

Designing PISA-like task on uncertainty and data using Covid-19 context

By Zulkardi Zulkardi

PAPER • OPEN ACCESS

4

Designing PISA-like task on uncertainty and data using Covid-19 context


To cite this article: Zulkardi *et al* 2021 *J. Phys.: Conf. Ser.* **1722** 012102

5

View the [article online](#) for updates and enhancements.

You may also like

- [Student strategy in solving PISA problem through realistic mathematics education approach](#)
K A Fitri, R Johar, C M Zubainur *et al.*
- [Designing PISA-like mathematics problem in covid-19 pandemic \(PISAComat\)](#)
D S Nusantara, Zulkardi and R I I Putri
- [Searching for Authentic Context in Designing PISA-like Mathematics Problem: From Indoor to Outdoor Field Experience](#)
T Y E Siswono, A W Kohar, A H Rosyidi *et al.*




The Electrochemical Society
Advancing solid state & electrochemical science & technology

243rd Meeting with SOFC-XVIII
Boston, MA • May 28 – June 2, 2023

Accelerate scientific discovery!

Learn More & Register



Designing PISA-like task on uncertainty and data using Covid-19 context

Zulkardi*, D S Nusantara and R I I Putri

Department of Mathematics Education, Universitas Sriwijaya
Jl. Srijaya Negara, Bukit Besar, Palembang, Indonesia

*zulkardi@unsri.ac.id

Abstract. COVID-19 pandemic is an example of a global context and real-world phenomena. This context is an excellent example of the uncertainty and data, a part of the content knowledge in the PISA 2021 framework. This new content of the uncertainty and data as a part of mathematics literacy focuses on conditional decision-making. This paper aims at sharing the development and implementation of the PISA like task using three steps of design research method. Firstly, a preliminary study on the history and development of PISA in Indonesia. Then, the PISA-like items' design process continued with the tasks' experiment using focus group discussion. In the end, the PISA problems have resulted after a formative evaluation. Finally, it is produced valid and practical of three PISA-items and had a potential effect on students' mathematical literacy.

1. Introduction

New challenges in mathematics education today with the emergence of educational disruptions need to be done both contently and pedagogically to prepare students for the 21st-century skills and mathematical reasoning [1, 2]. Considering the little improvement of Indonesian students in the domain content of mathematics in PISA, a decision to make PISA as the standard of international education in Indonesia is prompted [3-5]. The underlying factors were driven by students who are not accustomed to solving PISA-like tasks [6], the limitations of teachers in providing PISA-like [7, 8], and the absence of learning resources that offer PISA-like problems both in school and in bookstores [9].

As a result, the emergence of a bold movement, commonly known as “*Freedom of Learning*” was established by the Indonesian Minister of Education and Culture (MoEC). This agenda substitutes national examination into a minimum competency assessment (MCA). This test would mainly evaluate students' literacy and numerical competence. The team from Assessment and Learning Center MoEC will design test items based on the instructional practice and PISA framework. This new educational assessment will not be held just before students are set to graduate but it will plan for students grades 4, 8, and 11 [10, 11].

It takes a reasonable effort to provide problems with PISA-characters by incorporating the local context. Thus, Indonesian students will be familiar with PISA-task and ready for MCA [12]. One real example of a well-known context to students is the COVID-19 phenomenon that became a pandemic for the rest of the world [13]. This context is an excellent example of the Data and Uncertainty, a part of the content knowledge in the PISA 2021 framework [14]. Various data distribution and infographics related to COVID-19 cases in Indonesia are always displayed regularly in both printed and online platform media. Consequently, it is interesting to apply as the source of students' learning. The uncertainty and data content is the right content in shaping, interpreting, evaluating, and drawing



conclusions from various data related to COVID-19 [5]. On the other hand, the regulations issued by the Ministry of Education require teachers to improve students' competence and life skills to face the COVID-19 situation [15].

The previous studies have been conducted by producing the development of PISA-like mathematics problems using local [16], national [17], and international [18] contexts. These efforts attract students to learn and enhance mathematical literacy skills [19, 20]. However, there have been no PISA-like mathematics problems using the didactic phenomenon of the Covid-19 pandemic. It means there is a gap between desired demands and conditions in the field (school). Therefore, researchers are interested in developing mathematics problem with the characteristic of PISA using the context of Covid-19 Pandemic (PISAComat) the content of uncertainty and data which aimed to produce valid and practical PISAComat and had a potential effect on students' mathematical literacy.

2 Method

Design research with the type of development studies as the main framework was used [21, 22]. This research was carried out by involving students of secondary school number 1 Palembang. The framework took several activities, such as a preliminary study on PISA's history and development in Indonesia, the PISA-like items' design process continued with the tasks' experiment using focus group discussion, and the developed PISA-like items were piloted to prototyping/formative stages [23]. The online system supported the development process, such as Zoom Meeting, email reviews, and WhatsApp group discussion. The comments and suggestions from FGD and the prototyping stage were considered revising the developed PISA-Items in producing valid and practical PISA-items. A walkthrough, test, and interview were used as data resources, and the result of each step from the phases was analyzed descriptively.

3. Result and Discussion

Various research resulted related to the development of PISA Items were used as both a learning activity and an assessment. The following figures are a description of previous PISA research results in terms of content, level, and context.

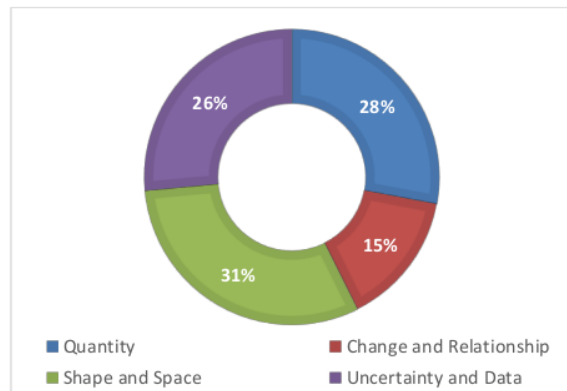


Figure 1. The percentage of contents knowledge used in PISA research

As illustrated in Figure 1, most PISA research focuses on shape and space content with 31%, followed by quantity content with 28%. The uncertainty and data with 26%, and the change and relationship content 15%.

Furthermore, as depicted in Figure 2, most of the PISA research resulted in applying level difficulty (48%), followed by reasoning (34%) and understanding (18%). In addition, the international context used from previous research related to international sports in the last two years with a 43% percentage, followed by the general context (national) with a 30% ratio, and the local context contributed by 27%.

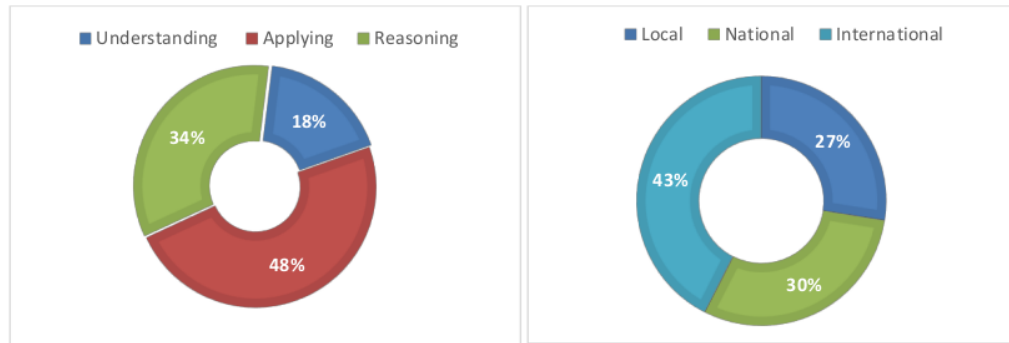


Figure 2. The percentage of difficulty level and context used in PISA research

In this study, there were three items of PISA-like mathematics problems on uncertainty and data content using the context of Covid-19. This study's result on each stage of the preliminary and for formative evaluation/prototyping is shown below.

The researchers conducted student analysis, curriculum analysis, PISA framework, and design an instrument that included the problem grids, problem cards, and scoring rubrics in the preliminary stage. The development process is based on the original PISA mathematics problem concerning the PISA 2021 framework. The PISA items developed tend to ask students to use their reasoning, give arguments or opinions, and solve the problems by making the decision.

At the prototyping stage, focus group discussion (FGD) and 1-1 activity were involved to see the developed PISA Items' validity. FGD is done through Zoom Meeting by engaging PISA experts (researchers who have conducted PISA research), Ph.D. students, graduate students, and secondary school teachers. In parallel, one to one is conducted through Zoom Meeting involving six students with heterogeneous abilities.

The comments and constructive suggestions from FGD and 1-1 activity were considered to revise the prototype. Table 1 is presented comments and advice from expert review and students.

Table 1. Comments and suggestions from FGD and 1-1 activity on PISAComat

Validators	Comments/Suggestions	Revision
FGD (Lecturers, Ph.D. students, Graduate students and Teachers)	- The selected context is attractive and authentic according to the current situation but language construction indicated the difficulty at the level 1	Changing the questions and statements
	- The information on the table is only cropped into the ten high provinces	The table only provides 10 highest provinces of Covid-19
1-1 (Students)	- I do not understand the problem	The word "increased" is removed, change the language construction,
	- I do not get the important point from the table	Cropped the table into 10 provinces

The prototype was declared valid, reflected in experts' comments and suggestions, and students' understanding of the problems [21]. The small group stage was performed by involving six students who work on it individually. The developed PISAComat after revision can be seen in Figure 3.

DATA COVID-19 DI INDONESIA
Update terakhir: 12 September 2020, 11:53 WIB

The following data are the 10 highest provinces of Covid-19 in Indonesia

No.	Province	Confirmed	Deaths	Recovered
1	DKI Jakarta	52840	1386	39793
2	Jawa Timur	37839	2746	29924
3	Jawa Tengah	17460	1139	10969
4	Jawa Barat	14231	294	7493
5	Sulawesi Selatan	13235	376	10103
6	Kalimantan Selatan	9249	386	7319
7	Sumatera Utara	8362	355	5042
8	Bali	7113	168	5593
9	Kalimantan Timur	5752	238	3445
10	Sumatera Selatan	5018	297	3601



Question:

- Based on the table, which provinces have the highest number of patients in care? Explain your reason.
- For each statement, please circle your preferred answer based on the data given.

Statement	Is this statement correct?
Sumatera Selatan is the province that has the highest percentage of recovery	Yes/No
Jawa Tengah can model how Covid-19 handled from DKI Jakarta	Yes/No

The task force for acceleration of covid-19 handling showed this picture and said: "On September 11th, 2020, four people died every hour in Indonesia due to Covid-19"

Question:

- What do you think, is it wrong or right? Explain your reason.

Figure 3. The developed PISA-items after revision

Student' strategy on PISA Items unit number 1 can be seen in Figure 4. It shows the student' strategy used in answering unit number 1. The student analyzed the data provided at first. Then the student performed the calculation process in her mind. However, the calculation process is not seen because student knew the patients' difference is confirmed, recovered patients and death patients looking significantly different from other provinces.

1) DKI Jakarta, karena berdasarkan data yang diberikan selisih antara tertkonfirmasi dan meninggal juga sembuh terlihat jauh berbeda dengan provinsi lain.
(Pasien dalam perawatan = tertkonfirmasi - (sembuh + meninggal))

Translated:
DKI Jakarta, because based on the data provided, the difference between (patients) confirmed and deaths also recovered looks significantly different from other provinces.
(Patients in care = Confirmed - (Recovered + Deaths))

Figure 4. Student' strategy on PISA Items unit number 1

The previous research result stated that students with sound reasoning and argumentation abilities could understand, formulate, and solve the problem correctly [19]. Furthermore, student' strategy on PISA Items unit number 2 can be seen in Figure 5.

2) Tidak, karena masih ada provinsi lain yang memiliki persentase kesembuhan yaitu provinsi Kalimantan Selatan sebesar hampir 80%.
Ya, karena DKI Jakarta memiliki persentase kesembuhan lebih baik dari Jawa Tengah.

Translated:
No, because there are still other provinces that have (the highest) percentage of recovered (patients), e.g. Kalimantan Selatan of 80%.
Yes, because DKI Jakarta has a percentage of recovered (patients) higher than Jawa Tengah.

Figure 5. Student' strategy on PISA Items unit number 2

Figure 5 shows the student' strategy used in answering unit number 2. Student was asked to decide whether the statement is "yes" or "no" by providing an answer based on the data. The first statement was "no" because student calculated that other provinces had a higher recovery percentage, namely

Kalimantan Selatan. Simultaneously, the second statement is “yes” because DKI Jakarta has a better recovery ratio than Jawa Tengah. On the other hand, student’ strategy on PISA Items unit number 3 can be seen in Figure 6.

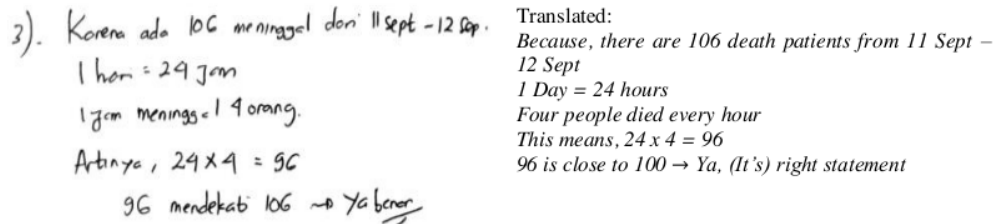


Figure 6. student’ strategy on PISA Items unit number 3

Figure 6 shows the students’ strategy used in answering unit number 3. Student understand a specific symbol in the image that shows the increasing number of patients who recovered in the previous day. Then student use the concept of division operations to determine whether the given statement is true or false. Student make conclusions by rounding numbers.

4. Conclusion

It is necessary to develop diverse and balanced PISA-items in terms of contents, knowledge, contexts, and difficulty levels. The development process has produced three useful and practical PISA items. The PISA item 2 validity was seen from the FGD and prototyping stage regarding content, construct, and language. The practicality of the PISA items was viewed from the small group phase. It obtained the revised prototype that can be understood easily and interpreted well by students with different reasoning, argumentation, interpretation, and decisions based on existing data.

Acknowledgments

We would like to thank the Directorate General of Higher Education via Master’s Education towards a Superior Doctor of Bachelor (PMDSU) grant for the financial support, as well as participated teachers and students.

References

- [1] Gravemeijer K, Stephan M, Julie C, Lin F L and Ohtani M 2017 *International Journal of Science and Mathematics Education* **15** 105.
- [2] Stacey K and Turner R 2015 *Assessing Mathematical Literacy: The PISA Experience* (Australia: Springer).
- [3] OECD 2019 *PISA 2018 Mathematics Framework, Science, Problem Solving and Financial Literacy* (Paris: OECD Publishing).
- [4] OECD 2016 *PISA 2015 Assessment and Analytical Framework: Science, Reading, Mathematics and Financial Literacy* (Paris: OECD Publishing).
- [5] MoEC 2019 *Kebijakan Merdeka Belajar: 4 Pokok Kebijakan Pendidikan* (in Bahasa) (Jakarta: MoEC).
- [6] Wijaya A, Van den Heuvel-Panhuizen M, Doorman M and Robitzsch A 2014 *The Mathematics Enthusiast* **11** 3.
- [7] R I I Putri and Zulkardi 2018 *J. Phys.: Conf. Ser.* **948** 012056.
- [8] Zulkardi and A W Kohar 2018 *J. Phys.: Conf. Ser.* **947** 012015.
- [9] Wijaya A, Van den Heuvel-Panhuizen M and Doorman M 2015 *Educational Studies in Mathematics* **89** 81.
- [10] Harususilo Y E 2019 *Empat Kebijakan Pokok dalam Merdeka Belajar* (Jakarta: Kompas).
- [11] Chaterine R N 2019 *Gantikan UN, Apa Asesmen Kompetensi Minimum dan Survey Karakter?* (Jakarta: DetikNews).

- [12] Kohar A W, Zulkardi and Darmawijoyo 2014 *Proc. Int. Conf. on 2nd South East Asia Development Research (SEA-DR)* (Palembang: Universitas Sriwijaya).
- [13] Bakker A and Wagner D 2020 *Educational Studies in Mathematics* **104** 1.
- [14] OECD 2018 *PISA 2021 Mathematics Framework* (Paris: OECD Publishing).
- [15] MoEC 2020 *Surat Edaran Mendikbud No. 4 Tahun 2020 tentang Pelaksanaan Kebijakan Pendidikan dalam Masa Darurat Penyebaran Corona Virus Disease (Covid-19)* (in Bahasa) (Jakarta: MoEC).
- [16] S Hardianti and Zulkardi 2019 *J. Phys.: Conf. Ser.* **1315** 012016.
- [17] Dasaprawira M N, Zulkardi and Susanti E 2019 *Journal on Mathematics Education* **10** 303.
- [18] Putri R I I and Zulkardi 2020 *Journal on Mathematics Education* **11** 1.
- [19] Ahyan S, Zulkardi and Darmawijoyo 2014 *Journal on Mathematics Education* **5** 47.
- [20] D Yansen et al 2018 *J. Phys.: Conf. Ser.* **1088** 012086.
- [21] Zulkardi 2002 *Developing a learning environment on realistic mathematics education for Indonesian student teachers* (Enschede: Universiteit Twente).
- [22] Bakker A 2018 *Design research in education: A practical guide for early career researchers* (London: Routledge).
- [23] Tessmer M 1993 *Planning and conducting – formative evaluations* (London, Philadelphia: Kogan Page).

Designing PISA-like task on uncertainty and data using Covid-19 context

ORIGINALITY REPORT

20%

SIMILARITY INDEX

PRIMARY SOURCES

1	backend.orbit.dtu.dk Internet	114 words — 5%
2	files.eric.ed.gov Internet	91 words — 4%
3	ghcmarijuana.com Internet	44 words — 2%
4	dh-ch.openaire.eu Internet	40 words — 2%
5	sipora.polije.ac.id Internet	36 words — 2%
6	R Permatasari, R I I Putri, Zulkardi. "Uncertainty and data content in bowling: Task design", Journal of Physics: Conference Series, 2018 Crossref	28 words — 1%
7	D. S. Nusantara, Zulkardi, R. I. I. Putri. "Designing Pisa-like mathematics problem using a COVID-19 transmission map context", AIP Publishing, 2021 Crossref	20 words — 1%
8	I N Aini, Zulkardi, R I I Putri, Turmudi. "Designing PISA-like mathematics problems using the context of	16 words — 1%

9 Koeno Gravemeijer, Michelle Stephan, Cyril Julie, Fou-Lai Lin, Minoru Ohtani. "What Mathematics Education May Prepare Students for the Society of the Future?", International Journal of Science and Mathematics Education, 2017 15 words — 1%

Crossref

10 eprints.utm.my 14 words — 1%

Internet

11 B Hasan. "The exploration of higher order thinking skills: students' difficulties and scaffolding in solving mathematical problems based on PISA", Journal of Physics: Conference Series, 2019 11 words — 1%

Crossref

EXCLUDE QUOTES ON

EXCLUDE SOURCES < 1%

EXCLUDE BIBLIOGRAPHY ON

EXCLUDE MATCHES OFF