

Development of PISA-Like Math Tasks for Uncertainty and Data Using the Context of COVID-19

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Abstract

This study aims to produce valid and practical questions and discover the potential effect of PISA-Like Math Tasks on uncertainty and data content using the COVID-19 context on mathematical literacy skills. The subjects of this study were students in Grade 9 of Junior High School number 19 Palembang. The research was conducted using the research design of developmental research. The stages in question development research are the preliminary and formative evaluation stages. The preliminary stage includes analysis of student needs, curriculum analysis, and analysis of PISA evaluation instruments. The formative evaluation stage includes self-evaluation, expert reviews, and one-to-one, small group, and field tests. This study resulted in a set of PISA-Like Math Tasks on uncertainty and data content using the COVID-19 context which consisted of 7 units with 12 valid and practical questions and potential effects on mathematical literacy skills, which included communication skills, reasoning skills, mathematical abilities, representation ability, and strategy selection ability. The resulting PISA-Like Math Tasks can help students think mathematically by using ideas from different subjects to solve a given problem.

Keywords: Development Research, PISA-Like Math Tasks, Mathematical Literacy, COVID-19

Abstrak

Penelitian ini bertujuan untuk menghasilkan soal yang valid dan praktis serta mengetahui efek potensial soal terhadap kemampuan literasi matematika tipe PISA konten *uncertainty and data* menggunakan konteks COVID-19. Subjek penelitian ini adalah peserta didik kelas IX SMP Negeri 19 Palembang. Penelitian yang dilakukan menggunakan metode *Design research* tipe *development study*. Tahapan dalam penelitian pengembangan soal melalui tahap *preliminary* dan *formative evaluation*. Tahap *preliminary* meliputi analisis kebutuhan peserta didik, analisis kurikulum, dan analisis instrumen evaluasi PISA. Pada tahap *formative evaluation* meliputi *self-evaluation*, *expert reviews*, *one-to-one*, *small group* dan *field tests*. Penelitian ini menghasilkan seperangkat soal matematika tipe PISA pada konten *uncertainty and data* menggunakan konteks COVID-19 yang terdiri dari 7 unit dengan 12 butir soal yang valid dan praktis serta terdapat efek potensial terhadap kemampuan literasi matematika yang meliputi kemampuan komunikasi, kemampuan penalaran, kemampuan matematisasi, kemampuan representasi dan kemampuan pemilihan strategi. Soal tipe PISA yang dihasilkan dapat membantu siswa dalam berpikir secara matematis dengan menggunakan ide-ide dari mata pelajaran yang berbeda untuk memecahkan masalah yang diberikan

Kata kunci: Penelitian Pengembangan, Soal Matematika Tipe PISA, Literasi Matematika, COVID-19

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INTRODUCTION

Programme for International Student Assessment (PISA) is an international study to evaluate the education system conducted every 3 years on 15 year old students who are randomly selected to take tests in the core subjects namely reading, mathematics and science (Murdaningsih & Murtiyasa,

2016; OECD, 2019). Mathematical literacy is very important for students to have in order to master mathematics well so that students can make the right decisions and can deal with problems or jobs that are found in everyday life (Rifai & Wutsqa, 2017; Astuti, Kartono, & Wardono, 2018; Amelia, Syamsuri, & Novaliyosi, 2020). Therefore, it is important that students should have literacy skills.

One of the most important contents of PISA mathematics literacy items is uncertainty and data. This is due to the fact that uncertainty and data are at the center of mathematical analysis of a wide range of problems with probability theory and statistics as methods of representing and explaining data (OECD, 2019). However, research conducted by Mutia & Effendi (2019) indicated that the mathematical literacy of junior high school students, based on their performance in working on PISA-based mathematical problems in uncertainty and data, is still not good. Many students are still unable to complete processes that involve mathematical literacy.

The low accomplishment of Indonesian students in PISA mathematical literacy can be attributed to a variety of issues, including Indonesian students' difficulty solving mathematical problems because PISA uses context and turns them into mathematical problems, as well as being less acclimated to tackling PISA problems and simply being used to tackle routine tasks (Wijaya, Heuvel-Panhuizen, Dorman, & Robitzsc, 2014; Nizar, Putri, & Zulkardi, 2018; Zulkardi, & Kohar, 2019). In order to strengthen their mathematical literacy skills, students must be conversant with PISA-Like questions in order to solve contextual situations in real life mathematically such as communication (Dasaprawira, Zulkardi, & Susanti, 2019), reasoning and representation (Efriani, Putri, & Hapizah, 2019), strategy selection (Bahar, Syamsuadi, Gaffar & Syahri, 2020), and mathematical ability (Noviana & Murtiyasa, 2020). In order to improve students' literacy skills, it is recommended to develop PISA math problems with the context of problems in the surrounding environment and familiarize students with PISA-Like Math Tasks (Pratiwi, Effendi & Ummah, 2020; Veronica, Zainil, & Helsa, 2020).

Putri & Zulkardi (2020) stated that it is important to integrate the context in the surrounding environment that is used in assessment activities. Previous research has used the 2018 Asian Games as a context to generate PISA-like Math Tasks based on jumping task with uncertainty and data in the context of football (Yansen, Putri, Zulkardi, & Fatimah, 2019), long jump (Pratiwi, Putri, & Zulkardi, 2019), bowling on the jumping task (Putri & Zulkardi, 2020). The context used by these researchers is the context of major events that were happening at that time in Indonesia. The big issue that is happening both in the world and in Indonesia is the COVID-19 pandemic (WHO, 2020). The researchers decided to take the issue of the COVID-19 pandemic as the context that will be used in developing the problem. Saputri, Turidho, Zulkardi, Darmawijoyo, & Somakim (2020) in his research using COVID-19 as a context for PISA-Like Math Tasks containing valid and practical questions without looking at the potential effects of the questions. In addition, several other studies have used the same context, including the context of physical social distancing, change and relationship content (Nusantara, Zulkardi, & Putri, 2020a), the context of COVID-19 for questions developed focusing on level 5 only (Nusantara, Zulkardi, & Putri, 2020b), and the context of COVID-19 in relation to quantity and change

and relationship content (Nusantara, Zulkardi, & Putri, 2021).

According to the preceding description, this cannot be separated from the mathematical literacy score of Indonesian students, which remains poor according to PISA 2019 especially in uncertainty and data content. Furthermore, previous research using COVID-19 as a context has not yet reached the stage of seeing the potential effects of questions, especially for mathematical literacy skills at uncertainty and data content. The purpose of this study is to generate valid and practical questions and to discover the potential effect of PISA-Like questions on uncertainty and data using the COVID-19 context on mathematics literacy skills.

METHODS

The research design of developmental research was used to perform the research. The stages of question development are preliminary and formative evaluation. The preliminary step comprises an examination of student needs, a review of the curriculum, and an examination of the PISA assessment tool. Self-assessment, expert evaluations, and one-on-one, small group, and field tests are all part of the formative evaluation stage (Bakker, 2018; Zulkardi, 2002).

During the preliminary stage, the researchers did a student analysis, an examination of the curriculum for junior high school students in the COVID-19 era given by the Ministry of Education and Culture, and an examination of PISA questions on uncertainty and data content. The researchers then created PISA-like math tasks using the COVID-19 context. The items created at this step is referred to as Prototype 1. At this step, the researcher designed a set of questions which includes the design of grids, question cards, scoring rubrics, and math problems using the PISA model of uncertainty and data content based on indicators of mathematical literacy ability. The problem design process is carried out by prototyping using three characteristics, namely content, construct, and language.

The set of questions that have been made was evaluated by the researchers themselves. The result of this self-evaluation was called Prototype 1. The next step for Prototype 1 was prototyping, which began with an expert review and one-on-one sessions held simultaneously. This was accomplished by monitoring and evaluating each item based on its content, structure, and language. The content assessed is in accordance with the curriculum used and the material studied by junior high school students. The construct that was observed conforms to the characteristics of the PISA questions. The language validation in question is the suitability of the use of language in the questions with the applicable language rules. Along with validation by two experts, a one-to-one stage was carried out. This stage involved two teachers and six students who were asked to collaborate in reading and observing the questions and then giving responses about the readability and clarity of the meaning of the questions. The findings from the expert review and one-on-one sessions were used to revise the Prototype 1. The redesigned Prototype 1 resulted in Prototype 2. Prototype 2 was put to the test on students in small groups.

In the small group stage, Prototype 2 was tested on two groups of four students from State Junior High School 19 Palembang with heterogeneous abilities, including high-, medium-, and low-level abilities. In this situation, the teacher supported the researcher in determining which students were assigned to one group. The teacher used report cards to see each student's ability selected so that one group of students consisted of students with heterogeneous abilities. This small group stage was carried out for 3 meetings, namely two lessons using blended learning, the LSLC system, and the PMRI approach consisting of asynchronous and synchronous learning and one final test in which the researcher became the teacher. Synchronous learning was carried out through virtual face-to-face meetings via Zoom. Students incorporated various abilities to solve Prototype 2 questions. Then, the students were also asked to give their opinions and comments about the questions that they have worked on. This stage focused on the practicality of the questions that have been developed.

At the field test stage, prototype 3 was tested on a class of students at Junior High School 19 Palembang. The field test results were in the form of student answer sheets, which were then descriptively evaluated to determine the potential effects of the PISA model questions using the created COVID-19 context and through a validation process. Validation sheets and tests were employed in this study as instruments. During the validation process, experts employed validation sheets, while test instruments were used to acquire information about the feasibility of the questions created and to identify their potential effects.

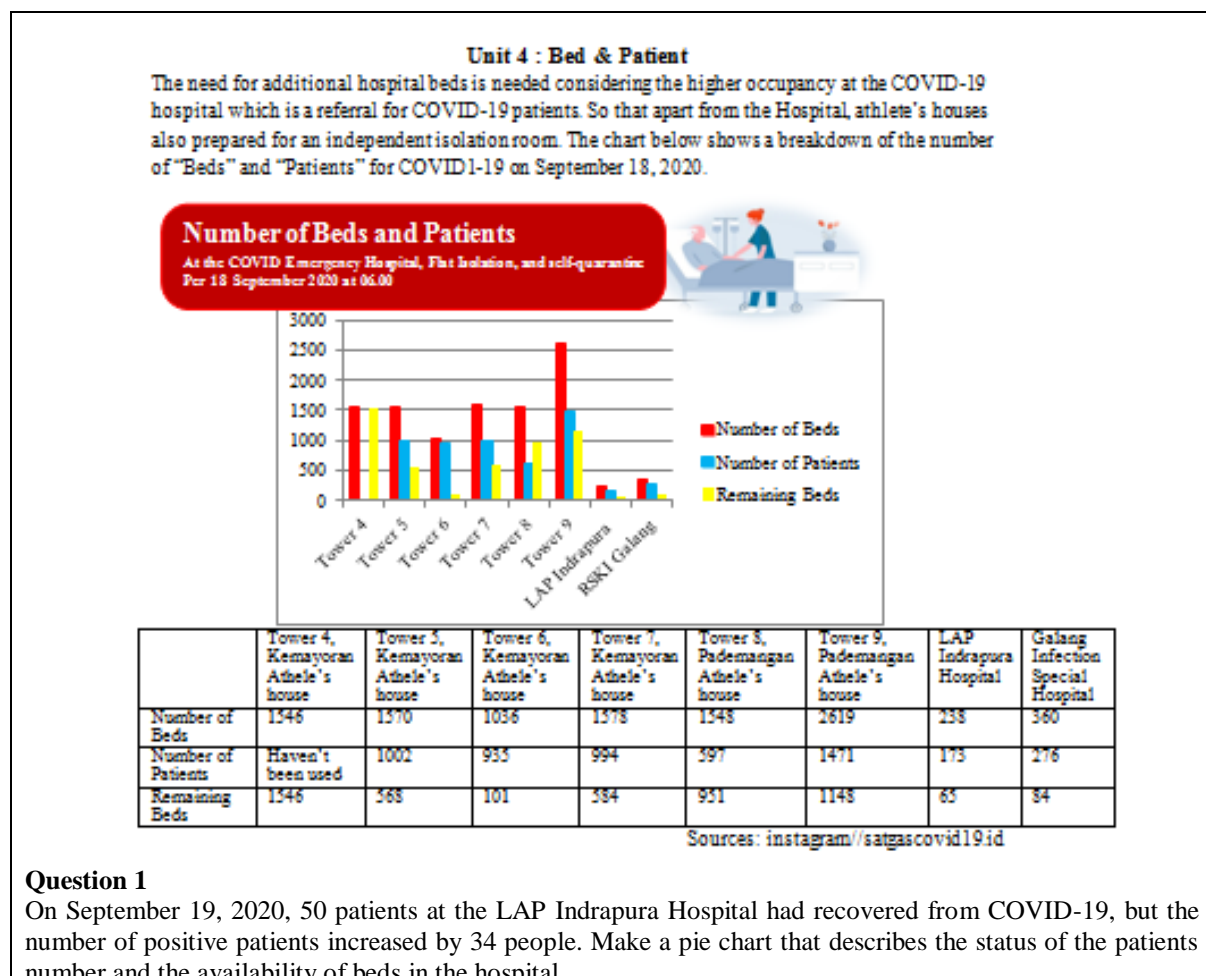
Observation, tests, and document review were used to obtain data. The PISA-Like Math tasks are valid, as determined by referring to expert comments and suggestions and one-on-one validation. Qualitative validation results were based on predetermined criteria, including content, construct, and language. The practicality of the questions was determined by observation and document analysis in small groups. Furthermore, student test results and field test observations revealed that the generated questions had the potential to affect mathematical literacy. The acquired data was then descriptively evaluated.

RESULTS AND DISCUSSION

Twelve items have been developed as a result of research into the development of PISA-Like Math Tasks using the COVID-19 context. These items use the context of COVID-19 such as the spread of cases, the availability of isolation places for COVID-19 patients, COVID-19 cases by age group, nutritional needs, the increase and decrease in the highest COVID-19 cases, daily needs, and COVID-19 death cases based on comorbidities. The focus of this discussion is the bed and patient unit (2 items) and the comorbidity unit (3 items). The two units consisting of 5 items covered mathematics literacy abilities of students that emerged from the whole unit, therefore the researcher decided to focus on discussing these 5 questions.

The researcher did a literature study, the result is the COVID-19 emergency curriculum employed in the school where the research was conducted, and examined the PISA framework in the preliminary stage. The next stage is to design the COVID-19 context to create PISA-like mathematics tasks on uncertainty and data content and other necessary research instruments. The material used in the developed questions was statistics contained in the curriculum for junior high school. The level in the question consists of levels 2, 3, 4, 5, and 6. In addition, researchers analyzed at the students who would be the subject of the study. The students involved in this study were students with heterogeneous abilities who were selected based on the teacher's recommendation by considering the existing student score documentation. Six students were selected to be involved in one-to-one stage and eight students were divided into two groups for small groups stage, then the class was determined for field test.

The results of the development of PISA-Like Math Tasks on uncertainty and data content using the COVID-19 context that have been designed, examined, and re-evaluated by researchers in terms of content, constructs, and language were examined and re-evaluated by researchers in the self-evaluation stage. The original PISA question used to develop unit 4 were question in 2012 with the unit faulty players and for unit 6 were question in 2006 with the unit exports. The results of the revised version of Prototype 1 on the bed and patient unit and comorbidities unit is presented in the following [Figure 1](#).



Questions 2

Below are three statements regarding the number of beds and patients at Kemayoran athlete's house. Are all statements correct?

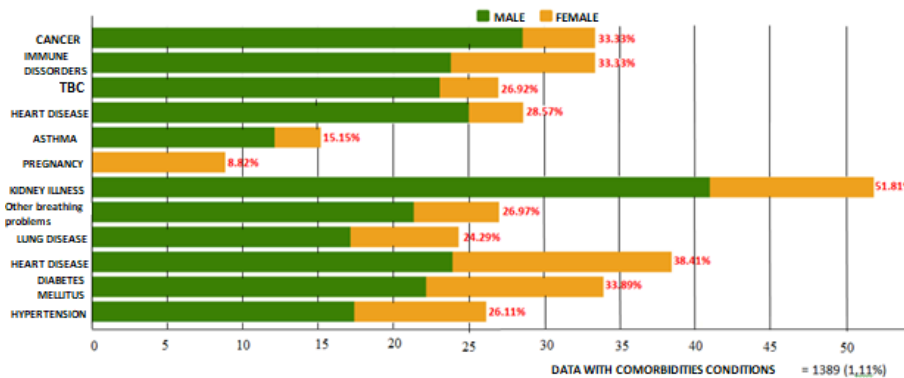
Circle "Yes" or "No", for each statement.

Statement	Is the statements correct?
Tower 7 is the place to stay for the fewest patients	Yes/No
The average number of patients per tower is 833 patients	Yes/No
Tower 5 and tower 7 have the same remaining bed supplies	Yes/No

(a)

UNIT 6: Comorbidities

COVID-19 disease is risky for people who previously had a disease in medical terms called comorbid. Patients who have these comorbidities require more attention because their conditions are more vulnerable so that when they contract COVID-19 it can have a fatal impact. The Ministry of Health's list contains the 12 co-morbidities of COVID-19 with the most positive COVID-19 patients. People who already have this disease must strictly implement health protocols to avoid the transmission of COVID-19. The diagram below shows the percentage of deaths of Covid-19 patients due to comorbidities by gender.



Source : <https://covid19.do.id/peta-sebaran>

Question 1

How many data on patients exposed to COVID-19 who died with comorbidity?

Question 2

Based on the data above, kidney disease has the highest risk of death, especially in male patients. Does this also apply to female patients? Give your reasons.

Question 3

Is the number of female COVID-19 patients who died with comorbidities of other respiratory disorders the same as those with cancer?

(b)

Figure 1. Prototype 1 of the development of PISA-like mathematical problems

Figure 1(a) shows Prototype 1 of the Development of PISA-Like Mathematical problems, uses the context of bed and patient. In question 1, students have to create a diagram that solves the problems described in the question. In question 2, students need to clarify the truth regarding the assertion posed

in the question. [Figure 1\(b\)](#) shows Prototype 1 of the development of PISA-type question, uses the context of comorbidities. Question 1 asked students to calculate the amount of data on patients who died because of comorbid tuberculosis (TB). Meanwhile, question 2 asked students to determine the risk of death in female patients due to kidney disease. Furthermore, question 3 asked students to compare the number of female patients who died from COVID-19 with other comorbid respiratory disorders and comorbid cancer.

In the expert review stage, two experts examined, assessed, and evaluated Prototype 1, which was designed by the researcher in terms of content, construct, and language. In addition, during the one-to-one stage, the researchers tested Prototype 1 on six students from Junior High School 19 Palembang who had heterogeneous abilities, including high-, medium-, and low-level abilities. The summarizes of suggestions and comments as well as the researcher's revised version for the development of PISA-type problem in bed and patient and comorbidity units are presented in the following [Table 1](#).

Table 1. Comments of experts and students on bed & patient units and comorbidities

Validators	Comments / Suggestions	Revised Version
<i>Experts</i>	<ul style="list-style-type: none"> • It is better if question 2 in unit 4 of bed and patient does not only have yes / no but is accompanied by reasons for choosing the option • Unit 4 image is better made at higher resolution. • It is better if question 3 is accompanied by the students' reasons for their answers for unit 6. • Image on unit 6 needs to be improved • The term COVID-19 virus should be used consistently. 	<ul style="list-style-type: none"> • Adding the sentence, "give reasons that support your answer" on question number 2 of Unit 4 and question number 3 of Unit 6 • Increase the resolution of the images on Unit 2 And Unit 4 • Consistently using the term COVID-19
<i>One-to-one (Students)</i>	<ul style="list-style-type: none"> • Students only choosed yes / no without reasons when students answered question 2 unit 4 • Students did not give the reason when answered the question 3 for unit 6 • Image on unit 6 needs to be improved because the numbers in the picture are unclear 	

[Table 1](#) presents expert comments in terms of content, construct, and language and students' comments in understanding and solving the questions given by the researcher. Then, the question was revised by the researcher and Prototype 2 was declared valid qualitatively (Zulkardi, 2002). Prototype 2 was put to the test in a small group to evaluate how practical the questions were.

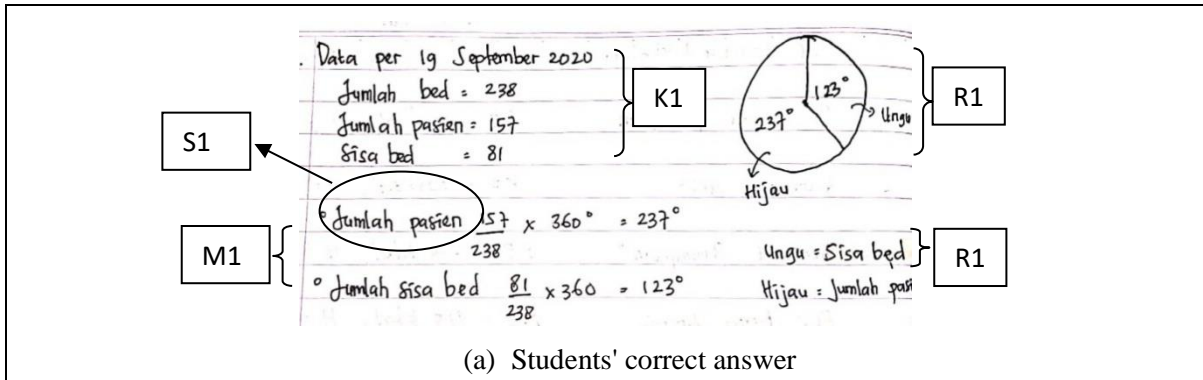
Students discussed two units of PISA-Like Math Tasks that were accomplished collaboratively in small groups, especially Unit 1 on nutritional needs and Unit 4 on beds and patients. Synchronous learning is a type of independent learning in which each group discussed two units of PISA-Like Math Tasks that were discussed collaboratively in WhatsApp groups. The two items were Unit 2, which is cases of COVID-19, and Unit 6, which is comorbidities. The next step was to do a virtual face-to-face individual written test via Zoom meeting and then the student's work was collected via Google Form. The written test consisted of 7 units consisting of 8 questions.

The researchers revised Prototype 2 based on the findings in the small group stage. When students worked on Unit 6, there were students who asked the relationship between the amount of data and the percentage of 1.11% contained in the data description with the accompanying conditions in the diagram. Apparently, the students focused on the percentage and based on this consideration, the researcher decided to omit the percentage because it was not necessary in the question.

In asynchronous and synchronous learning as well as written tests that have been carried out, it was revealed that the PISA-Like Math Tasks that have been developed can be applied because participants could understand comprehensively and integrate questions with various strategies. As a result, the PISA-Like Math Tasks produced are made up of seven units and twelve problems that are considered practical (Zulkardi, 2002). The revisions yielded Prototype 3, which was both valid and practical.

The field test was the last stage in the development process where at this stage, Prototype 3 trials were carried out at Junior High School Number 19 Palembang. The research subjects at this stage were 24 students in Grade 9. At the beginning of the lesson, the teacher explored students' knowledge about the COVID-19 pandemic, then students tried to solve PISA-type math problems collaboratively. After that, students presented the results of their group discussions. At the field test, Grade 9 teacher of Junior High School 19 Palembang, namely, Isri Mawarni, S.Pd, acted as the model teacher in learning.

In working on the questions, students were required to use their mathematical literacy skills. Like the problem in Unit 4 with bed & patient contexts consist of two questions as seen in figure 1. To solve the first problem, for example, students needed to involve some literacy skills in PISA. Students were asked to reconstruct existing data regarding the number of patients and the remaining beds. After that, students were asked to make pie charts that can represent the new data that students have obtained. The answers of students who could solve the questions correctly (a) and students who could demonstrate their literacy skills although the results were still inaccurate (b) are shown in Figure 2.



Translated into English:

Data as of 19 september 2020

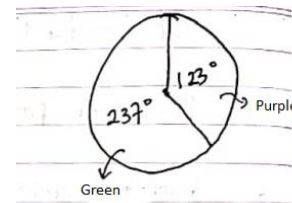
Number of beds : 238

Number of patients : 157

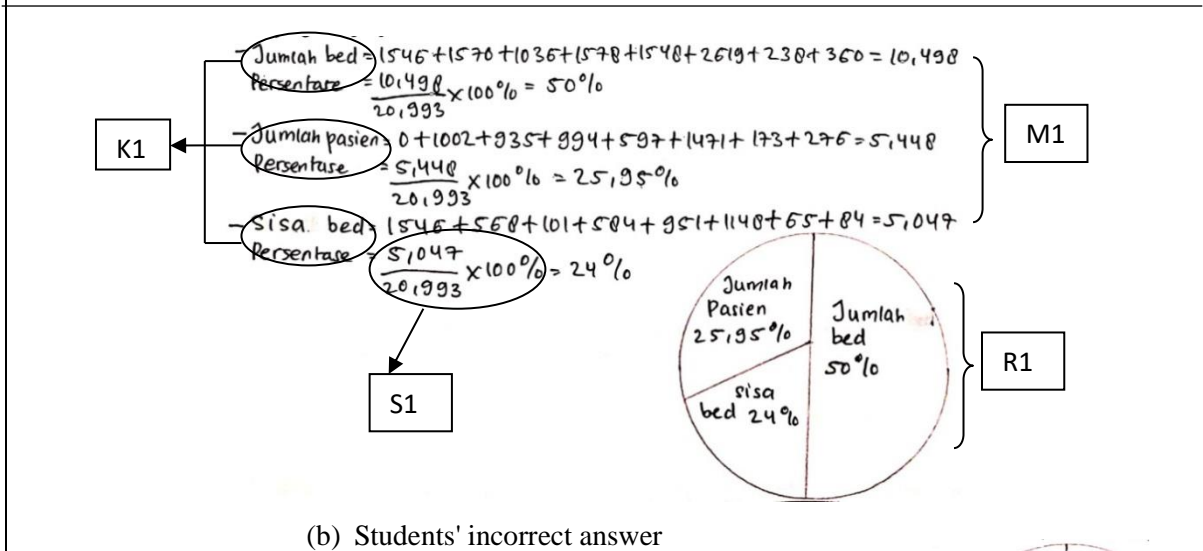
Unoccupied bed : 81

Number of patients : $157/238 \times 360^\circ = 237^\circ$

Number of remaining beds : $81/238 \times 360^\circ = 123^\circ$



Purple: Unoccupied bed
Green: Number of patients



Translated into English

- Number of beds = 1546 + 1570 + 1035 + 1578 + 1548 + 2619 + 238 + 360 = 10,498

Percentage = $10,498/20,993 \times 100\% = 50\%$

- Number of patients = 0 + 1002 + 935 + 994 + 597 + 1471 + 173 + 276 = 5,448

Percentage = $5,448/20,993 \times 100\% = 25,95\%$

- Unoccupied beds = 1546 + 568 + 101 + 584 + 951 + 1148 + 65 + 84 = 5,047

Percentage = $5,047/20,993 \times 100\% = 24\%$

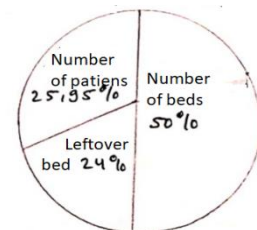


Figure 2. Examples of students' answer to question number 1 of unit 4 in the field test phase (Prototype III)

Figure 2(a) shows that students were able to understand and work correctly. Students were able to construct problems (K1) by carefully writing down data that has changed on the 19th, so that in making diagrams, students did not make mistakes. Students were able to determine the right formula in making diagrams and determine the data to be used in making diagrams, showing that students can design and apply strategies in solving mathematical problem (S1). Furthermore, students counted the number of remaining beds and the number of patients in making a diagram and this shows that students understand the range in solving problems (M1). Then, students were able to interpret the mathematical results in various formats related to the situation by making diagrams based on the results that have been obtained previously (R1).

Figure 2(b) also shows that students were able to involve all of the same literacy skills, although they were still not able to construct the existing problems correctly (K1). Students also did not understand the range in making diagrams (M1). This can be seen from students who are looking for the degree measures of angles from the number of remaining beds, the number of patients, and the total number of beds. The total number of beds is universal in determining the making of the diagram, so the number of beds is not included in the diagram section. Students were also still not correct in choosing a strategy (S1) to find degree measures in making diagrams. However, students were able to make a diagram (R1) based on the calculations made previously.

In the process, students must find information that is not in the problem. Students must first calculate the information provided by the question. Some students did not find the information but immediately made a diagram so that the diagrams they made were incorrect even though they were right in their calculations. If the strategy used is not right, it would result in incorrect conclusion or final answer (Noviana & Murdiyasa, 2020). In addition, there were students who could choose the right strategy in making the diagrams described in the questions but in the calculation process, they were still not thorough so that they proposed incorrect final answers. This happened in research conducted by Noviana & Murdiyasa (2020), where students were correct in choosing a problem-solving strategy using a number pattern, but during the calculation process, the student's answers were still wrong.

In question number 2 of Unit 4, students were asked to circle the option “yes” or “no” according to the statement given. The majority of students were able to accurately answer the questions. However, there were a few who were not careful in interpreting the results. The responses of the students are represented in Figure 3.

Pernyataan	Apakah pernyataan benar?
Tower 7 menjadi tempat menginap pasien yang paling sedikit	Ya <input checked="" type="radio"/> Tidak <input type="radio"/>
Jumlah rata-rata pasien setiap tower adalah 833 pasien	Ya <input type="radio"/> Tidak <input checked="" type="radio"/>
Tower 5 dan tower 7 mempunyai persediaan sisa bed yang sama	Ya <input type="radio"/> Tidak <input checked="" type="radio"/>

Berikan alasan atau perhitungan yang mendukung jawabanmu.

1. Tower 4, Tower 5, Tower 6, Tower 7, Tower 8, Tower 9, RSLAP, RSKIP
 0, 1002, 935, 994, 597, 1471, 173, 276
 Jumlah pasien dan yg terkecil sampai terbesar
 0, 173, 276, 597, 935, 994, 1002, 1471
 Jadi jumlah pasien yg paling sedikit adalah tower 4 adalah 0 pasien
2. $0 + 1002 + 935 + 994 + 597 + 1471 = 4,999 : 6 = 833$ pasien
3. Tower 5 = 568
 Tower 7 = 584 } Perbedaan $584 - 568 = 16$ sisa

P2

K1

M1

K2

P3

Translated into English

Give reasons or calculations that support your answer.

1. Tower 4, tower 5, tower 6, tower 7, tower 8, tower 9, RSLAP, RSKIP
 0, 1002, 935, 994, 597, 1471, 173, 276

The number of patients from smallest to largest
 0, 173, 276, 597, 935, 994, 1002, 1472

So, the least number of patients is tower 4 = 0 patient

2. $0 + 1002 + 953 + 994 + 597 + 1471 = 4,999 \div 6 = 833$ patients

3. Tower 5 = 568
 Tower 7 = 584 } Difference $584 - 568 = 16$ left

Figure 3. Results of student answers to unit 4 question number 2 at the field test stage (Prototype III)

Figure 3 shows that students were able to conclude by circling the option “yes” or “no” with various mathematical arguments (P3) written below the table. Students were able to understand the statement number one by writing the right reasons (M1), and students wrote the conclusion of the results (K2) based on the information written by the previous students. In the second statement, students were able to provide solutions (K1) by calculating the average number of patients in the towers in the diagram. However, students have not been careful in concluding the arguments (P3) that have been given and this can be seen from students circling the option 'no' in the table despite the fact that the statement is true. Furthermore, students were able to connect pieces of information to reach a mathematical solution (P2) for the third statement by writing down information from the diagram and finding that there is a difference in the number of beds with a difference of 16 beds, so the third statement is false.

Unit 6 with the context of comorbidities consists of three questions. There were some students who were still using the information that must be used to solve the problems incorrectly. However, the majority of students were capable of answering the questions correctly and precisely. Two answers from students who have full and incomplete scores are shown in Figure 4.

P2

Berapa jumlah data pasien terpapar Covid-19 yang meninggal dengan penyakit Penyerta TBC?
 26.92% Jumlah persentase pasien meninggal dng Penyakit penyert TBC adalah 26.92%.

Data dng kondi: Penyerta = 1389 (1,11%)
 Total Persentase Pasien Covid-19 yg meninggal dng Penyakit Penyerta: $33,33 + 26,92 + 28,57 + 15,15 + 8,82 + 51,81 + 26,9 + 24,29 + 38,41 + 33,89 + 26,11 = 347,6\%$

K2

Berapa jumlah pasien ^{Covid-19} meninggal dengan penyakit Penyerta TBC? $482.816 \times 26,92\% = 129.974$ →

Jadi jumlah ^{data} pasien terpapar Covid-19 yg meninggal dng Penyakit Penyerta TBC adalah 129.974

K1

(a)

Translated into English:

How many data on patients exposed to COVID-19 who died with TBC comorbidity?
 Total percentage of patients who died with TBC is 26.92%.
 Data with comorbid conditions :1389
 Total percentage of COVID-19 patients who died with comorbidities =
 $33,33 + 26,92 + 28,57 + 15,15 + 8,82 + 51,81 + 26,9 + 24,29 + 38,41 + 33,89 + 26,11 = 347,6\%$

How many COVID-19 patients have died with TBC comorbidity?
 $482.816 \times 26,92\% = 129.974$

So, the number of patients exposed to COVID-19 who died with TBC comorbidities was 129,974

(b)

Translated into English:

Known:

Data on comorbid conditions: 1389

TBC percentage: 26.92%

Answer:

$$\text{TBC} = \frac{P.TBC}{100\%} \times \text{data condition of comorbidities}$$

$$\text{TBC} = \frac{26.92\%}{100\%} \times 1389 = \frac{37,391,88}{100\%} = 373,9188$$

Figure 4. Results of student answers for unit 6 question number 1 at the field test stage (Prototype III)

Figure 4(a) shows that students were able to write down the information that is needed (P2) to solve the problem. After that, students performed calculations that showed the work in solving the problem (K1) even though it was still not correct and they drew incorrect conclusions from the results of calculations. (K2) regarding the number of patients who died from comorbidities. This is in accordance with the findings of Bahar, et al. (2020), who found that while students can express the produced problems, the techniques for solving them are not exactly right. As a result, students will propose less exact solutions.

In contrast, the students' responses in Figure 4(b) indicate that the students were able to write down the information that is required (P2) in solving the problem. The students also wrote down the strategy (S1) used and showed the work in solving the problem (K1), but they did not give conclusions (K2) on the results of their calculations.

In solving problem number 2 of Unit 6 (as shown in Figure 1 (b)), students need to have a strategy in making appropriate conclusions regarding the statements given in the questions. One of the answers of students who were able to provide strategies and represent the information provided well is shown in Figure 5.

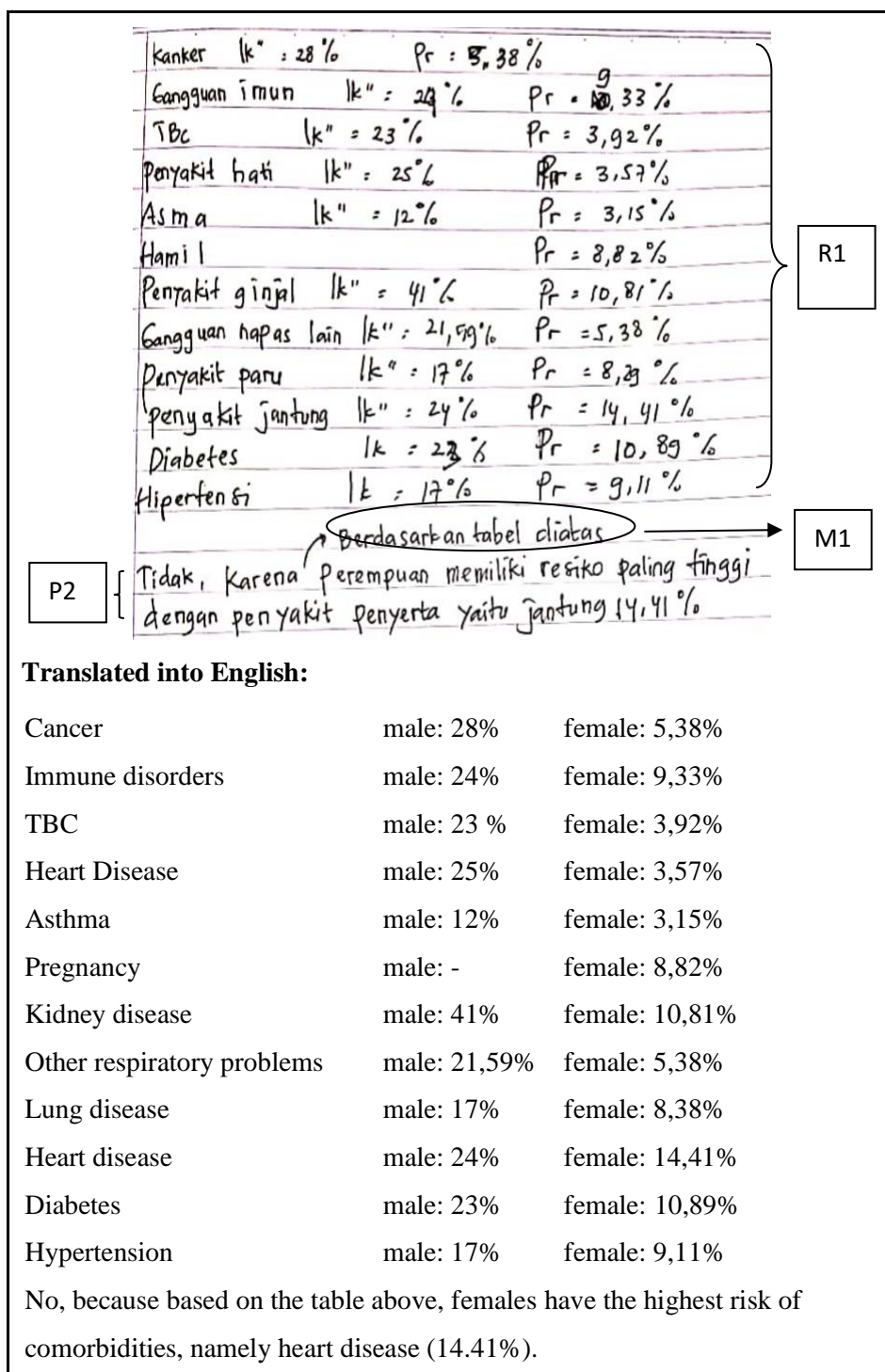


Figure 5. Results of student answers from unit 6 number 2 at the field test stage (Prototype III)

Figure 5 shows how students were able to adapt information presented in the form of diagrams into words and tables. This is in contrast with Nusantara et al (2021), who found that students solve problems and interpret mathematical solutions by using mathematical symbols made by students to simplify the explanations on the graphs given to the problems. This shows that students are able to reinterpret (R1) information in the context into tabular form. The table remade by students shows that students understand the range in solving problems (M1) so that students can draw conclusions and give

reasons for these conclusions. Students can propose an explanation or argument that meets the requirements (P2) regarding disagreements with the statements contained in the questions so that the student's statements can be accepted and support students' answers.

In solving problem number 3 of Unit 6, students had different arguments or strategies in answering the questions. One of the student's answers is shown in [Figure 6](#).

Penyakit penyerta Gangguan nafas lain "ang penyakit penyerta kanker? Berikut alasan atau perhitungan yang mendukung jawabanmu

Data ang kondisi penyerta : 1389

Jumlah pasien kanker perempuan = $33.33 - 28.57 = 4.76\%$ → S1

28.57 didapat dari melihat grafik penyakit hati yang sama dengan panjang grafik laki-laki kanker.

$4.76\% \times 1389 = \frac{4.76}{100} \times 1389 = 0.0476 \times 1389 = 66$ → K1

Jumlah pasien perempuan gangguan nafas lain : $28.57\% - 25\% = 3.57\%$

$3.57\% \times 1389 = \frac{3.57}{100} \times 1389 = 0.00357 \times 1389 = 49$

K2 → Jadi, jumlahnya berbeda.

Translated into English:

Other respiratory disorders as comorbid conditions with and co-morbidities of cancer as comorbid condition? The following are reasons or calculations that support the answer.

Data of patients with comorbid conditions: 1389

Number of female cancer patients: $33.33 - 28.57 = 4.76\%$

28,57 obtained from looking at the graph of liver disease which is the same as the length of the graph of male cancer male patients

$4,75\% \times 1389 = \frac{4,75}{100} \times 1389 = 0,0476 \times 1389 = 66$

The number of female patients with other respiratory disorders:

$28,57\% - 25\% = 3,57\%$

$3,57\% \times 1389 = \frac{3,57}{100} \times 1389 = 0,00357 \times 1389 = 49$

So, the numbers of those patients are different.

Figure 6. Results of student answers for unit 6 question number 3 in the field test stage (Prototype III)

[Figure 6](#) shows that students were able to write down the strategy (S1) that they needed to draw conclusions, namely, finding the number of female patients who died with cancer and other respiratory disorders. Students were able to connect pieces of information (P2), namely, the percentage of each comorbid disease with the total amount of data to find the number of patients according to the strategy (S1) that students used. Furthermore, students were able to write down the work or calculations involved

in solving questions (K1) correctly, so that students can conclude (K2) that the number of cancer and other respiratory disorders as comorbidity in women has differences.

In this study, there were still several students who made mistakes in calculating and constructing the problems in the questions developed by the researchers. This occurs when students are unfamiliar with complex problems or questions that need attentive reading and comprehension. In line with research conducted by Astuti, et al. (2018), what the researchers found showed that the accuracy of students in counting, using tools, and operating to answer questions was still lower than other aspects.

Other factors that make it difficult for students to work on PISA-Like Math tasks include a lack of preparation in answering these questions. According to Efriani et al. (2019), students made errors in turning the questions into a counting process because students did not read the questions correctly. Students are focused on developing the given problem, students simply pay attention to the question's description and do not understand the main problem so that the time given is not enough to understand the supporting information provided (Nizar, et al., 2018; Zulkardi, et al., 2020). This makes students not careful in doing calculations or giving final conclusions.

According to the results of the analysis of students' solutions during the field test stage, the majority of students were able to use their mathematical ability. The students were able to understand the context of the problems presented to help the process of solving mathematics (Nusantara, at al., 2020a), but there were still some students who have not been able to understand the range or limits of mathematics in solving the problems. The limited mastery of the material and not being able to relate the concepts that have been studied for a long time with the problems being worked on make students unable to understand the range of problem solving.

Students were able to understand, identify, and employ various representations when they solved problems, according on the results of the analysis of their responses to representational abilities. Students had various answers in representing the results of the answers. There were students who represented information in tabular form to support their arguments in answering questions. However, there were students who were able to represent the questions, but were still wrong in their calculations. This is in accordance with Bahar, et al. (2020), who found that the subject can represent the developed questions, but the procedures used in solving the questions are not quite right so that the subject gets a solution or answer that is less precise.

The results of the analysis of students' answers in relation to reasoning abilities are that students were able to make explanations to defend arguments well, although there were some students who were still wrong in making arguments because the problems in the questions were not understood well by the students. This is in line with Asdarina & Ridha (2020), stating students were able to write down the information in the questions well, but students did not make any additional guesses when it came to problem solving so that students were not yet correct in making arguments to answer questions.

Students were able to construct ways sequentially to solve difficulties, according to the researcher's study of their responses regarding their capacity to choose strategies. This is in line with

Nusantara, et al. (2020b), the majority of students were capable of selecting the appropriate strategy. Although there were some students who were not right in designing strategies because students were not correct in constructing the initial information contained in the problem.

The use of COVID-19 context in PISA-like math activities had the potential to affect mathematical literacy skills, such as communication, mathematical, representation, reasoning, and strategy selection ability, according to the analysis of student answers. This finding supports Nusantara, et al. (2021), who claimed that using the COVID-19 context as a learning resource helps students enhance their mathematical literacy by allowing them to relate COVID-19 questions to a variety of other math topics.

Students require special questions that allow them to improve their mathematical literacy abilities while solving problems. PISA questions are designed to improve students' mathematical literacy skills in applying math to real-life situations. It is expected that students will be used to solving issues that are similar to PISA questions and have an impact on PISA scores in the future. The use of context guides students to think mathematically because their capacity for mathematical thinking processes emerges from the particular circumstance (Kohar, et al., 2019; Zulkardi et al., 2020), and it will engage students in collaborative learning, resulting in more meaningful learning (Putri & Zulkardi, 2020).

CONCLUSION

This research produces a set of PISA-Like Math Tasks on uncertainty and data specifically statistical material using COVID-19 context that are valid and practical and have the potential to affect mathematical literacy. The problem given are about how students can read the data, calculate, represent and can change data into other diagrams. Students can utilize mathematical literacy skills such as communication, strategy selection, mathematization, representation, and reasoning while working on PISA-Like Math Tasks using COVID-19 context. Communication skills are assessed in items 1 and 2 of Unit 4 and item 1 and 3 of Unit 6. Unit 4 items 1 and 2 and Unit 6 item 2 both require mathematization skills. Unit 4 item 1 and Unit 6 items 1 and 3 both bring up the ability to choose strategies. The ability of representation is mentioned in item 1 of Unit 4 and item 2 of Unit 6. The ability of reasoning is assessed in Unit 4 item 2 and all items of Unit 6. Students can further improve their mathematical literacy by using the COVID-19 context as a learning resource. As a result, students will be able to work mathematically on COVID-19 cases and connect ideas from many subjects to come up with a solution.

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REFERENCES

- Amelia, I., Syamsuri, & Novaliyosi. (2020). Identify the process of solving mathematical literacy questions for ninth grade students on opportunity and data content [in Bahasa]. *Jurnal Pendidikan Matematika*, 04(01), 331-345. <https://doi.org/10.31004/cendekia.v4i2.212>
- Asdarina, O., & Ridha, M. (2020). Analysis of students' mathematical reasoning ability in solving PISA equivalent problems in Geometry content [in Bahasa]. *Jurnal Numeracy*, 7(2), 192-206. <https://doi.org/10.46244/numeracy.v7i2.1167>
- Astuti, D., Kartono, & Wardono. (2018). Analysis of mathematical literacy ability JUCAMA learning model with PMRI approach with google form as Self-Assessment [in Bahasa]. *PRISMA, Prosiding Seminar Matematika*, 1, 69-76. <https://journal.unnes.ac.id/sju/index.php/prisma/article/view/19572>.
- Bahar, E. E., Syamsuadi, A., Gaffar, A., & Syahri, A. A. (2020). Analysis of mathematical ability in solving PISA (Program for International Student Assessment) Questions on Quantity Content [in Bahasa]. *Delta-Pi: Jurnal Matematika dan Pendidikan Matematika*, 9 (2), 260-276. <https://dx.doi.org/10.33387/dpi.v9i2.2327>
- Bakker, A. (2018). *Design research in Education: A Practical Guide for Early Career Researchers*. London: Routledge.
- Dasaprawira, M. N., Zulkardi, & Susanti, E. (2019). Developing mathematics questions of PISA type using Bangka context. *Journal on Mathematics Education*, 10(2), 303-314. <https://doi.org/10.22342/jme.10.2.5366.303-314>.
- Efriani, A., Putri, R. I. I., & Hapizah. (2019). Sailing context in PISA-like mathematics problems. *Journal on Mathematics Education*, 10(2), 265-276. <https://doi.org/10.22342/jme.10.2.5245.265-276>
- Kohar, A. W., Wardani, A. K. & Fachrudin, A. D. (2019). Profiling context-based mathematics tasks developed by novice PISA-like task designers. *Journal of Physics Conference Series*, 1200(1), 012014. <https://doi.org/10.1088/1742-6596/1200/1/012014>
- Murdaningsih, S., & Murtiyasa, B. (2016). An analysis on eight grade mathematics textbook of new Indonesia curriculum (K-13) based on PISA's framework. *JRAMathEdu (Journal of Reserch and Advances in Mathematics Education)*, 14-27. <https://doi.org/10.23917/jramathedu.v1i1.1780>
- Mutia & Effendi, K. N. S. (2019). Analysis of the mathematical literacy ability of Junior High School Students on PISA similar questions for uncertainty and data content [in Bahasa]. *Prosiding Seminar Nasional Matematika dan Pendidikan Matematika Sesiomadika*, 2 (1) 137-148. <https://journal.unsika.ac.id/index.php/sesiomadika/article/view/2333>

- Nizar, H., Putri, R. I. I., Zulkardi. (2018). Developing PISA-like mathematics problem using the 2018 Asian Games football and table tennis contexts. *Journal on Mathematics Education*, 9(2) 183-194. <https://doi.org/10.22342/jme.9.2.5246.183-194>
- Noviana, K. Y., & Murtiyasa, B. (2020). PISA-Oriented mathematical literacy ability quantity content for Middle School students [in Bahasa]. *JNPM (Jurnal Nasional Pendidikan Matematika)*, 4(2), 195-211. <http://dx.doi.org/10.33603/jnpm.v4i1.2830>
- Nusantara, D. S., Zulkardi, & Putri, R. I. I. (2020a). Designing PISA-like mathematics problem relating change and relationship using physical distancing context. *Journal of Physics Conference Series*, 1663(1), 012004. <https://doi.org/10.1088/1742-6596/1663/1/012004>
- Nusantara, D. S., Zulkardi, & Putri, R. I. I. (2020b). Designing PISA-like mathematics problem in COVID-19 pandemic (PISAComat). *Journal of Physics Conference Series*, 1657(1), 012057. <https://doi.org/10.1088/1742-6596/1657/1/012057>
- Nusantara, D. S., Zulkardi, & Putri, R. I. I. (2021). Designing PISA-like mathematics task using a COVID-19 context (PISAComat). *Journal on Mathematics Education*, 12(2), 349-364. <http://doi.org/10.22342/jme.12.2.13181.349-364>
- OECD. (2019). *PISA 2018 Assessment and Analytical Framework*. Paris: OECD Publishing. <https://doi.org/10.1787/b25efab8-en>
- Pratiwi, A. A., Effendi, M. M., & Ummah, S. K. (2020). Development of PISA-Type mathematics learning evaluation instruments with local culture characteristics [in Bahasa]. *Jurnal Pendidikan Matematika RAFA*, 6(1), 28– 53. <https://doi.org/10.19109/jpmrafa.v6i1.4985>
- Pratiwi, I., Putri, R. I. I., & Zulkardi. (2019). Long jump in Asian Games: Contexts of PISA-Like mathematic problems. *Journal on Mathematics Education*, 10(1), 81-92. <http://dx.doi.org/10.22342/jme.10.1.5250.81-92>
- Putri, R. I. I., & Zulkardi. (2020). Designing PISA-like mathematics task using Asian Games context. *Journal on Mathematics Education*, 11(1). 135-144. <https://doi.org/10.22342/jme.11.1.9786.135-144>
- Rifai, R., & Wutsqa, D. U. (2017). Mathematical literacy abilities of state junior high school students in Bantul Regency [in Bahasa]. *Jurnal Pendidikan Matematika Dan Sains, IV* (2), 152–162. <https://doi.org/10.21831/jpms.v5i2.15747>
- Saputri, N. W., Turidho, A., Zulkardi, Darmawijoyo, & Somakim. (2020). Design of PISA question using uncertainty content and data context of the spread of COVID-19 [in Bahasa]. *Jurnal Pendidikan Matematika*, 8 (2), 106 – 118. <https://doi.org/10.22342/jpm.14.1.6825.1-14>
- Sutrisno, U., & Adirakasiwi, A. G. (2019). Analysis of mathematical literacy skills on questions oriented to the content of uncertainty and data based on gender [in Bahasa]. *Prosiding Seminar Nasional Matematika dan Pendidikan Matematika Sesiomadika 2019*, 1224-1235. <https://journal.unsika.ac.id/index.php/sesiomadika/article/view/2991>
- Veronica, A. M., Zainil, M., & Helsa, Y. (2020). PMRI-Based teaching materials using the context of karate sports in Elementary School students during the COVID-19 pandemic. *Journal of Teaching and Learning in Elementary Education (JTLEE)*, 3 (2), 200-207. <http://dx.doi.org/10.33578/jtlee.v3i2.7855>
- WHO. (2020). *Coronavirus disease (COVID-19) outbreak*. <https://covid19.who.int/>

- Wijaya, A., Heuvel-Panhuizen, M.v.d., Doorman, M., & Robitzsch, A. (2014). Difficulties in Solving Context-Based (PISA). *Journal The Mathematics Enthusiast*, 11(3), 555-584. <https://doi.org/10.54870/1551-3440.1317>
- Yansen, D., Putri, R. I. I., Zulkardi, & Fatimah, S. (2019). Developing PISA-like mathematics problems on uncertainty and data using Asian Games Football context. *Journal on Mathematics Education*, 10(1), 37–46. <https://doi.org/10.22342/jme.10.1.5249.37-46>
- Zulkardi, (2002). *Developing a learning on realistic mathematics education for Indonesian students and teachers*. [Doctoral dissertation, University of Twente, Enschede]. The Netherlands. (Online). http://doc.utwente.nl/58718/1/thesis_Zulkardi.pdf
- Zulkardi, & Kohar, A. W. (2018). Designing PISA-like mathematics tasks in Indonesia: experiences and challenges. *Journal of Physics: Conference Series*, 947(1), 012015. <http://dx.doi.org/10.1088/1742-6596/947/1/012015>
- Zulkardi, Meryansumayeka, Putri, R. I. I., Alwi, Z., Nusantara, D. S., Ambarita, S. M., Maharani, Y., & Puspitasari, L. (2020). How students work with PISA-like mathematical tasks using COVID-19 context. *Journal on Mathematics Education*, 11(3), 405-416. <https://doi.org/10.22342/jme.11.3.12915.405-41>