contexts close to students to be used as problems in questions. Suggestions that can be conveyed from this study are that in designing test instruments, it is necessary first to choose a local context close to students and relevant to the material. In addition, in designing PISA questions, it is necessary to pay attention to the content, context, and level of the questions.

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