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Analysis of PISA Model Problems on Junior High School Mathematics Textbooks Published by Indonesia Ministry of Education in the 2017 Revised Edition

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Abstract: This study aims to describe the problems of the PISA model in mathematics textbooks which are in terms of the aspects contained in the components of the PISA model. The research subjects were competency test questions in the 2017 revised edition of the 2017 curriculum 2013 math textbooks, totaling 180. This study used a descriptive method with a qualitative approach. The research instrument was an analysis guide sheet based on the aspects of content, context, and cognitive level of the PISA model questions. Data analysis uses the stages of unit purchasing analysis, categorizing, and coding. The results showed that there were 17.22% of the PISA model questions. The questions are distributed based on each content consisting of number, space & shape, change & relationship, and impossibility & data. In the context aspect, the questions only fulfill three contexts, personal work, and social judging from the level of cognitive questions that are applied at the level of remembering, understanding, applying, analyzing, and assessing levels.

Keywords: mathematics textbook, PISA model, junior high school.

Abstrak: *Penelitian ini bertujuan untuk mendeskripsikan soal model PISA dalam buku teks matematika.. yang ada dalam ditinjau dari aspek yang terdapat dalam komponen model PISA. Subjek penelitian adalah soal uji kompetensi dalam buku teks matematika kelas VIII kurikulum 2013 edisi revisi 2017 yang berjumlah 180. Penelitian ini menggunakan metode deskriptif dengan pendekatan kualitatif. Instrumen penelitian berupa lembar pedoman analisis berdasarkan aspek konten, konteks, dan level kognitif soal model PISA. Data dianalisis menggunakan tahapan penentuan unit analisis, pengkategorian, dan pengkodean. Hasil penelitian menunjukkan bahwa terdapat sebanyak 17,22% soal model PISA. Soal tersebar berdasarkan pada setiap konten terdiri dari bilangan, ruang & bentuk, perubahan & hubungan, dan ketidakmungkinan & data. Pada aspek konteks soal hanya memenuhi tiga konteks yaitu konteks pribadi, pekerjaan, dan konteks sosial. Ditinjau dari level kognitif soal tersebar pada level mengingat, memahami, penerapan, analisis, dan level menilai.*

Kata kunci: *buku teks matematika, model PISA, SMP.*

▪ INTRODUCTION

The achievement of student learning outcomes in Indonesia internationally needs special attention in preparing for classroom learning. Particularly in mathematics, the performance of Indonesian students is still low. In the PISA survey, the average score of Indonesian students, especially in mathematics, is below the international average score (OECD, 2019; Schleicher, 2018). In addition, student results in the PISA survey from 2012-2018 were still low in the field of mathematics (Kemendikbud, 2019). In addition, students' mastery in Indonesia on the PISA and TIMSS-based national assessments shows mastery in mathematics, especially mathematical literacy below 50% (Pusmendik-Kemendikbud, 2022).

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Observational data on the achievement of junior high school student learning outcomes as an example in Bengkulu is still low. The results of research conducted by Susanta, Susanto, and Maizora (2021) at SMP/MTs Bengkulu show that the ability of students to solve TIMSS-based math problems at the knowing level is dominated by moderate ability, at the highest application level at medium ability, and the average reasoning level at a low ability level. Other research is supported by the research results of Haji, Yumiati & Zamzaili (2018) which state that one of the difficulties students experience in solving PISA questions is understanding the questions and relating them to real life.

Solutions to the problems above lead teachers to be innovative in classroom learning. This is in accordance with the opinion of Susanta, Koto, and Susanto (2022) which states that teachers in developing students' abilities need to carry out innovative learning. Besides that, the availability of relevant learning resources and supporting students' thinking skills are very necessary. One of the government's efforts to improve the quality of educational attainment is through the implementation of a minimum competency assessment (AKM). However, the availability of learning resources that support this application is inadequate. The results of the initial survey by the authors found that the learning resources of some schools still refer to textbooks that have not been updated. Learning resources that are commonly used in SMP/MTs, for example in Bengkulu City, use the 2013 Curriculum mathematics textbook. Some schools have used the 2017 revised edition of the book in accordance with the current conditions and circumstances without reducing or eliminating the basic material that already exists or has been discovered by previous researchers. Updates to the student's handbook will help them understand math knowledge as fully as possible, and through the math handbook the knowledge they can apply in everyday life.

One of the objectives of updating the 2013 curriculum is to support student achievement in Indonesia internationally, especially in the PISA survey. These results are in accordance with one of the objectives of developing and implementing the 2013 Curriculum (Dewantara, Zulkardi, & Darmawijoyo, 2015), namely to support PISA results. The PISA results reflect the fact that in modern times, individuals are given appreciation not for what they already know, but for what they have done (Rastuti & Prahmana, 2021). In addition, the development of learning resources with PISA problems has been carried out a lot (Stacey, 2011; Zulkardi & Kohar, 2018). PISA is also believed to be able to diagnose the strengths and weaknesses of the education system (Prensel et al., 2013). But in reality, there are still questions in the 2013 Curriculum book that do not meet the PISA criteria or model. The application of contexts such as PISA in classroom learning can support students' thinking skills. presenting real contexts on assignments such as the student environment that is better known to students may have an impact on increasing student competence (Susanta, et al., 2023). So it is necessary to set questions or assignments in textbooks in class. Suharyono's research (2020) concluded that in the books of mathematics students for class VII SMP/MTs Curriculum 2013 there are questions that are not in accordance with the PISA model. The percentage of conformity of the questions in the student's book with the PISA model questions was still very low, namely 408 questions were analyzed, there were 49.26% of questions similar to the questions in PISA.

The proportion of context is dominated by general context with a percentage of 42.29%. The process aspect is dominated by the process of using concepts, facts, procedures, and reasoning with a percentage of 66.17%. Furthermore, the PISA mathematics competency level is dominated by level 2 with a percentage of 52.74%, and level 1 with a percentage of 39.80%. Less than 10% for levels 3 to 6. This means that the questions in the textbook are only able to train students at level 2 of PISA mathematics competence. The characteristics of mathematical literacy have not been optimally integrated into the 2013 Curriculum textbook questions.

In supporting PISA in Indonesia, a lot of research has been done on PISA. Volleyball Context in the Asian Games for PISA-LIKE Mathematics Problems" (Jannah, Putri, & Zulkardi, 2019), Long jump in Asian Games: Contexts of PISA (Pratiwi, Putri, & Zulkardi, 2019). In addition, the use of context in PISA is believed to be able to support student's ability to solve problems. The design of PISA-based assignments needs to consider the context (Zulkardi & Kohar, 2018). It is necessary to present a real context in mathematics assignments in order to provide experience for students (Susanta et al., 2023). So there is a lot of emphasis on PISA questions using real contexts. Research by Efriani and Putri (2019) regarding the sailing context in PISA-Like Mathematics Problems, Questions of PISA Type Using Bangka Context (Dasaprawira, 2019). PISA Questions Using the Context of Aceh Traditional Houses (Usnul, Johar, & Sofyan, 2019).

Based on the description that we have conveyed, it is necessary to analyze how the availability of questions contained in books used in Indonesia refers to the PISA model questions. This analysis will reflect how much the teaching materials provided by the government contribute to the achievement of student learning outcomes in Indonesia in an international survey.

▪ METHOD

Participants and subject research

Participants in this data collection were students and teachers of grade VIII junior high schools in Bengkulu City as users of math textbooks. The subject that became the focus of this study was the mathematics textbooks for class VIII students of junior high school curriculum 2013 published by the 2017 revised edition of the Ministry of Education and Culture. The focus of the discussion was on material evaluation questions referring to the PISA model questions

Research Design and Procedures

Descriptive research aims to understand phenomena about what is experienced by research subjects, for example, behavior, perceptions, motivations, actions, etc., holistically (Moleong, 2011). The aim of the study was to describe the questions in the 2013 curriculum 2013 SMP/MTs class VIII mathematics student books published by the Ministry of Education and Culture in the 2017 revised edition according to the content, context, and process of the PISA model. Data collection is done by means of document analysis. The research instrument consisted of a question analysis guide sheet referring to the PISA model. The instrument refers to four aspects of PISA, namely content, context, process, and level of mathematical literacy

Instruments

Data collection was carried out by documenting items in the 2013 revised edition of the 2017 semester II Mathematics Textbook for Middle Schools/MTs published by the Ministry of Education and Culture. The instrument we used in this study was an analysis guide sheet referring to the PISA model (OECD, 2015). The grid of indicators for the PISA model problem analysis sheet in the 2017 revised edition of the 2017 Mathematics class VIII Curriculum II textbook in this study was developed based on PISA, namely content, context, and level of thinking. Material content consists of the Pythagorean theorem, circles, plane side shapes, statistics, and probability. The context aspect consists of personal context, work context, social context, and scientific context. Meanwhile, the level of thinking consists of remembering, understanding, applying, and analyzing.

Data analysis

In this study, the data was processed according to the data analysis steps suggested by Kolovou, Bakker, and Panhuizen (2009). The first step is the determination of the Unit of Analysis. In this case, the researcher conducted an analysis of the 2013 revised edition of the 2017 Mathematics Curriculum textbook for class VIII junior high school focusing on competency test questions to measure competency knowledge and skills. The second stage is categorization of analyzed content. The content referred to in this study is all competency test questions contained in the 2013 Curriculum 2013 revised edition of mathematics textbook class VIII. After obtaining all the questions, the researcher categorizes the questions that belong to the PISA model and those that do not belong to the PISA model. Researchers only focus on questions that can be classified as the PISA model.

After the data is collected, the final stage is carried out, namely coding. In the coding process, the researcher investigated each item related to the characteristics of the PISA questions. The questions were analyzed and described for each aspect of content, context, process, and the most dominant level of mathematical literacy in the questions. As a basis for coding reference, the researcher used the analysis framework of the questions in the 2013 Curriculum textbook based on the PISA Model (OECD, 2015). After the coding process is completed, it is followed by calculating the percentage of the number of questions for each aspect which consists of aspects of content, context, process, and level of mathematical literacy based on the formula suggested by (Munayati, Zulkardi, & Santoso, 2015).

$$\text{Pk} : \frac{\sum v}{\sum item\ test} \text{ x } 100\%$$

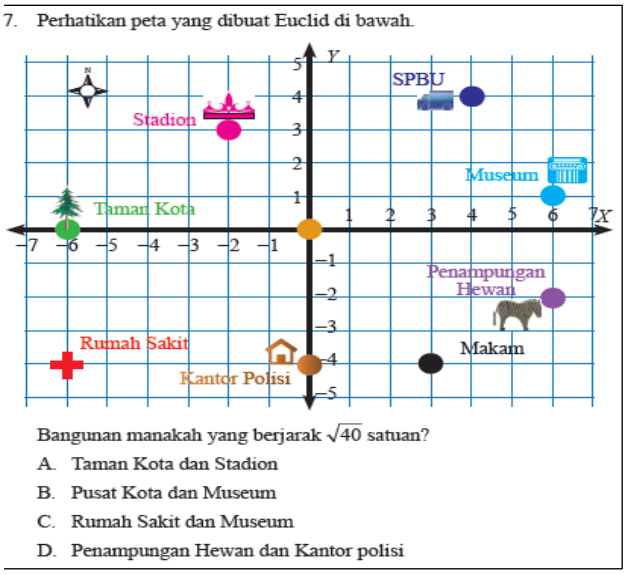
Information:
Pk : Percentage of each aspect of PISA
∑v : The number of questions that correspond to each aspect of the PISA question
∑item test : Number of questions from all aspects of PISA questions

▪ RESULT AND DISSCUSSION

The data analyzed in this study were competency test questions contained in the 2017 revised edition of the mathematics textbook for class VIII semester II of the 2013 curriculum. This Mathematics textbook is published by the Ministry of Education and

Culture with a total of 344 pages, consisting of 5 chapters. Chapter 6 Pythagorean Theorem from pages 1-52, Chapter 7 Circles from pages 53-120, Chapter 8 Construct Flat Sided Spaces from pages 121-222, Chapter 9 Statistics from pages 223-270, and Chapter 10 Probability from pages 271-310. Each chapter contains competency test questions with the same number of questions, namely 20 multiple-choice questions and 10 essay/description questions. In addition to the competency test questions at the end of each chapter, there are also semester II competency test questions which contain all of the material with a total of 25 multiple-choice questions and 5 essays. Table 4.1 presents data on the competency test questions contained in the Mathematics Textbook for class VIII semester II.

Analysis result showed that there were 31 questions or 17.22% of the PISA-based questions. The questions are spread on each competency test for each material and the second-semester competency test. The results of the analysis showed that the material covering the PISA model was mostly in the statistical material competency test, namely 7 questions, and the lowest in the circle material competency test, namely 3 questions. The results of the analysis of PISA questions refer to four aspects, namely aspects of content, context, process, and cognitive level. The following is an example of questions in the form of PISA and not the PISA model based on the results of the analysis of the Ministry of Education and Culture's books



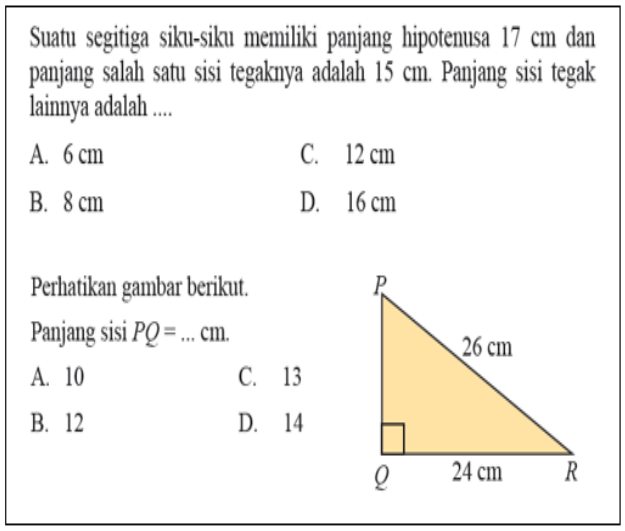
Translate:

7. Look at the map that Euclid made below

Which building is √40 units away?

A. City Park and Stadium
B. City Center and Museum
C. Hospitals and Museums
D. Animal Shelter and Police Station

Figure 1. Examples of PISA model questions



Translate:

A right triangle has a hypotenuse of 17 cm and one side of the vertical is 15 cm. The length of the other perpendicular is...

A. 6 cm C. 8 cm
B. 12 cm D. 16 cm

Pay attention to the following picture: The length of side PQ = ….cm

Figure 2. Problems example that are not PISA model

Content Analysis

The content aspect consists of 4 indicators namely Number, Space & Shape, Change & Relationship, and Impossibility & Data. This category is related to the understanding of numbers, ways of representing numbers, relationships between numbers, and number patterns. Number content includes natural numbers, fractions and decimals, integers, ratios or comparisons, and percentages. Based on the categorization results, there are no specific questions included in the number content aspect of the competency test questions contained in the Class VIII Mathematics book semester II.

Spatial and form content includes phenomena related to the visual world involving patterns, properties of objects, positions, and orientations, representations of objects, coding of visual information, navigation, and dynamic interactions related to real number shapes. Space & shape content requires participants to have competency in analyzing the properties and characteristics of two-dimensional and three-dimensional geometric shapes, geometric measurements such as determining circumference, area, and volume as well as skills in using spatial visualization in converting two-dimensional shapes into three dimensions, as well as in calculating the Pythagorean theorem. Based on the categorization results, there are 12 questions that are included in the spatial & form content in the form of the PISA model. Examples in this book are examples of questions related to circle material that uses gear problems on bicycles.

Impossibility & Data content deals with material odds and statistics. Impossibility and data content include knowledge in organizing data that has been collected and displaying data in the form of graphs or diagrams. This content also requires the ability of students to calculate and compare the characteristics of data sets including the mean, mode, median, and range (range). Based on the results of the categorization, 11 items were obtained which were included in the impossibility and data content. One example of a problem that uses data is the problem of the average weight of fish caught by fishermen in the sea.

The next content to be analyzed is the content of changes and relationships related to the subject matter of algebra learning where mathematical relationships are often expressed in equations or general relationships, including addition, subtraction,

multiplication, and division. This content relates to material on linear functions, coordinate systems, and depiction and description of data. Based on the results of the analysis, only one question was obtained using the PISA model. The PISA context used is a fountain in the middle of a city-center intersection

The context aspect is part of the PISA model aspect which consists of 4 indicators, namely personal context, work context, social context, and scientific context. In the personal context, it refers to activities in daily life, of course, students face various personal problems that require solving problems as soon as possible. Personal context is directly related to students' personal activities in their daily life. The results of the analysis show that there are 3 questions that measure personal context. The context used is the long sleep problem. The problem is closely related to personal context

Furthermore, the work context relates to the use of Mathematical knowledge in the lives of students in the workplace environment. Students' knowledge of mathematical concepts is expected to help formulate, clarify problems, and solve educational and work problems in general. Based on the results of the analysis there are 5 questions that use the context of work. The following is an example of the work context used in the book being analyzed

7. Suatu pabrik membuat biskuit yang berbentuk lingkaran padat dengan diameter 5 cm. Sebagai variasi, pabrik tersebut juga ingin membuat biskuit dengan ketebalan sama namun berbentuk juring lingkaran dengan sudut pusat 90°. Tentukan diameter biskuit tersebut agar bahan produksinya sama dengan biskuit yang berbentuk lingkaran.

Translate:
A factory makes biscuits in the form of solid circles with a diameter of 5 cm. as a variation, the factory also wants to make biscuits with the same thickness but in the shape of a circular wedge with a central angle of 90°. Determine the diameter of the biscuit so that the production material is the same as the circular biscuit

Figure 3. PISA model questions in the Job context

The social context relates to the use of mathematical knowledge in social life and the wider environment in everyday life. The results of the analysis show that questions that use social context are only found in 4 competency tests, namely the competency test 6 questions number 7 multiple choice, the competency test 9 questions number 1 description, the competency test 10 questions number 10 description, and the semester II competency test on question number 5 description. Here is one example of the use of social context.

Translate:
The bar chart below shows data on the number of children in each family in RT 5 RW 1 Sukajadi distric. The horizontal axis shows data on the number of children in each family, while the vertical axis shows the number of families having children between 0 and 5.

a. Determine the total number of families and the number of children in the neighborhood
b. How many families have more than 2 children?
c. What percentage of families do not have children?
d. How many children are there on average in each family?
e. What are the median and mode of the data?

Figure 4. PISA model question in the social context

Cognitive Level Analysis

The cognitive level of questions in PISA is divided into 6 levels. Level one (remembering) is the lowest level and level six (creating) is the highest level.

Cognitive Level Remembering

Problems that are included in the cognitive level of remembering can be easily identified through the available information. Clearly available information and available instructions are indicators of questions at this level. Based on the results of the analysis, there are no questions that can be categorized into the cognitive level of remembering.

Understanding Cognitive Level

Questions that are included in the cognitive level of understanding require students to be able to work on basic algorithms, use formulas, and carry out procedures or agreements in solving problems. At this level too, students are able to sort out relevant information from a single source and use a single presentation method. Based on the results of the analysis, 1 item is obtained which is included in the cognitive level of understanding.

Cognitive Level Apply

Questions that are included in the applying cognitive level require students to be able to carry out procedures clearly, solve problems, apply simple strategies, interpret, and be able to state reasons for the arguments presented. Based on the results of the analysis, 6 questions were obtained which were included in the applying cognitive level. In competency test 6 there are 2 multiple choice items, namely in numbers 5 and 7. And in competency test 8 there is only 1 item, namely in number 16 multiple choice, while in

competency test 9, there is 1 item in multiple choice and 1 item in the description question, finally the second-semester competency test also only 1 item in one multiple choice questions

Cognitive Level Analyze

Problems that are included in the cognitive level of analyzing require students to be able to work effectively with models in concrete situations involving restrictions on making assumptions, using a variety of limited skills, and expressing reasons with multiple views in a clear context. As well as being able to provide an explanation of the arguments or answers given. Based on the results of the analysis, 22 questions were obtained which were included in the cognitive level of analyzing. Of the 31 questions included in the PISA model questions, the questions for the category of cognitive level to analyze were mostly found in the competency test questions in the Mathematics textbooks for class VIII of SMP/MTs semester II. The following is an example of the level of analysis.

19. Tabel di bawah menunjukkan usia 20 anak di suatu kelas, 2 tahun yang lalu. Bila pada tahun ini tiga orang yang berusia 7 tahun dan seorang yang berusia 8 tahun pindah sekolah, maka usia rata-rata 16 orang yang masih tinggal pada saat ini adalah ... tahun.

A. 7 C. $8\frac{4}{3}$

B. $8\frac{1}{2}$ D. 9

Usia	Frekuensi
5	3
6	5
7	8
8	4

Translate:
The table below shows the ages of 20 children in a class, 2 years ago. If in this year three people who are 7 years old and someone who is 8 years old change schools, then the average age of the 16 people who are still living at this time is … years.

Figure 5. PISA model question at the cognitive level analysis

Cognitive Level Assessing

Questions that are included in the cognitive assessing level require students to be able to develop and work with models for complex situations, identify problems, and choose, compare, and evaluate appropriately the strategies used when solving a given problem. Then be able to reflect on the work and be able to formulate and communicate the interpretation of the answers given.

in the cognitive level assessing the percentage of 6.45%. Questions that are included in the cognitive level are found in multiple-choice question number 15 in competency test 9 and description question number 3 in the semester II competency test. examples of questions that contain assessing cognitive level.

15. Tabel berikut ini menunjukkan lama tidur di waktu malam (dalam jam) beberapa siswa kelas VIII.

Lama tidur (jam)	4	5	6	7	8
Frekuensi	1	2	3	2	2

Dari tabel di atas, diperoleh informasi sebagai berikut.
(1) Median = 6
(2) $Q_1 = 5$
(3) $Q_3 = 7{,}5$

Translate:
The following table shows the length of sleep at night (in hours) for some Grade VIII students From the table above, the following information is obtained.
Dari tabel di atas, diperoleh informasi sebagai berikut.
1) Median = 6
2) Q_1 = 5
3) Q_3 = 7,5

Figure 6. Sample question of the PISA level assessing model

Judging from the cognitive level of the PISA model in mathematics textbooks, it has only reached the cognitive level of assessing, while level 6 has not yet been found. Cognitive level 4 (analyzing) is the most dominant cognitive level in the competency test questions in the 2017 edition of grade VIII semester II K-13 mathematics textbooks with a percentage of 70.97%. Questions with a cognitive level of analysis require students to work on questions by analyzing them first before looking for a solution. This shows that students in Indonesia have started to have the ability to solve non-routine problems or questions that are required to think higher.

▪ CONCLUSION

Based on the description of the research results and discussion, the results showed that there were 17.22% of the PISA model questions. The questions are spread based on each content consisting of numbers, space and & shape, changes and relationships, and impossibility & data. In the context aspect, the questions only fulfill three contexts: personal, work, and social. In terms of the cognitive level, the questions are spread across the levels of remembering, understanding, applying, analyzing, and assessing. The advice that can be given based on the research results is that educators can add PISA questions from other sources as reinforcement exercises in classroom learning.

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