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The Design Development of PISA-Like Mathematics Problem in Uncertainty and Data Content

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ABSTRACT

This study discusses the design development that produces the PISA-Like Mathematics in uncertainty and data content. This research uses a design research method with the type of development studies. This study consists of two stages are preliminary and formative evaluation stages. The evaluation flow used is formative study, including self-evaluation, expert review, one to one, small group, and field test. However, this study only would be discussed about the expert review phases. The research subjects is students of grade VIII SMP Negeri 3 Depok, Sleman, Yogyakarta Indonesia. Data collected using validation sheet and document. The data analysis technique used is the validity analysis by the validator, the validity analysis of the items. Based on the results of validation by the validator, a test package was obtained with a validity coefficient of 0.45, the interpretation of its validity was moderate. Based on the analysis, it concluded that research has resulted in a valid product in the form of the PISA-Like mathematics test in uncertainty and data content.

Keywords:
PISA-like mathematics problems, literacy ability, uncertainty and data

1. Introduction

The Program for International Student Assessment (PISA) is an international evaluation program to measure the literacy skills of students who are up to 15 years old [1]. Furthermore, the problems in PISA including mathematics, science, and reading [2]. On the other hand, PISA is carried out by the Organization for Economic Cooperation and Development (OECD) every three years since 2000 [3]. In Indonesia, the Mathematics Literacy Contest (KLM) has been held since 2010 with the editor Prof. Zulkardi from UNSRI Palembang. KLM which was once called the Mathematical Literacy Competition (LMM) also measures students' abilities concerning literacy [3]. Therefore literacy ability is an essential thing for students to master in solving everyday problems.

Mathematical literacy skills as a person's ability to formulate, apply, and interpret various problems faced daily [3]. Furthermore, Rusdi [5] reveals that the three words are then referred to as mathematical processes. The mathematical process here is a process that is carried out by someone to connect specific problems with mathematics, which are then used to solve the problem. The

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process includes formulating a problem mathematically, applying concepts, facts, and procedures, as well as mathematical reasoning, then interpreting and evaluating mathematical results [6]. In line with this, the literacy abilities of Indonesian students are still low [7]. Students who have good mathematical literacy skills if they can apply mathematical processes to various problems in daily life. The component of the process of mathematical literacy in the PISA framework is shown in Figure 1.

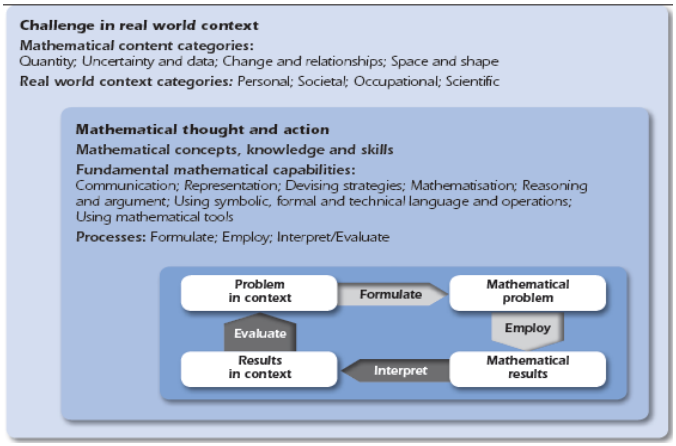

Fig. 1. Component of the mathematical literacy process

Travel is related to the trip that is relatively far away and involves a fleet such as cars or other vehicles. Furthermore, daily problems often involve travel using travel. The context of travel is one of the contexts used in designing mathematical questions of the type of PISA. This context is related to the PISA context, namely the occupational context. This is in line with Stacey [2] which states that the context in PISA consists of four, including relating to personal (personal), occupational (occupational), general (societal), and scientific con-texts. The context in mathematical learning makes students easier to understand a mathematical concept [8]. Therefore, making students more interested in solving PISA questions.

Travel is one area in solving problems using data or in PISA called Uncertainty and data. This content is significant for students to master because it is called the heart of mathematical analysis of various everyday problems [9]. However, in reality, the literacy abilities of Indonesian students are still low, especially in uncertain-ty and data content. This is shown in the PISA results in 2015 which placed Indonesia as ranked 63 out of 70 participating countries [10]. Whereas in literacy skills, Indonesia was ranked in the bottom three in 2000 and 2003 [11].

On the other hand, the PISA results in Indonesia's uncertainty and data contract obtained a score of 385 in PISA in 2003 and 384 in PISA in 2012 with a ranking of 63 out of 65 countries [3,12]. From these results, Indonesian students are not yet accustomed to solving the PISA type math problem. Therefore, KLM is one of the programs implemented in Indonesia as an effort to improve mathematical literacy skills, which in turn can increase the score and ranking of Indonesia in PISA. Related to this, researchers are interested in designing mathematical types of PISA on uncertainty and data content using the travel context. The PISA type math problem designed here is related to students' mathematical literacy skills, namely formulating, applying, and interpreting. The design of the type of PISA mathematical problem carried out by the author is still at the stage of designing questions and performing self-evaluations.

2. Methodology

This study uses the method of design research with development studies type [13]. This study was conducted in three stages, that is a preliminary or preparatory stage, the prototyping stage, and an assessment stage [14]. In the prototyping stage, the evaluation uses formative evaluation with the phases includes self-evaluation, expert review and one-to-one and small group, as well as field tests. Meanwhile, to analyze the two previous stages, the researchers use the assessment stage [15,16]. In this study, the discussion of research is the result of expert review phase. Expert review is phases at the prototyping stage. The purpose of this study was to design a mathematical type of PISA on uncertainty and data content using the travel context. The PISA type math problem designed here is related to students' mathematical literacy skills, namely formulating, applying, and interpreting. The subjects of this study were grade VIII students of SMP Negeri 3 Depok, Sleman, Yogyakarta, Indonesia. This study only reaches the formative evaluation stage, is self-evaluation shown in Figure 2.

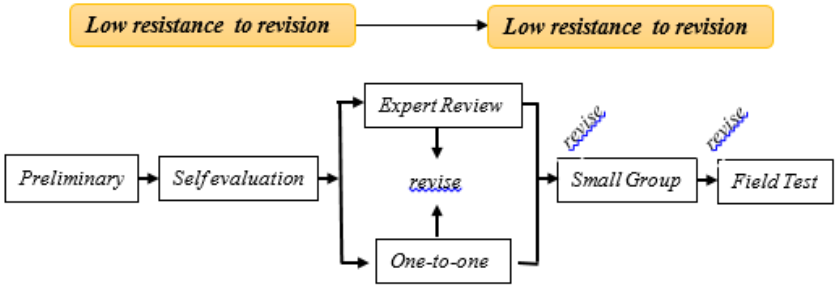

Fig. 2. Design Research Stage [15,16]

2.1. Preliminary

The preliminary stage is carried out by examining some literature related to previous research. Besides, researchers also determine the subject and place of study, and analyze the curriculum and then connect with the PISA framework [17].

2.2. Self-Evaluation

At the self-evaluation stage, the researchers designed PISA-Like mathematics Test. The design process uses three characteristics that the content, constructs and language. The result are analyzed to form the first prototype can be seen in table 1 [18].

Table 1
The characteristics of the prototype

No	Characteristics	Examined Aspect
1	Content	Design questions that are made following the 2015 PISA framework mathematical literacy domain. Design questions that are made fol-lowing the basic competencies and the material being tested Design questions that are made fol-lowing the indicators of students' mathematical literacy abilities

2	construct	The level of design of the questions made is following the level of student's ability of class X. The problem used is following the characteristics of the level problems in the PISA framework.
3	Language	Sentence on communicative problem design The sentence in the design of the question uses good and correct language following EYD (Enhanced spelling) The sentence in the design of the question does not give rise to multiple interpretations or misunderstandings.

2.3. Expert Review

At The expert review stage, the expert validated the prototype. Expert validation uses analysis in terms of content, constructs, and language. Expert who are referred in this study are mathematics education experts. The first prototype's validation process of the expert review stage is done through three ways face-to-face review. Based on result, the product is revised. The validation sheet in this study was used to measure the validity of the PISA test design.

The analysis technique used is descriptive qualitative analysis. Data analysis is done by examining the design of the questions made. The analysis in this study uses the coefficient formula the validity of the instrument with the interpretation category can be seen in table 2.

Table 2
Category interpretation of the validity coefficient

r_{xy}	Interpretation
$0{,}80 < r_{xy} \leq 1{,}00$	Very high
$0{,}60 < r_{xy} \leq 0{,}80$	High
$0{,}40 < r_{xy} \leq 0{,}60$	medium
$0{,}20 < r_{xy} \leq 0{,}40$	Low
$r_{xy} \leq 0{,}20$	Very low

3. Results

The design of the mathematical problem type PISA produces three items according to mathematical literacy skills; formulating, employing, and interpreting. The design phase of the mathematical problem in the PISA model includes the preliminary and formative evaluation stages.

3.1 Preliminary

In the preliminary stage, researchers conduct subject analysis, curriculum analysis, and analysis of PISA questions. In the subject analysis, it was found that the VIII grade students of SMP Negeri 3 Depok, Sleman, Yogyakarta, Indonesia were the subjects of the study. Curriculum analysis is done by identifying learning material based on the 2013 curriculum on uncertainty and data content on class IX students with the subject matter of statistics. In the analysis of PISA questions, researchers analyzed PISA questions. This is done to determine the characteristics of the PISA problem, both level, context, and content. The results of the next analysis were used to design the PISA type math problem. In this case, the re-searcher designed the PISA type math problem uncertainty and data content using the travel context.

3.2 Self Evaluation

At this stage, the researcher checks and revaluates the PISA type math problems that have been designed, both concerning con-tent, constructs, and language. Furthermore, if there are errors in designing questions, either from word selection or typing, or other errors, then the researcher corrects at this stage [18].

Researchers and validators validated the three contents. From the results obtained in this phase, prototype one will be tested by expert. The reviewers in this research were Anggit Prabowo, M.Pd. (AP) also, Darto, S.Pd. (D)

3.3 Expert Review

Based on the results of the validation by the validator, the validity coefficient was 0.45 with a medium validity interpretation. There-fore the researcher revised it. The followings were comments from Experts and Students as well as the revision decision on the problem in Table 3.

Table 3
Comments from expert review

Validation	Comment	Revision
D	1. Change words "and" become "or" in the matter of "departure cancellation." 2. Changing the word "you" to "with" to the question about "restriction of departure."	1. Adding words to the question becomes: "Which of the two travel, Be-jeu Travel or Travel Shuttle and Courier Day-trans amounts to a lower percentage of overall cancelation of passengers?" 2. Adding words in the question becomes: "Show calculation using data from the table above."
AP	1. After the word "using data from the table above" uses an exclamation point (!), not a period (.) 2. The question sentence on the question about "the generation of force" is very effective.	3. Change the sentence to "Which of the two travels has the percentage of passengers who make lower payments?" 4. Change the dot to exclamation point after the sentence "uses data from the table above."

4. Conclusions

The research had produced valid PISA-like mathematics test in uncertainty and data content. Validity was shown from the validator assessment results at the expert reviews phase regarding of content, construct, and language problem and also based on the results of validation by the validator, it was found that the mortality coefficient was 0.45 with a medium validity interpretation. Furthermore, the results of this question design are ready to enter the stages of one to one, small group and field tests as follow-up research.

References

[1] Pisa, O. E. C. D. "Assessment and Analytical Framework Mathematics, Reading, Science, Problem Solving and Financial Literacy, 2013." (2012).

[2] Stacey, Kaye. "The international assessment of mathematical literacy: PISA 2012 framework and items." In *Selected regular lectures from the 12th International Congress on Mathematical Education*, pp. 771-790. Springer, Cham, 2015.

[3] OECD. (2014). *PISA 2012 Results: What Students Know and Can Do – Student Performance in Mathematics, Reading and Science*. Paris: OECD Publishing.

[4] Ahmad, D., S. Suherman, and H. Maulana. "Teacher Mathematical Literacy: Case Study of Junior High School Teachers in Pasaman." In *IOP Conference Series: Materials Science and Engineering*, vol. 335, no. 1, p. 012109. IOP Publishing, 2018.

[5] Rusdi, Rusdi. "THE ANALYSIS OF STUDENTS'MATHEMATICS LITERACY IN SMP NEGERI BUKITTINGGI AS A REFLECTION OF PREPARATION TO FACE GLOBALIZATION ERA OF THE 21st CENTURY." *PROCEEDING IAIN Batusangkar* 1, no. 2 (2017): 343-360.

[6] Oktiningrum, Wuli, Zulkardi Zulkardi, and Yusuf Hartono. "Developing Pisa-like Mathematics Task with Indonesia Natural and Cultural Heritage as Context to Assess Students Mathematical Literacy." *Journal on Mathematics Education* 7, no. 1 (2016): 1-8.

[7] Wijaya, Ariyadi. "Students' Information Literacy: A Perspective from Mathematical Literacy." *Journal on Mathematics Education* 7, no. 2 (2016): 73-82.

[8] Prahmana, Rully Charitas Indra, Zulkardi Zulkardi, and Yusuf Hartono. "Learning multiplication using indonesian traditional game in third grade." *Journal on Mathematics Education* 3, no. 2 (2012): 115-132.

[9] Nizar, Harisman, and Ratu Ilma Indra Putri. "Developing PISA-Like Mathematics Problem Using the 2018 Asian Games Football and Table Tennis Context." *Journal on Mathematics Education* 9, no. 2 (2018): 183-194.

[10] OECD. (2016). *PISA 2015 results excellence and equity in education*. Paris: OECD Publishing.

[11] Stacey, Kaye, and Ross Turner. *Assessing mathematical literacy*. SPRINGER INTERNATIONAL Publishing AG, 2014.

[12] Programme for International Student Assessment. *Learning for Tomorrow's World: First Results from PISA 2003*. OECD Publishing, 2004.

[13] Akker J, et al. (2006). *Educational Design Research* (London and New York: Routledge)

[14] Plomp, Tjeerd, and Nienke Nieveen. "An introduction to educational design research." In *Proceedings of the seminar conducted at the East China Normal University, Shanghai (PR China)*, pp. 23-26. 2007.

[15] Zulkardi, Zulkardi. "Developing a learning environment on realistic mathematics education for Indonesian student teachers." PhD diss., University of Twente, Enschede, 2002.

[16] Tessmer, Martin. (1993). *Planning and Conducting Formative Evaluations*. London. Kogan page.

[17] Permatasari, Ranni, and Ratu Ilma Indra Putri. "PISA-Like: Football Context in Asian Games." *Journal on Mathematics Education* 9, no. 2 (2018): 271-280.

[18] Kastberg, David, Jessica Ying Chan, and Gordon Murray. "Performance of US 15-Year-Old Students in Science, Reading, and Mathematics Literacy in an International Context: First Look at PISA 2015. NCES 2017-048." *National Center for Education Statistics* (2016).