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PISA-Like Problem with Golf Context in ASIAN GAMES 2018

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Abstract. This research aims to produce golf sports context PISA-like problems which validity and practicality on Asian Games 2018. The research method used is Design Research type development studies which consist of two stages, preliminary and formative evaluation. Formative evaluation which includes: self-evaluation, one-to-one, expert review, small group, and field test. The data collection techniques used were walkthrough, documentation, tests, and interviews. Researchers used the golf context to require students to estimate which bunkers have the largest area using the map scale. The problems were tested to the students of grade X MIA 3 in SMAN 10 Palembang, Indonesia. The data analysis technique used in this study is a descriptive qualitatively analysis. However, this paper only shows the preliminary, formative evaluation (self-evaluation, one to one, expert review and small group). The result of the research shows that research has produced five problems PISA-like used golf context that has been valid qualitatively based on the framework PISA who validated by three expert reviews and practical, students are easy to understand and language the problem.

INTRODUCTION

PISA (Programme for International Student Assessment) is an international assessment to see the academic ability in literacy of reading, literacy of mathematical and literacy of science held every three years. The involvement of Indonesia in PISA is an effort to see the position of literacy ability of Indonesia's student when compared with student literacy achievement in other countries and the things that influence it [1]. Indonesian students' performance in solving high-level mathematical problems is lower than most of the other participants in PISA [2]. Indonesian ministry of education responds this problem by developing a new curriculum what so-called curriculum of 2013 to ensure that every student acquires the intended knowledge to be able to compete at the international level. Putri [3] reveals that one approach that is in line with the 2013 curriculum is PMRI approach. PMRI is a learning approach adapted from Freudenthal known as Realistic Mathematics Education (RME) and has been developed in Indonesia. Since 2001, PMRI has been widely used in improving the student's interests, attitudes and learning outcomes [4]. PMRI is one of the learning approaches that will lead students to understand the math concepts by constructing by themselves through the previous knowledge related to their daily lives, by finding the concept by themselves [5]. This is in line with the statement by Freudenthal that students should be given the opportunity to experience or be directly involved in the learning process [6]. Zulkardi and Putri [7] said that PMRI is one approach that uses contextual. Charmila [8] said that it is important to integrate the context in the surrounding environment.

In 2018, Indonesia will host the XVIII Asian Games. On this occasion will be held in Jakarta and Palembang. The Asian Games is a sports competition held every four years with athletes from all over Asia enrolled in the Olympic Council of Asia (OCA) membership [9]. From the sports that will be held at the Asian Games later, many contexts related to space and shape that can be applied into the math either from the equipment used, the situation of sports events and even the place of sport. There are several studies that developed PISA like problem in Asian Games, such as Rahayu [10] stated context of athletics hurdles which is an Asian Games sport is used as the starting point used as a helpful media to solve the problems associated with fractional multiplication operations with natural numbers, Roni [11] states used the context of sprint sport at the Asian Games give impression of

something new and different. Meanwhile, Gunawan [12] used the swimming context is chosen because it can represent fractions using measurements. The shape of the pool is one model that allows representing parts of the whole.

Different from those studies, the researcher developed PISA like problems that using golf context is chosen because the context can make student estimate area irregular shape with their assumptions. As we know, the shape of field golf includes an irregular area. So the purpose of this research is to produce a valid and practical PISA math problem with golf context in Asian Games 2018.

RESEARCH METHODS

This research method is design research type development studies which consist of 2 phases that is preliminary and formative evaluation which include: self-evaluation, one to one and expert review, small group, and field test [13]. By the provisions of the PISA framework subjects in this study are 15-year-old students in the class MIA 3 SMA 10 Palembang.

Initially, researchers evaluated and reviewed the initial prototype draft. The researcher also designed several instruments (lattice, question cards, scoring rubrics and PISA questions on Space and Shape content based on PISA questions criteria). This research begins by describing how the developed problem to be valid. Therefore, the subjects used in this stage are three students who have various capabilities such as high ability, moderate and low. The three students are subjects in the one-to-one stage given about Prototype 1. Prototype 1 is a matter that has been developed by researchers. In other, prototype one also given at the expert review step. In this case, expert review is a PISA expert. In this study, the expert who became expert review is Prof. Kaye Stacey, Dr. Ross Turner, and Prof. Ahmad Fauzan. This validation test focuses on three characteristics (content, constructs, and languages). The revision of prototype one is called prototype II. Prototype II is given to a small group of nonresearch subjects with six students with each low, moderate, high-ability student. At this stage also evaluated the appearance and use of questions to see the responses, assessments, and practicality of these questions and the results as input to revise the design question to the next stage. The revision result of the small group is called prototype III. Then the next stage, prototype III is tested with the subject of research by analyzing the results of student answers. It aims to see the potential effects that arise on students' mathematical abilities.

Data collection technique used in this research is walkthrough; used to know the validation of the problem both regarding content, constructs and language according to the PISA framework. The function of documentation as physical data in the form of related documents. The test is performed to see comments from students on clarity, legibility, results of student answers to basic mathematical skills that arise. Interviews serve to gather information about what students think when they complete the given problem.

RESULTS AND DISCUSSION

This study has produced five problems of PISA type using the context of golf sports. Researchers were interested in discussing the problem using the context golf because there are various ways of completion that students use, so there are many assumptions that students use in solving problems given. The following stages in the development of PISA problems using the context of golf sport at the 2018 Asian Games.

Preliminary

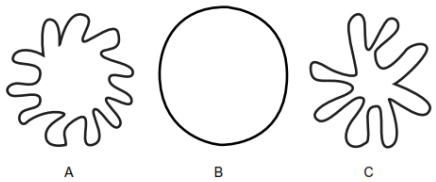
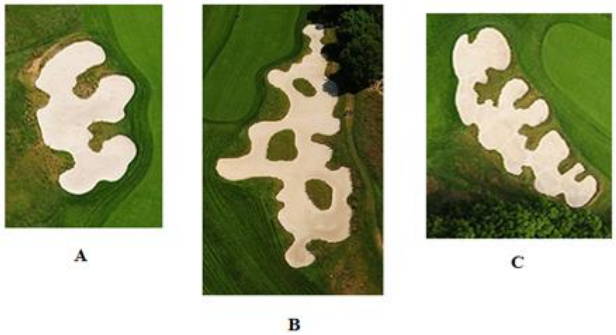
At this stage, the researcher determines the place and subject of the research, analyzes and designs the PISA (prototype 1), creates a grid containing the appropriate indicators of the curriculum, designs the cards problem, scoring rubrics according to the PISA framework. Also, the researcher contacts the subject teachers to be used as research sites and prepares other needs such as scheduling and working procedures with classroom teachers.

Formative Evaluation
Self-evaluation

On self-evaluation step, the researcher reviewed the prototype design by checking the conformity of the problem design with the PISA 2015 framework both regarding content, context, language and level prediction in PISA. This stage aims to check the error in the process of resolving the problem before the prototype is used in the next stage. The results of this prototype will be given to experts at the expert review stage and one-to-one. Furthermore, researchers also designed several instruments such as lattices, cards problem, scoring of rubrics and

PISA problems based on the PISA framework. From this stage, nothing changes or nothing to repair, because according to the researchers the instrument is made by the PISA framework. The result of this prototype is called prototype 1. Researchers are motivated to develop problems from the PISA problem about the area and a rock concert. In this case, researchers change the context using golf sport. Researchers want to estimate which bunkers have the largest area using the map scale. Researchers also want whether students who solve these problems have determined reasonable, relevant and accountable assumptions given their assumptions. The content used in this issue is space and shape. Predicted levels on this issue include level 4 predictions. Here is a comparison between the original PISA problem with the developed problem.

Table 1. Comparison between the original PISA problem with the developed problem

PISA problem	Developed problem
M158: Shapes  **Question 1: SHAPES** M158Q01- 0 1 8 9 Which of the figures has the largest area? Explain your reasoning. **(PISA, 2009)**	 Golf is one of these games that does not have a standard field; it is played on a golf course that each has its own unique design. The picture above consists of grass used for the field and the san-filled (bunker) used as a trap/obstacle surrounded by a path. Which of the bunker has the largest area? Explain your reasoning.

Expert Review and One to one

Prototype 1 then validated by experts at the expert review stage and by students at the one-to-one stage. Both of these stages are carried out simultaneously. This stage is to look at the validity of PISA math type instruments using the golf context that has been developed. Expert review is a qualitative stage of validation. Experts who act as validators through via mails reviews are Kaye Stacey, Ross Turner, and Ahmad Fauzan. The expert act as a validator on the review panel item is Zulkardi (Sriwijaya University Lecturer), Somakim (Sriwijaya University Lecturer) and Ika Pratiwi (University of Sriwijaya University graduate students).

The following inputs provided by the three experts, Ross Turner said that perhaps add a way to approach the problem that provides a reason for wondering about this bunker. Besides that, repair to make clear that the photographs or images of the three bunkers have been prepared to preserve the relative sizes. Meanwhile, for scoring rubric given any consideration to the possibility of variations or even of very different approaches. Kaye Stacey added that change for prediction level to be level 4 and that problem must add whether all the pictures are to the same scale.While Ahmad Fauzan comments that preferably the size of the images displayed on the same scale. While the advice given from the panel item results is to add a goal or reason why you want to develop a problem that uses the context of the sport. So that the students aim to be motivated to solve the problem.

In one-to-one step, the problem of the prototype I have tested also to three students who have various abilities which consist of each student has the low ability, the student has the medium ability, and the student has high ability. The focus of this stage is to get students comments on the clarity of the question intent, propose changes or alternatives, investigate why students are confused or have difficulty or even other interesting things from some aspect of the problem device. The three students at this one to one stage initials CAR, MFR and NA. MFR said that The picture given is clear. But if to find the area of each bunker is still confused. Because of any picture is not given any provision. We recommend that information about golf be removed. NA said that the size of the bunker is unknown, as the length or width of each bunker so it can't be searched for the bunker. So the student is confused about the interpreted area each bunker. While CAR said that add information on the problem such as the

scale used. He recommends that each bunker has a different scale and add distance information to each bunker. Based on the comments and suggestions from the validator and students at the one-to-one stage, the researcher made improvements to the prototype 1. So that the revision decision is Information on the matter has been added as it is using the same scale. Based on the revision of suggestions and comments from expert review and one to one conducted in parallel, then obtained a second prototype.

Small Group

On small group step, prototype two is tested to 6 students. Students involved at this stage are students which consist of each student has two low ability, two student has the medium ability, and two student has high ability. The six students at the small group stage were given prototype two simultaneously. The students were given time to work on the problem individually; then after a few minutes, they were asked to work on the matter with their group members by way of discussion.

The researcher's focus on this small group stage is to see if students can understand the purpose of the given questions, whether information such as tables, figures, numbers can be seen and understood well. As long as the students solve that problem, the researcher goes around to see if there are any problems that the students encounter in the process of solving the given problem. Then after the students completed the given problem, one of the group representatives was interviewed to ask how the problem had been worked out.

In general, students are still confused in solving the problem because the area on each bunker is unknown except the scale on the picture and square size of the unit. Then they add information about the scale of the numbers should be written directly on the image. So that the revision decision made by the researcher among others is the matter retained without being revised because of the matter designed without notifying the size each bunker. The aim this problem that students can estimate how much sand by first searching the area of each bunker by using other strategies that support and revise the writing of the scale of numbers written directly on the image.

From the revised findings, the results of the revision of the questions made based on the suggestions and comments of students in the small group stage then produced the third prototype. The third prototype is shown in Figure 1.

Figure 1. Golf Field

In golf, each towards the hole usually has a hazard (hazards). In the picture above there is an obstacle called a bunker. The bunker is irregularly shaped, the ground is dug up to 30 cm and re-sanded. Each bunker only filled $\frac{4}{5}$sand of unearthed depth. Determine which bunker requires more sand and how much sand the bunker needs (in cm^3) Note: If required using a unit square, then use the size of 0.5 x 0.5 (in cm)

Figure 1. Prototype 3

Here is the discussion of the results of student answers in the small group stage in solving problems with their respective strategies. Figure 2 is the incorrect response.

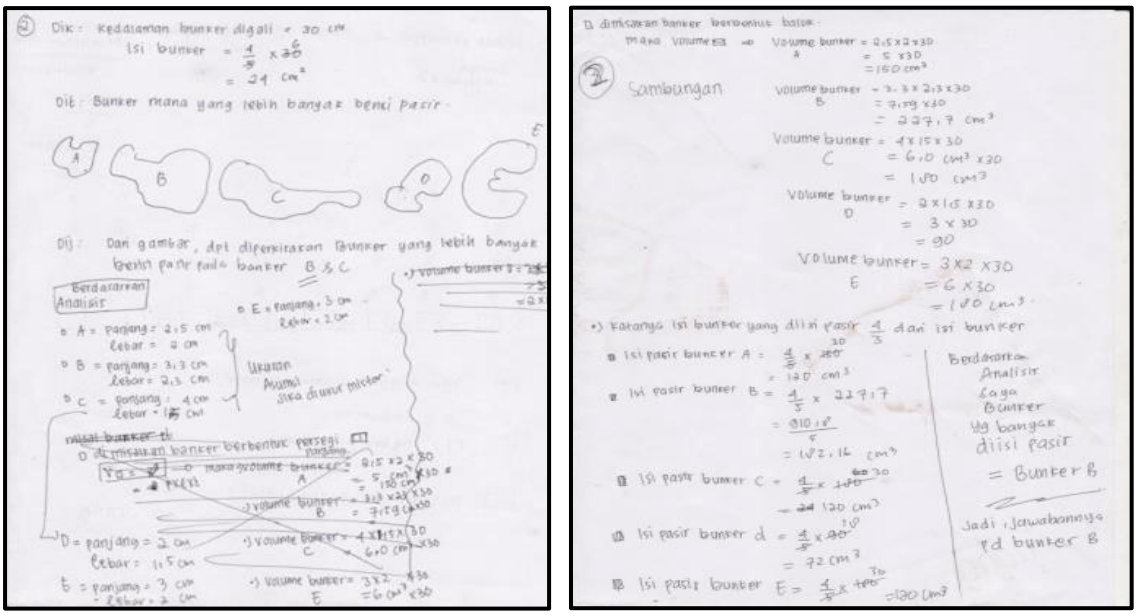


Figure 2. The Incorrect Answer

The above answer is student's answer. It appears that assumes that how to find the area of each bunker is to use the cuboid formula. The student states using the cuboid formula caused because the bunker has a depth so that she used the cuboid formula to the found area of the bunker. The length and width of each bunker are obtained by calculating the manual using the ruler. While the height obtained from the depth that has been determined by the problem. In this case, students are mistaken in estimating the area of the irregular shape.

Some students can't answer this problem. Because students are still confused in solving the problem because the area on each bunker is unknown except the scale on the picture and square size of the unit no number is known in every bunker. So students can't determine the area of each bunker. This is in line with Lutfianto [14] statement which 75% of student can't finish contextual math problem with the maximum.Here Figure 3 is the correct answer to this problem.

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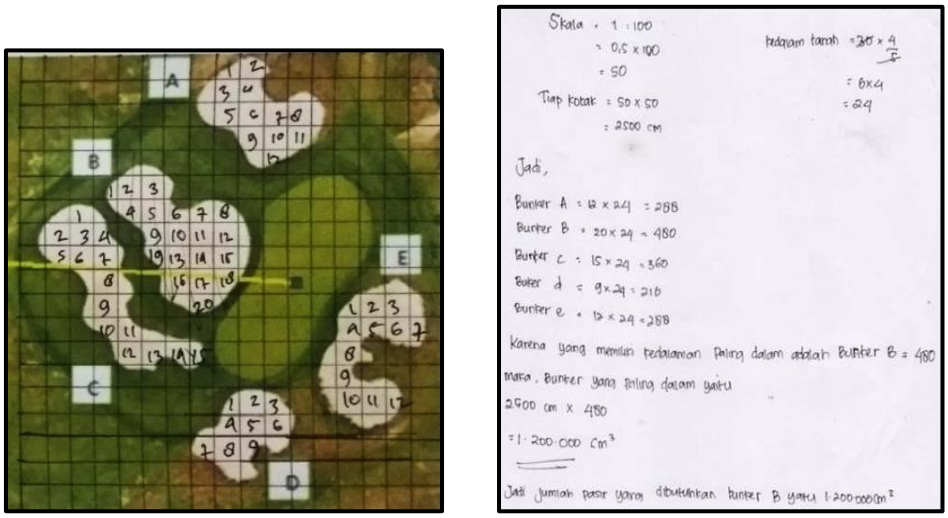

Figure 3. The Correct Answer

The above answer is another student's answer. It appears that students understand the concept of area irregular shapes. The student created square boxes of 0,5 x 0,5 (as specified by the problem). Then in figure 3, student looks at counting how many units of squares can be counted into one unit each bunker. Then their looks for the volume of sand depth and calculates the area of each square unit using the scale. After that, students calculated area of

each bunker. Then concludes which bunker has the largest area to hold sand, so the final stage is students looking for how much sand it takes to fill the bunker by multiplying between the widest area of bunker and area of one unit. So, their can conclude that the bunker that needs the most amount of sand is bunker B which is 1.200.000 cm^3.

To solve this problem, students need to involve some mathematical literacy skill in applying concepts, facts, procedures, and mathematical reasoning. Based on field test results, there are 17 of 33 students can use mathematical tools to describe a complete mathematical relationship. It appears when students sketch to find the area of each bunker. To make the sketch, students try to make it by making a square unit. In this case, the student can use mathematics tools ability.

Besides that, there are 10 of 33 students can explain the justification in determining the processes and procedures used to determine the results or complete mathematical solution. Furthermore, 6 of 33 students can connect between previous information to determine a complete mathematical solution. In this case, the student can use reasoning and argument ability. Another mathematical literacy ability that arises is communication ability; there are 13 of 33 students can write the process in reaching the solution completely and correctly. Also, there are ten students can use understanding context to solve math problems completely. In this case, students are able using the mathematizing ability. So seen from the result of students answer can be concluded that there are several abilities of mathematical literacy such as communication ability, mathematizing ability, using mathematical tools and reasoning and argument ability. Hapizah [15] said the ability of reasoning is the ability to direct the mind to produce a statement in reaching conclusions when solving a problem.

Same like Nasution [16] stated the use of the rowing sport could be a bridge of students' thinking and help students in understanding the operation of addition and subtraction of fractions. Gunawan [17] added with the support of context and learning media, students learn will be more enthusiasm. Also, many students reveal that in solving this problem requires sufficient reasoning and to solve problems ability. This is in line with Putri [18] said that learning mathematics through sports can make students prefer mathematics, this is because they will adapt faster because it concerns daily activities. The concept of learning will be effective and minimize the level of difficulty of students in mathematics. As stated by Zulkardi and Jurnaidi [19] in their research which concluded that the results of interviews with 5 students of the field test field is illustrated that in general the problems of mathematical reasoning PISA model can provoke students to think reason in solving the problem even though some students still have problems in understanding and resolving it. This means that the PISA model of sports content developed can explore students' mathematical ability, and give positive effects to the students so it can be concluded that the problem has the potential effect on the students.

CONCLUSION

Based on the results and discussion, it can be concluded that a five-item of mathematics developed golf context has been valid and practical. Valid is shown from the results of the validator assessment at the expert review stage which states that the problem has been good regarding content, constructs, and language. For practicality, it can be seen in the small group stage that students can use the problem so well, easy to read and do not generate multiple interpretations.

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