

Student Worksheets Using the PISA Context for Statistics Topic in Class VIII SMP

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Abstract: This study was inspired by the achievements of Indonesian students who were still low on the PISA test. The low of these results suggests that students must be trained to use mathematics in their daily lives. One way that can be done is to provide contextual problems to students in mathematics learning. In this study the contextual problems are poured into worksheets that can be used by students and become a reference for teachers to develop other contextual problems. The context used in the problem refers to the PISA contexts, namely, personal, occupational, societal and scientific. This development aims to produce worksheets that are valid and practical to be used on statistical topics of class VIII SMP. The development model used is 4-D consisting of define, design, development, and disseminate. The results showed that the statistical worksheet was valid in terms of content, constructs, and languages based on the validator's assessment with an average of 3.52 and was practically based on a large group trial of 88.57%.

Keywords: students' worksheet, the PISA context, statistics, class VIII SMP

Introduction

One of the characteristics of the 21st century is the swift flow of information in daily life, it needs skill to choose and sort data or information to be used as conclusions accurately (Kusumah, 2018). Nowadays, the information presented is not only in the form of text, but also in the form of numbers, pictures/charts, tables, and patterns, so that it requires literacy skills for the reader. This condition force everyone to have critical thinking skills, literacy skills, and master information and communication technology to deal with the 21st century issues (Frydenberg & And one, 2011). In other words, literacy is one of the important competencies or skills that must be owned by students in accordance with the demands of the 21st century.

Literacy is initially interpreted as "literacy" and then is interpreted as "understanding". But understanding literacy in the end does not only reach the problem of reading and writing. A person's ability in sixth basic literacy is used as an indicator of someone able to survive in the 21st century [3]. The sixth basic literacy are reading, mathematics, science, information technology and communication, finance, and culture and citizenship.

Mathematical literacy is one of the focuses of the assessment of The Program International Student Assistance (PISA). Puspendik Balitbang Kemendikbud (2012) explains that PISA is a study developed by several developed countries in the world which are members of the Organization for Economic Cooperation and Development (OECD) which serves as an administrative evaluation where the results will show the extent of education in a country compared to the state other participants. The following are Indonesia's achievements in the field of mathematics based on the results of the PISA study.

Table 1. Indonesia's Achievements in Mathematics on PISA Study

Year	Rank	Score	International Average
2000	39 of 41	367	500
2003	38 of 40	361	500
2006	50 of 57	391	498
2009	61 of 65	371	496
2012	64 of 65	375	494



Year	Rank	Score	International Average
2015	63 of 69	386	493

Source: OECD in Abidin, Mulyati, & Yunansah (2017)

From [Table 1](#) it can be seen that Indonesia is always in the bottom rank among all PISA participating countries. The low achievement of Indonesia was also seen from the achievement of scores that never reached the international average score. The results of the PISA study are in line with the research which shows that the literacy skills of junior high school students in Pekanbaru are still low (Siregar, Solfitri, & Roza, 2018). One of the factors of students' low mathematical literacy abilities is because students are less accustomed to working on problems with PISA characteristics (Wardhani, 2011).

The problems with PISA characteristics should not only be given during the exam. If students are not trained in learning, it is certainly difficult for students to answer questions with PISA characteristics. Therefore, we need a strategy in learning that can introduce and train students to be able to solve problems with PISA characteristics. One way that can be done is to develop student worksheets that use the PISA context. Student worksheets is a type of learning aid that can be used by students as a guide in conducting investigative or problem-solving activities (Hamdani, 2011; Trianto, 2012).

Context describes the situation of problems in everyday life. Problems in the PISA study involved four contexts: personal, occupational, social, and scientific. The problem of personal context is a problem related to the lives of learners in everyday life, problems in the context of occupational in relation to one's work, problems in the social context are issues related to life in society, and problems in scientific contexts related to mathematics, use technology tools, and others (Abidin, Mulyati, & Yunansah, 2017).

One of the material or content contained in the PISA study is uncertainty and data. This content requires students to be able to analyze data based on data distribution, average value, median, mode, and size of data distribution. Content uncertainty and data in the PISA study are in line with 2013 Curriculum which contains Basic Competencies 3.12 Analyze data based on data distribution, average values, median, mode, and data distribution to draw conclusions, make decisions, and make predictions; and 4.12 Presenting and resolving problems related to data distribution, average value, median, mode, and distribution of data to draw conclusions, make decisions, and make predictions (Permendikbud No. 24 Tahun 2016). These two basic competency pairs are intended for students of class VIII SMP which are contained in Statistics topic.

Research Method

The type of research conducted is Research and Development (R&D). This study uses a research development design with a 4-D model developed by Thiagarajan and Semmel (1974). The development model consists of four stages, are Define, Design, Develop, and Disseminate. The disseminate stage cannot be implemented because of the limitations of the researcher.

The activities carried out at the define stage are preliminary analysis, student analysis, concept analysis, task analysis and specification of learning objectives. At the design stage, the researcher designed the student worksheets and the selection of contexts that were in accordance with the Statistics topic in class VIII SMP. At the develop stage, several activities are carried out, are developing the student worksheets prototype, validating the product to fulfill the validity aspects, and conducting small group and large group trials to fulfill practical aspects.

The data obtained in this study are qualitative and quantitative data. Qualitative data comes from criticism, suggestions, and comments from the validator on the student worksheets while the quantitative data is obtained from the validation sheet and responses questionnaire of the students. To collect both types of data, researcher was used data collection instruments, namely validation sheets and questionnaires for students' responses. The validation sheet of a form containing statements using a Likert Scale with four scales, namely 1, 2, 3, and 4 which states are very inappropriate, inappropriate, appropriate and very appropriate. The questionnaires for students' responses of a structured form

containing several statements (positive and negative). Questionnaire responses of students using the Guttman Scale which consists of two alternative answers, namely Yes and No.

Discussion

The development of the student worksheets using the PISA context is carried out using the 4D development model, which includes the Define, Design, Development and Disseminate stages. But in this study, the stages carried out only to develop only because of the limitations of the researcher.

1.1. Define stage

At the define stage, the development activities carried out are to determine the initial problems encountered so that a solution is needed for these problems. Define stage consists of five stages, namely the initial analysis, analysis of students, material analysis, task analysis, and specifications of learning objectives.

1.1.1. Initial analysis. The results of the PISA study illustrate the extent to which mathematics education for students in a country is run. The results of the PISA study show that Indonesian students' literacy skills are still low. One of the causes of students' low mathematical literacy abilities is because students are not used to working on problems with PISA characteristics (Wardhani, 2011). This is due to the lack of available learning resources that can support the development of students' mathematical literacy abilities. One source of learning for students is the student worksheets. Therefore, as an effort to improve students' literacy skills, mathematics learning innovations can be carried out by developing student worksheets that use the PISA context.

1.1.2. Student analysis. Analysis of students is a study of the characteristics of students of class VIII SMP which includes the background of students' cognitive knowledge and development. The background of the knowledge possessed by students relating to Statistics is the material for presenting data in tables, bar charts, line diagrams, and pie charts that have been studied in class VII. The cognitive development of junior high school students is at the end of the concrete operational stage entering the formal operational phase. At this stage, students go beyond concrete experience and are able to think abstractly and logically. However, because all students have different abilities, the consideration in developing student worksheets that can be used by students with high, medium, and low ability.

1.1.3. Material analysis. Referring to Curriculum 2013, the mind map for Statistics topic in class VIII SMP is presented in Figure 1 below.

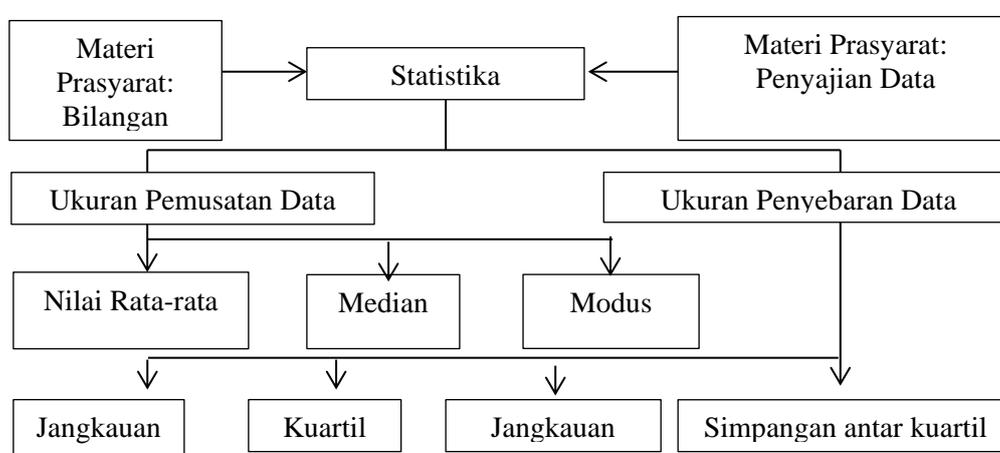


Figure 1. The mind map for Statistics topic in class VIII SMP

By considering the breadth of Statistics topic, the learning material is arranged into four parts, namely (1) analysing data based on data distribution, (2) single data average, (3) single median and data mode, and (4) single data deployment size. Thus, this study developed four student worksheets according to the four learning materials.

1.1.4. Task analysis. Student worksheets used the context of PISA as a learning resource used by students during Statistics learning. The tasks given can be individually and in groups according to the learning material. Individual tasks include practice questions aimed at knowing individual knowledge of students after learning. While group assignments aim to see students in solving more difficult problems through group discussions. The group assignments compiled at student worksheets include PISA questions on uncertainty and data content.

1.1.5. Specifications of learning objectives. In this step what is done is to describe the learning objectives that are in accordance with the results of the analysis of tasks and material. The purpose of learning Statistics topic is so that students can (1) interpret data presented in the form of tables or diagrams; (2) determine the average value, median, mode and size of data distribution; and (3) solve problems related to daily life using the data provided.

1.2. Design stage

The purpose of the design stage is to design 2013 curriculum-based student worksheets on Statistics topics using the PISA context. The developed student worksheets contain steps to find concepts and solve statistical problems so that students can be active in learning activities and fulfill deductive, constructive, and technical requirements. The preparation of the student worksheets design includes cover design and activities that will be carried out by students. The design cover of the student worksheets consists of the title of the learning material, the identity of the students, supporting pictures, learning objectives, and instructions for the work of the student worksheets. The learning objectives of each student worksheets are designed based on learning material.

Student worksheets begin with Statistics problems that use the PISA context. With the problem, students are directed to read and understand problems, write down information that is known, and formulate problems to find solutions. The next activity in student worksheets is to solve problems. Students are directed to discuss and gather information that can help them find the concepts learned so they can find solutions to the problems given.

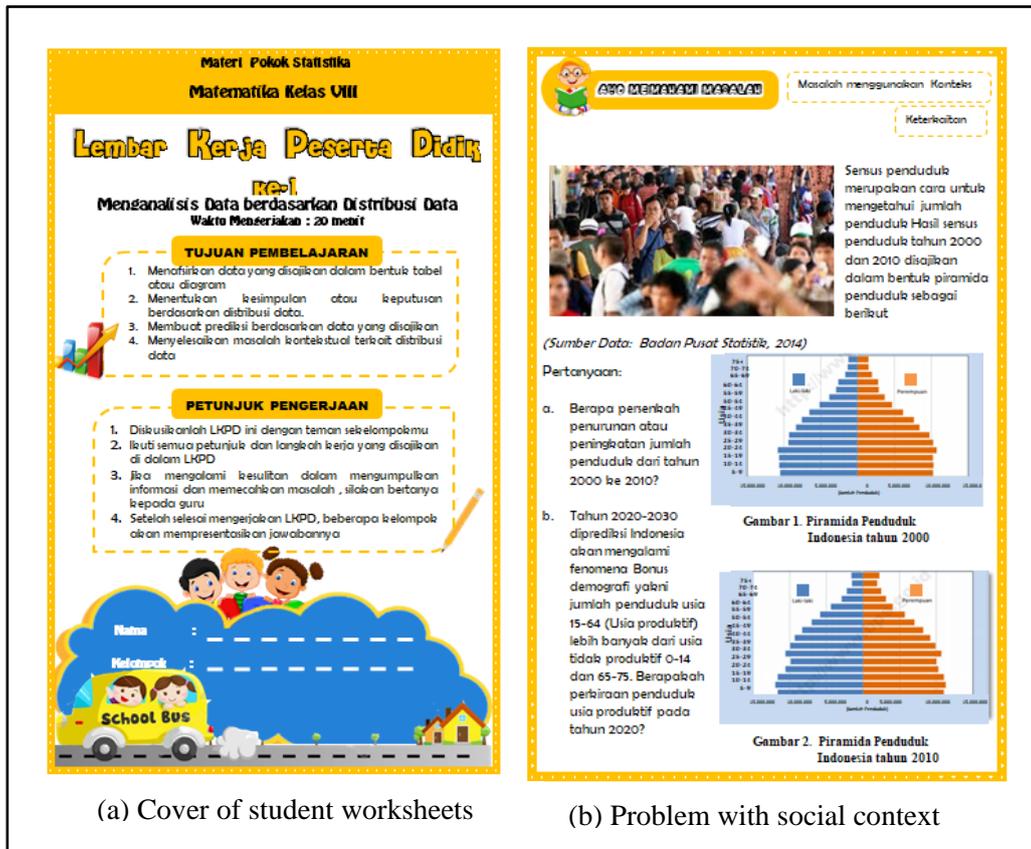
The PISA contexts are used in all four student worksheets, namely:

- 1) Social context (population census, fuel price, traffic accident, and number of baby births) used in 1st Student Worksheet.
- 2) The occupational context (bread entrepreneurs, grades of students, and clothes traders) is used in 2nd Student Worksheet.
- 3) Personal context (poetry competition, weight, height) used in 3rd Student Worksheet.
- 4) Personal context (drying clothes), occupational (flower traders), and social (Paskibraka), used in 4th Student Worksheet.

1.3. Development stage

The development phase includes three activities, namely product development, product validation and revision, and small group and large group trials.

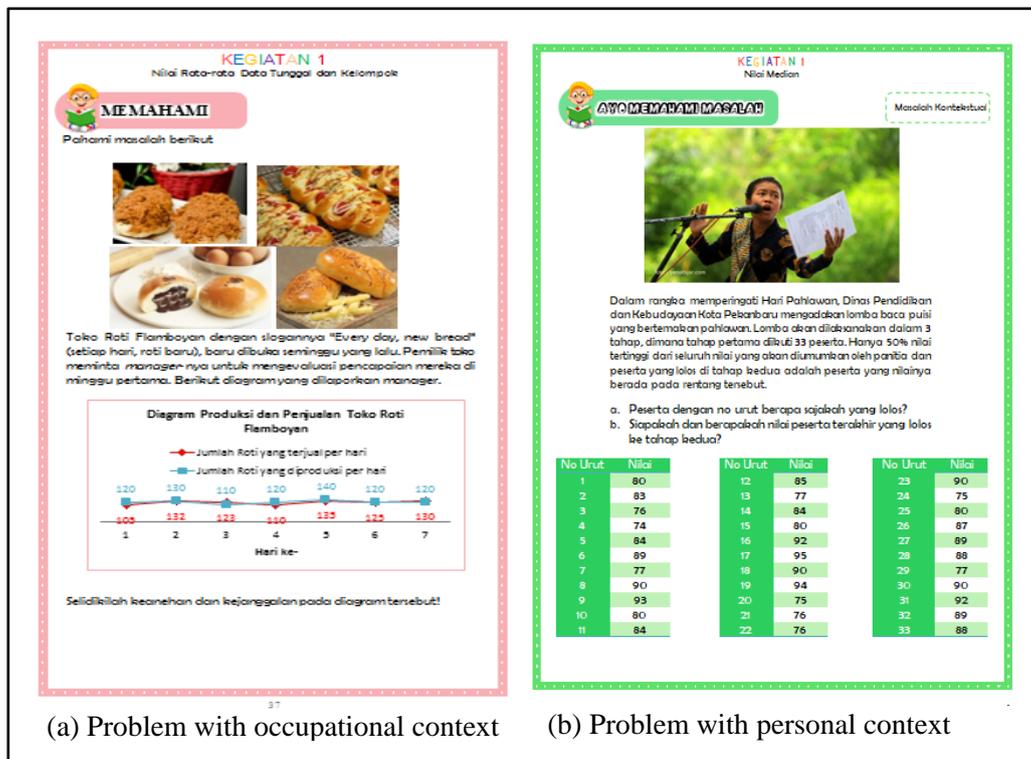
1.3.1. Product development. The activity that the researcher did at this stage was to make the student worksheets in accordance with the initial design. The resulting student worksheets is in the form of print out. The cover section and problems in the student worksheets are presented in [Figure 2](#) and [Figure 3](#).



(a) Cover of student worksheets

(b) Problem with social context

Figure 2. Cover of student worksheets and problem with PISA context



(a) Problem with occupational context

(b) Problem with personal context

Figure 3. The problem at student worksheets with PISA contexts

1.3.2. Validation and revision of product. Validation in this study was conducted by three validators consisting of two lecturers of Mathematics Education at the Riau University who were qualified doctors and a mathematics teacher at SMPIT Pekanbaru who already had educator certificates as mathematics teachers. The evaluation of the three validators is presented in [Table 2](#).

Table 2. Results of Student Worksheets Validation Using the PISA Context

Aspects assessed on Student Worksheets	Student Worksheets				Average	Validation Category
	1	2	3	4		
Cover of student worksheets	4.00	4.00	4.00	4.00	4,00	Very Valid
The suitability of the material with the basic competences that must be mastered by students	3.44	3.44	3.67	3.78	3.58	Very Valid
The suitability the problem with PISA context	3.56	3.67	3.89	3.67	3.69	Very Valid
The suitability student worksheets with didactical conditions	3.56	3.44	3.22	3.44	3.42	Very Valid
The suitability student worksheets with construction conditions	3.50	3.42	3.25	3.25	3.35	Very Valid
The suitability student worksheets with technical conditions	3.58	3.67	3.17	3.75	3.54	Very Valid
Average	3.62	3.60	3.51	3.64	3.59	Very Valid

From [Table 2](#), it can be seen that the perfect value (4.00) is given validator for cover of student worksheets. It means that the cover of student worksheets is complete, containing the identity of the students, the title of the material to be studied, the learning objectives, and the instructions for using student worksheets. The developed student worksheets are also very valid (3.58) in terms of the conformity aspects of learning material with basic competencies that must be mastered by students. In the suitability the problem with the PISA context, the average value given by the validator is 3.69 which is a very valid criterion. It means that the problems in the student worksheets are in accordance with the PISA context (personal, occupational, and social). The student worksheets also fulfilled didactical requirements, construction requirements, and technical requirements as indicated by the average value given by the validator is 3.42; 3.35, and 3.54 (very valid). Very valid criteria on aspects of didactical requirements indicate that the problems presented in the student worksheets can encourage students to learn independently and be confident in conveying their ideas. Very valid criteria in the aspects of construction requirements and technical requirements indicate that the use of the student worksheets and the learning objectives presented are clear, the sentence structure does not cause double meaning, and the images used in the student worksheets are in accordance with the learning material.

Three validators stated that the student worksheets could be tested by making several revisions, namely:

- 1) The context of the problem is in accordance with PISA, but still the closest to the student in general. In 3rd Student Worksheets, the problem uses a personal context, namely poetry competition that is followed by students. The validator recommends using a social context that shows tourist attractions in Riau Province. This adds insight to students and is related to social science. Revisions made by researchers can be seen in [Figure 4](#).

Kepala SMP Negeri 8 Pekanbaru merencanakan akan mengadakan perjalanan wisata bersama beberapa guru dan 30 siswa. Jika daerah yang akan dipilih adalah daerah dengan harga paling menengah, kemanakah rombongan tersebut akan berwisata?

Daerah Tujuan	Harga Tiket Pulang Pergi	Potongan Harga *
Bagan Siapi api	Rp 200.000	2% harga untuk rombongan 25 siswa atau lebih
Siak Sri Indrapura	Rp 180.000	10% dari harga tiket pulang pergi jika rombongan lebih dari atau sama dengan 20
Pasir Pangaraian	Rp 80.000	5% dari harga tiket pulang pergi jika rombongan lebih dari atau sama dengan 30
Ulu Kasok, Kampar	Rp 50.000	3% jika rombongan lebih dari 25 orang
Teluk Jering Siak	Rp 200.000	5% harga tiket jika rombongan lebih dari 30 orang

Keterangan: *Harga diskon tidak berlaku untuk setiap orang

Figure 4. Revision the problem at 3rd Student Worksheet

2) There are many words unknown to the learners in 4th Student Worksheet.



AYO MEMAHAMI MASALAH

Masalah Kontekstual

Kesenjangan ekonomi mengacu pada perbedaan pendapatan antara pendapatan masyarakat terendah dan tertinggi di suatu daerah serta bagaimana penyebaran data pendapatan seluruh masyarakat di daerah tersebut. Untuk mengetahui besar atau tidaknya kesenjangan ekonomi di suatu daerah, peneliti mengambil sampel 13 keluarga seperti tabel berikut.

Pendapatan Masyarakat (dalam juta)												
0,8	0,9	0,95	0,96	1,2	2,5	3,8	5	6	6,5	6,7	9	11,2

Ketiga belas keluarga akan dikategorikan kedalam 4 kelompok sama besar yakni rendah, menengah ke bawah, menengah keatas dan tinggi. Namun permasalahannya, ia harus menentukan batas nilai untuk masing-masing kategori dan menjelaskan hasil penelitiannya. Bantulah ia menentukannya

Figure 5. The problems at 4th Student Worksheet before revision

Based on suggestions from the validator, the researcher revised the section and the results are presented in Figure 6.

Dinas Pemuda dan Olahraga Kota Pekanbaru setiap tahun mengadakan seleksi calon Pasukan Pengibar Bendera Pusaka (Paskibraka) untuk tingkat kota. Pada tahun ini, ada beberapa siswa SMP yang berhasil lulus seleksi tersebut. Semua siswa yang terpilih akan dibagi kedalam 4 kelompok berdasarkan data tinggi badan. Berikut tabel siswa yang lulus seleksi.

Nama	Tinggi Badan (cm)	Nama	Tinggi Badan (cm)	Nama	Tinggi Badan (cm)
Abdul	175	Hanifa	168	Nisa	168
Andi	165	Helen	172	Septi	165
Andini	168	Jamal	175	Sri Dewi	161
Aurora	170	Jumiaten	165	Syukur	174
Cecep	174	Karimah	166	Slamet	169
Cheri	168	Kelvin	172	Sonya	162
Daniel	165	Kirana	165	Tina	168
Erman	167	Lili	167	Udin	175
Gunawan	174	Lintang	168	Wawan	175
Gani	167	Mohammad	163	Yusuf	170
Harianto	174	Michael	175	Zulkifli	176

Tentukanlah batas-batas tinggi badan sehingga panitia dapat membentuk 4 kelompok siswa

Figure 6. The problems at 4th Student Worksheet after revision

1.3.3. *Group Trial.* The trial was conducted to see the practicality of using student worksheets by students. The trial was conducted in small and large groups. The small group trial was conducted on five students of class VII of SMPN 8 Pekanbaru randomly selected with heterogeneous academic abilities. The selected students are students who have not studied Statistics topic but already have the prerequisite knowledge, namely Data Presentation topic. When students learned by using student worksheets, the researcher acts as a companion and mentor who provides direction if students experience difficulties in completing student worksheets. The researcher also observed the activities and responses of students while using student worksheets. Based on the observations of researchers, students seemed enthusiastic in carrying out the activities contained in the student worksheets and asked researchers if they were confused. After the students have finished learn by using student worksheets, the researcher asks the students to fill out the questionnaire according to their opinions. The results of the questionnaire responses of students in small group trials showed that student worksheets were very practical for students to use, which can be seen in Table 3.

Table 3. Percentage of Questionnaires for the Response of Students in the Small Group Trial

Percentage of Questionnaire for Students' Response to Students Worksheets				Average	Category
1	2	3	4		
87.14%	94.29%	92.86%	85.71%	90.00%	Very Practice

Next, the researchers conducted a large group trial of 20 people of class VII-3 SMPN 8 Pekanbaru who did not take a small group trial. In a large group trial, the researcher became a companion and mentor who gave direction if students experienced difficulties in completing student worksheets. Learning activities are carried out with group discussions. The researcher grouped students into four groups and each group consisted of five students. Students look more enthusiastic because learning activities are carried out in groups. On the first day of the trial, students had difficulty working on the problem because students usually were used to working on routine questions. After the end of the

learning, the researcher provides a questionnaire for students' responses to assess student worksheets that has been studied. The percentage of participants' questionnaire responses to student worksheets in the large group trials can be seen at [Table 4](#).

Table 4. Percentage of Questionnaires for the Response of Students in the Large Group Trial

Percentage of Questionnaire for Students' Response to Students Worksheets				Average	Category
1	2	3	4		
88.21%	93.93%	87.50%	84.64%	88.57%	Very Practice

Based on students' responses to questionnaires in large group trials, student worksheets using the PISA context for Statistics topic in class VIII SMP are categorized as very practical. As many as 88% of students stated that the problems found in student worksheets are often found in everyday life, so they have a curiosity about how to solve the problem. Students also stated that they could carry out activities at student worksheets because the activity instructions were clear, and the sentences contained in student worksheets were easy to understand so they could solve the problem. If reviewed from the aspect of the display, as many as 95% of students stated that the composition colour of student worksheets that interesting and the images presented could help them understand Statistical topic.

Conclusion

This development research produced four student worksheets that used the PISA context, namely personal, occupational, and social. Student worksheets have gone through the stages of validation and two trials which show that student worksheets are very valid and gets a very practical response from students. Thus, it can be concluded that student worksheets that uses the PISA context in the developed Statistics material is valid and meets the practical requirements to be used by the eighth-grade students of SMP.

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