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## **DESIGNS OF PISA-LIKE ASSIGNMENTS WITH YOGYAKARTA CONTEXT TO DETERMINE STUDENTS' LITERACY ABILITIES**

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### **ABSTRACT**

This study aims to develop the need to create PISA type problems using the Yogyakarta context that is designed to obtain student literacy skills. This research is a type of development research by adapting the Tessmer development model. This research was carried out in two stages, namely the preliminary stage, starting from the preparation and design, then the evaluation stage, which included self-evaluation, prototype making, small groups, and field tests. This research is limited to making prototypes. The subjects of this study were grade IX students of SMP Negeri 3 Depok, Indonesia. Data collection instruments consist of a collection of observations, interview guidelines, documentation sheets, and questionnaires. Data were analyzed with qualitative and quantitative techniques. The results showed that the design of the type of PISA that had been developed was declared valid; it could be used in the development of small groups and field tests. Thus, PISA design in the Yogyakarta context can be used by students, both with low, medium, and high abilities according to the needs of students in the industrial revolution era 4.0.

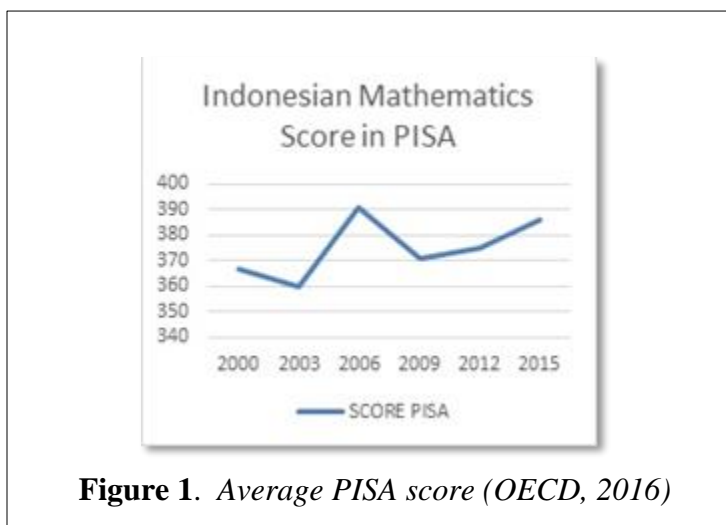
**Keywords:** Design, PISA, yogyakarta context

## INTRODUCTION

PISA (Program for International Student Assessment) is an international assessment conducted by the OECD on the skills and abilities of 15-year-old students (OECD, 2013; Shiel, et al. 2007) where the age of most countries is nearing its end from compulsory education (Stacey, 2011). Skills and abilities in PISA that are assessed include mathematics, reading, and science (OECD, 2015), the first PISA was carried out in 2000 and then carried out every three years (Shiel, et al., 2007). From the start of the first year, PISA assessments carried out always included mathematical literacy skills (OECD 2016). Mathematical literacy is a person's ability to formulate, apply and interpret mathematics in various contexts, including the ability to reason mathematically and use concepts, procedures, and facts to describe, explain or estimate phenomena/events (OECD, 2003; Stacey, 2012).

Mathematical literacy ability is essential because in everyday life activities experienced by humans are very much related to mathematics which requires understanding literacy in solving it (De Lange, 2004). Mathematical literacy can help someone to understand the role or usefulness of mathematics in everyday life (Edo, Ilma, & Hartono, 2014). In a life that is always developing the role of mathematical literacy is very useful to prepare students to face the problems of everyday life. Critical, systematic, logical, creative thinking and willingness to work together effectively in an increasingly tricky era Indonesia experiences changes in the world of education that competes in the international world so that good human resources are needed. According to (OECD, 2013) and (Stacey, 2012) the ability to formulate, implement, and interpret mathematics into various contexts is a mathematical literacy ability.

An overview of mathematical reasoning abilities in using mathematical concepts, procedures, facts, and tools are to describe, explain and predict phenomena that occur in everyday life (OECD, 2013). The PISA international survey study states that mathematical literacy has become their main issue. Indonesia participated in mathematics PISA five times. PISA is a program for assessing students' abilities in the international scope organized by the Organization for Economic Cooperation and Development (OECD). Real problems are a reference used by PISA that requires capabilities abilities including reasoning, spatial or problem-solving abilities (OECD, 2013). Thus, students used for PISA assessment subjects are students aged less than or equal to 15 years (OECD, 2013). This study examines students in reading skills (reading literacy), mathematics (mathematical literacy), science (scientific literacy), finance (financial literacy) and problem-solving (OECD, 2015).



**Figure 1.** *Average PISA score (OECD, 2016)*

In the 2009 Mathematics PISA, almost all Indonesian students only reached level 3, while only 0.1% of Indonesian students were able to reach levels 5 and 6 (Stacey, 2010). The results of the latest PISA survey in 2012 which placed Indonesian students ranked 64 out of 65 countries with relatively low levels where almost all Indonesian students (98.5%) in this survey were only able to reach level 3 (NCES, 2012). Several factors are influencing the low achievement in Indonesia, that is, the teacher lacks mastery in understanding the 2013 curriculum, students are poorly trained in working on problems with PISA characteristics and students require understanding in solving contextual questions. PISA is an international standard study organized by the OECD which studies students' literacy skills (Edo, Ilma, & Hartono, 2014). Research on PISA has been carried out among others by (Kamaliyah, Zulkardi, & Darmawijoyo, 2013).

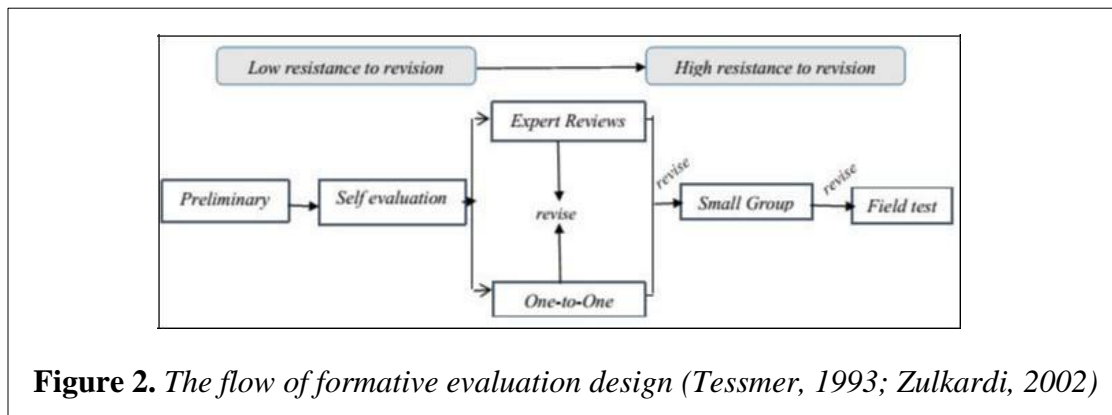
Development of Mathematical Problem Level 6 model PISA, (Ginsburg, et al., 2009) Development of mathematical questions in the model of content quantity to measure students' mathematical reasoning abilities (Ahyan, Zulkardi, & Darmawijoyo, 2014) developed the question of the PISA model using change and relationship content. But of all the research on PISA that has been carried out, none of them have used the right Yogyakarta context that students often encounter in their daily lives. While the importance of solving mathematical questions that use context according to (Lutfianto, Zulkardi, & Hartono, 2013) is one way that can be used so that students have the skills needed to live in the present century. Also, questions using context can challenge students' mathematical thinking patterns (Vogel, 2005).

Furthermore, mathematical literacy does not only exist when a person gets a formal education, but when students socialize or play, they will also develop mathematical literacy (Hayat & Yusuf, 2010). As well as an essential aspect of mathematical literacy is that mathematics is involved in solving problems defined in context, the context is the aspect of the individual world in which the question is placed (OECD, 2013). So that the PISA problem using context will help students maximize students' mathematical literacy abilities. This is in line with the concept of assessment in PISA which prioritizes the current mathematical literacy skills. As a form of contribution to the implementation of

the 2013 curriculum that integrates PISA content into mathematics learning, efforts are needed such as the development of mathematical literacy-based questions. Through this effort, it is expected that the resulting questions can be used as an additional vocabulary based vocabulary and as study material in designing PISA based learning. From the previous description, it will be known to what extent the students' mathematical literacy abilities in completing PISA questions using the Yogyakarta context. Thus, the purpose of this article is to describe the process and results of the design of mathematical problems in the PISA model with the Yogyakarta context.

## RESEARCH METHODOLOGY

This study is a design research type of development study. This type of research is development with a repetitive cycle that uses formative evaluation (Tessmer, 1993). This study aims to produce mathematical questions in the PISA model using the Yogyakarta context that is valid and practical and has a potential effect on students' mathematical literacy abilities. The subjects of this study were 3 grade IX students of SMP Negeri 3 Depok Sleman Yogyakarta. Figure 2 is a formative evaluation design flow.



**Figure 2.** *The flow of formative evaluation design (Tessmer, 1993; Zulkardi, 2002)*

The instrument of data collection consists of observation guidelines, interview guidelines, and documentation sheets. Data is analyzed by qualitative techniques. Furthermore, this study produced PISA-like mathematics tasks that fit the needs of students in the 4.0 industrial revolution. Meanwhile, the subjects in the study were students of SMP N 3 Depok, Sleman, Yogyakarta. Following the formulation of the problem proposed in the background, research is limited to the stages of designing, self-evaluation, and prototyping (expert reviews and one-to-one).

## RESULT AND DISCUSSION

In this stage it is divided into 2 stages, namely preliminary stage and formative evaluation stage

## Preliminary Stage

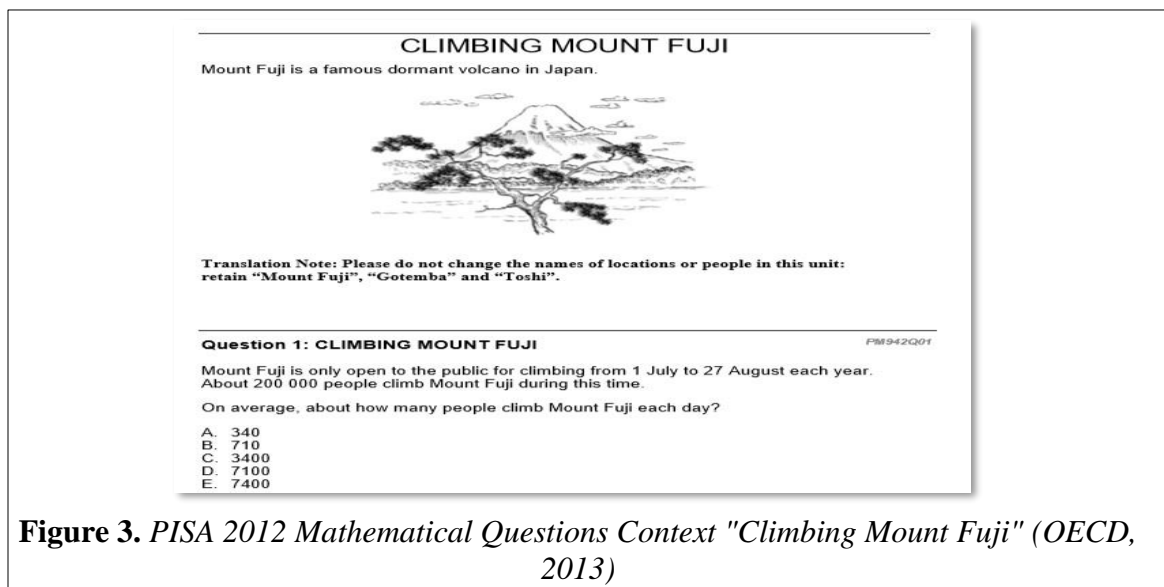
At this stage, the researcher poured the initial idea, which began with studying various literature studies before designing the mathematical problem of the PISA model. The researcher analyzes the curriculum, context, makes an instrument, examines the 2015 PISA framework and some literature on development research that relates to research that will be planned to be used as a draft of the initial prototype. The researcher determines the place and subject of the study that will be used as a place of research by contacting the Principal and the mathematics teacher at the school. These results are used as a foundation for the depth of students' abilities so that instructional design becomes more appropriate. After that, plan a mathematical task model similar to PISA related to the Quantity of content using the Yogyakarta context. The design of this product is a draft that focuses on three characteristics, namely: content, construct, and language. So at this stage, we obtained a question to measure the mathematical literacy skills of junior high school students based on PISA questions in the Yogyakarta context.

## Formative Evaluation Stage

In this stage, there are two stages, namely self-evaluation and prototyping

### *Self-Evaluation*

At this stage, the researcher conducted an assessment of the results of the design of mathematical questions in the PISA model on Quantity content with the Yogyakarta context created by the researcher. The development of a conceptual framework is done by designing a question grid. This PISA type math problem was developed in 6 levels, level 1 to 6. Questions were inspired by the PISA 2012 problem with the context unit "Climbing Mount Fuji" presented in Figure 3.



**Figure 3.** PISA 2012 Mathematical Questions Context "Climbing Mount Fuji" (OECD, 2013)

Furthermore, the researcher conducted a paraphrase method to obtain new questions and change data from statements on specific questions. The paraphrase method is used to obtain new questions by reformulating problems to different mathematical domains. In Figure 3, students must apply their understanding of how many people climb Mt. Fuji on average every day. The competencies in the question will be paraphrased into content quantity. While the method of changing data from statements on specific questions is by adding a representation of formulas to compare information and determine the values associated with other information. Next, in this problem, questions will be made with content quantity using the societal context and formulate process. Next is the design of the questions that will be made with the prediction of level 4, which is then referred to as prototype 1. The picture below is one of the mountains in Yogyakarta, namely Mount Merapi or "Yogyakarta Merapi Mountain".



**Figure 4.** *Photo Mount Merapi*

In May 2018, the Merapi volcano in Yogyakarta erupted and caused a puff of hot clouds into the air, so that all the activities around Mount Merapi were suspended. After almost two months closed for climbing activities, at the end of June 2018, Mount Merapi's activities declined, and in July 2018 the climb was reopened. Four months after the decline in Mount Merapi activity, it was noted that 11,070 people did the climb. Show what is the estimated average number of climbers of Mount Merapi each day at four months after the decline in mountain activity? Give your reasons!. In the context unit "Mount Merapi Yogyakarta," a number statement is available to find the average number of mountain climbers. The statement of numbers is used to link some other information so that students can assess the average number of climbers after the decline in mountain activity. The statement in the context unit "Mount Merapi Yogyakarta" is what makes the question classified as content quantity. The context unit "Mount Merapi Yogyakarta" presents a problem about the activity of Mount Merapi after the eruption. Such topics are discussed in environmental science in everyday life. Because this is a general subject, the above questions are included in the societal context. Furthermore, in the question with the context unit "Mount Merapi Yogyakarta" presented above, students must be able to identify, understand the size of the information, and then formulate the problem in the form of a number pattern to make conclusions. Therefore, the formulate process is the main focus in this matter. Judging from the mathematical abilities involved, communication skills are needed to identify and combine information on the number of climbers and time. Also, students also need mathematical abilities to make mathematical

models of numbers. Furthermore, representation capabilities are also needed. The reasoning and argument skills are also needed in combining information in making conclusions. In finding a direct strategy by using information on text and questions in making conclusions, students need to choose step by step to find a solution to solve the problem. In the end, students also need to do mathematical procedures in using statements in making conclusions.

### ***Prototyping***

In the expert review stage, the design of the questions made by the researcher is then validated by experts and the mathematics teacher. Products that are designed to be seen, assessed and evaluated. The validity test is done, namely: test the validity of content, constructs, and languages. Next, the suggestions from the validator are used to improve the design of the mathematical problem in the PISA model made by the researcher. Suggestions and responses from the validator about the question design are written on the validation instrument as a reference for revising and stating that the question is valid.

In this study data, collection instruments were used, namely:

- Document

To get the data and be able to know the practicality of the PISA model questions on the content quantity that has been made by the researcher include clarity and readability of the questions.

- Mathematical test of the PISA model on content quantity

To get data about students' ability is to solve math problems in content quantity. This test is conducted to see the literacy abilities students have on mathematical questions in the PISA model on the context content of Yogyakarta which is presented based on the criteria made.

The question was validated by Anggit Prabowo., M.Pd as Ahmad Dahlan University lecturer and Darto, S.Pd. As a Mathematics teacher who currently serves as Head of Depok Sleman Middle School 3. The results of the calculation of the validation sheet by the validator are shown in Table 1.

**Table 1.**

*Results of Validation Sheet Calculation*

No	Validator	Total score	Qualitative Criteria
1.	Anggit Prabowo, M.Pd.	48	Valid
2.	Darto, S.Pd.	46	Valid
	Average	47	Valid

In Table 1 it can be seen that the average total validity of the PISA type math problem on content quantity is 47. The results of the calculation of the validation sheet are in the validity criteria as shown in Table 2.

**Table 2.***Criteria for Ideal Rating Categories*

No.	Score	Qualitative Criteria
1.	$\bar{X} > 50,4$	Very Valid
2.	$40,8 < \bar{X} \leq 50,4$	Valid
3.	$31,2 < \bar{X} \leq 40,8$	Enough
4.	$21,6 < \bar{X} \leq 31,2$	Less
5.	$\bar{X} \leq 21,6$	Very Less

The results of the validation sheet calculation show the validity criteria of  $40.8 < \leq 50.4$  so that the design of the mathematical type PISA developed was declared valid. Because prototype one has been declared valid, the prototype one must be revised, and the revised results are called prototypes 2. Revisions are made based on the comments given by both validators as a whole and comments on each question. Following are the overall comments from the validator presented in table 3.

**Table 3.***Suggestions for Improvement and Revised Decisions*

No.	Comments and Suggestions for Improvement	Revised Decision
1.	Overall in the aspect of the content is good, but again adjusted information about the content contained in each question.	Revision of improving information about the context contained in each question.
2.	In the construct aspects of each question is good.	In a good construct aspect is maintained and corrected.
3.	The language used in the question needs to be adjusted again with EYD (Enhanced Spelling).	Revisions related to EYD on developed questions.
4.	The use of the sentence in the question needs to be corrected and felt in reading so that it can be easily and understood by students.	Revision of the language of sentence sentences that are easily understood by students.

In the one-to-one stage, three non-research subjects were asked to work on the draft prototype 1. Based on the results of the student's work, the researcher made several improvements. These changes are one of those languages which have several interpretations and are easy to understand, so it requires clear sentences to use.



## CONCLUSION

The development of the PISA-like mathematics tasks design of quantity content to know mathematical literacy ability has gone through a process of analysing, both student analysis and material analysis, self-evaluation, expert review, and one-to-one. The results of the development of the design of the tasks are declared valid and are ready to enter the stages of small group and field tests as follow-up research. In the small group stage, the prototype that has been revised will be tested on six non-research subjects. Then in the field test stage, the revised prototype of the small group stage was tested on the research subject students.

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