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Developing Hot's Mathematics Task with Indonesian Heritage as Context to Assess Mathematical Literacy of Students in Primary School

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ABSTRACT

The goal of this research produces a set of HOT mathematics tasks with Indonesian heritage as a context that is valid and practical to assess the mathematical literacy of students in primary school. The participants of the study were 120 students in primary school. The data was collected through documentation, questionnaire, test result, and interviews. This is design research using a type of development research with formative evaluation. The mathematics task not only reviewed by 7 experts, who assess the context, content, and language of prototype but also beyond empirical evaluation of validation and reliability testing. The field test result showed that the HOT mathematics task has a potential effect on the mathematical literacy of primary school students.

1. INTRODUCTION

Science in the present century has developed according to demands life that also develops. One effort to deal with demands in the 21st century is to develop one's literacy abilities or skills which can be used to face challenges in the life of the current century. Literacy is the ability or skills in reading, mathematics, and science. The efforts to promote and develop thinking skills should begin at the primary school level because this level is considered as the best time to cultivate the basic foundation for further education (Ikhsan and Norlia, 2005).

NCTM (2000) in Yuniawati (2013) explains that the learners have to study mathematics with understanding, it means learners have to develop their new knowledge actively from their own experience and previous knowledge. To achieve those things, it is formulated in 5 general aims of mathematics learning, i.e: first, learn to communicate (mathematical communication) second, learn to reasons (mathematical reasoning), third, learn to solve the problem (mathematical problem solving), forth, learn to connect an idea (mathematical connections) and fifth, forming the positive attitude towards mathematics (positive attitudes toward mathematics). These skills are normally called Higher Order Thinking Skills (HOTS).

However, the implementation of thinking skills is lack especially for primary school students in Malang Regency. It shows by the result of UASBN, the students of Malang regency ranked 32nd in East Java and has been carried for years. There are two factors causing the problems, the first is UASBN have several questions with a higher standard, this is known as HOTS or High Order Thinking Skill, and the second due to changes in the test mode from Paper and Pencil-Based National Exams (UNKP) to Computer-Based National Exams (UNBK).

The High Order Thinking or HOT problem which is applied in UASBN is an implementation from Kurikulum 2013. HOTS is measured using tasks, including analyzing, evaluating, and creating conceptual and procedural knowledge, or metacognition (Retnawati et al. 2018). Kemendikbud (2017) also explain that HOTS task measured the ability of students'; 1) transfer of one concept to another; 2) process and apply information; 3) looking for correlation form various different information; 4) using the information to solve the problems; and 5) examining ideas and information critically. Therefore, acquaint students with HOT tasks is important to help them get ready for solving recent issues, adapt themselves to a new atmosphere, making a decision about particular problems and practice reasoning and communication skills.

In addition, Saputra (2016) mention, the purpose of Higher Order Thinking Skill (HOTS) is how to improve students' thinking skill of a higher level, related with the ability to think critically when receiving various information, think creatively in solving problems using knowledge possessed and making the decision in complex situation.

Table 1. Basic Concept of Higher Order Thinking Skill (Dinni,2018)

Problem Solving Krulik & Rudnick (1988)	Bloom Taxonomy (1956)	Bloom Taxonomy Revision by Ander and Krathwohl (2001)	Higher Order Thinking Skill
Recall	Knowledge	Remember	
Basic	Comprehence	Understand	
	Application	Apply	
Critical	Analysis	Analyze	Critical Thinking
Creative	Synthesis	Evaluate	Creative Thinking
	Evaluation	Create	Problem Solving
			Decision Making

Besides, being able to solve the HOTS problems, students should have mathematical literacy. De Lange (2006) explain if mathematical literacy is about the functionality of the mathematics you have learned at school. This functionality is important for students to survive in a successful way in the present information and knowledge society. Mathematical literacy is an individual's capacity to formulate, employ, and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena. It assists individuals to recognizes the role that mathematics plays in the world and to make the well-founded judgments and decisions needed by constructive, engaged and reflective citizens (OECD, 2017).

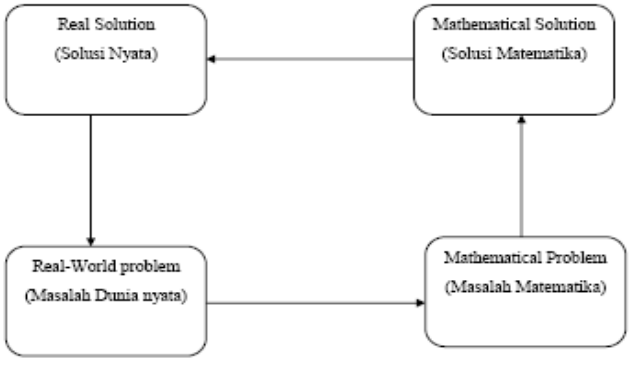


Figure 1. Mathematical Process (Dinni, 2018)

The indicator of mathematical literacy is (1) reasoning and mathematical thinking; (2) mathematical argumentation; (3) mathematical communication; (4) modeling; (5) submission of problems solving; (6) representation; (7) symbol; and (8) media and technology (Aini, 2013). Oktiningrum (2016) also expresses, if the mathematical literacy process begins with recognizing realistic problems, formulate the problem mathematically, calculate with mathematical procedures, and interpret the results. Nowadays, the mathematical literacy of Indonesian students very concerned. It showed by results of PISA and TIMSS, from the Ministry of Education and Culture page it is known that the results of PISA in 2015, Indonesia ranked 63 out of 70 countries, and ranked 45 out of 50 countries for the TIMSS ranking.

This happens because students are not common in working on questions with high-level thinking (Shadiq, 2007). In addition, Julaiha (2011) said that most of the students are not familiar with realistic context. Jupri, et al (2013) explain that there are several things that make the students fail because the students formulate mathematical problems into formal form and when they have found the results, they don't proceed to the next step. It's mean that the mathematical literacy of students did not develop well.

Base on the problem, the aim of this study produces a set of HOT mathematics tasks with Indonesian heritage as a context that is valid and practical to assess the mathematical literacy of students in primary school. Indonesian Heritage chooses as context because the researcher wants to introduce the Indonesian Heritage to students' especially students' in the Malang Regency. McConatha and Schanell (1995) in Bishop (2001) explain that culture has been defined as an organized system of values transmitted to its members both formally and informally. Learning mathematics as a cultural induction has been and continues to be researched over the past twenty years, and the research shows that cultural values are an integral part of every teaching of mathematics (Bishop, 2001).

2. MATERIALS AND METHODS

The goal of this study produces a set of HOT mathematics tasks with Indonesian heritage as context to assess the mathematical literacy of students in primary school through design research with the type of development study. This study concern with iterative development using formative evaluation in various consumers (Plomp & Nieveen, 2007). The formative evaluation in this research contained preliminary stage and prototyping phase which includes self-evaluation, expert reviews and one-to-one, small group, and a field test (Zulkardi, 2002; Tessmer, 1993).

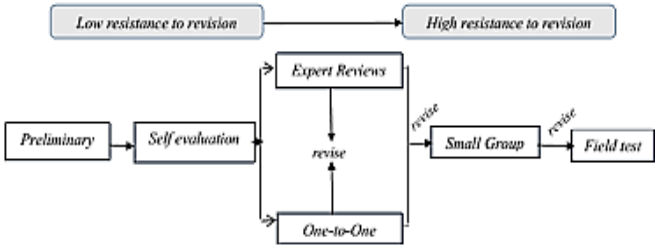


Figure 2. Formative Evaluation Design (Zulkardi, 2002; Tessmer, 1993).

The first step of the development process is the preliminary phase. In this phase, the researcher organizes the concept and theory of mathematics tasks with HOT type, select Indonesian cultural and natural heritage as context, and then call it as a prototype. Next, the prototype reviews by experts and students. They checked the content, construction, and concept of the task.

The phase when the students check the mathematics task called a one-to-one phase. The five students involved in this phase. They check the language, grammar, diagrams, pictures, content, context, etc. The result of this phase will revise by the researcher before the small group phase.

The students who involved in the small group phase have different abilities. The researcher gives 75 minutes to the 10 students to complete the task. This phase focus on students' performance to solve the task. The outcome of the small group phase will evaluate by the researcher and expert before to final phase or field test phase.

The field test implemented in the four elementary schools in Malang Regency. The total of students involved in the field test is 120 students with various abilities. The result of the filed test used to know the potential effect of the task to measure the mathematical literacy of students.

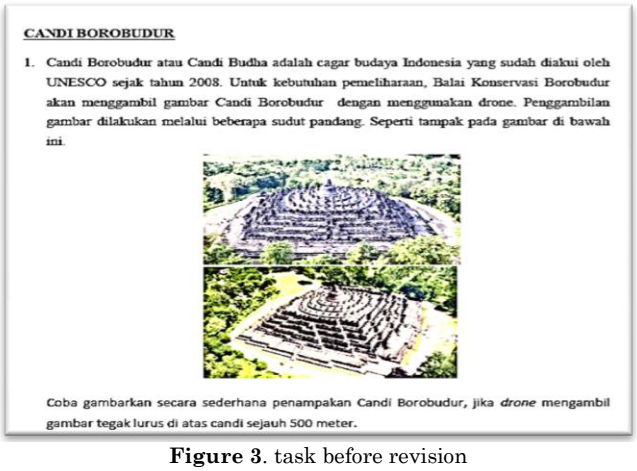
3. RESULTS AND DISCUSSIONS

3.1 Developing Task

In the preliminary stage, we organize few steps; (1) examined the literature on developing a mathematical task, the level cognitive of thinking, (2) designed an initial prototype comprising a set of HOT task and its scoring, (3)determined the validators, (4) determined the research subject. At the stage of self-evaluation, we examined the initial prototype by prototype-1.

The prototype-1 assess by 6 experts and also five students through the one-to-one phase. The expert assesses the task by email and face to face. The experts assess the content, context, language, and construct the mathematics task.

The task before revision



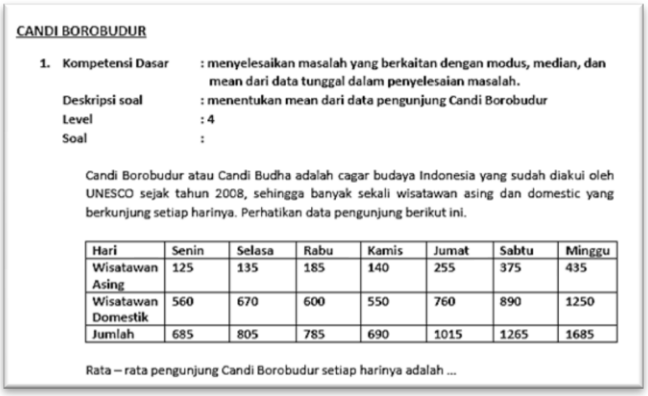
CANDI BOROBUDUR

1. Candi Borobudur atau Candi Budha adalah cagar budaya Indonesia yang sudah diakui oleh UNESCO sejak tahun 2008. Untuk kebutuhan pemeliharaan, Balai Konservasi Borobudur akan menggambil gambar Candi Borobudur dengan menggunakan drone. Penggambilan gambar dilakukan melalui beberapa sudut pandang. Seperti tampak pada gambar di bawah ini.

Coba gambarkan secara sederhana penampakan Candi Borobudur, jika *drone* mengambil gambar tegak lurus di atas candi sejauh 500 meter.

Figure 3. task before revision

The question on figure 3 uses Borobudur Temple as context. The researcher wants to know the spatial abilities of students by asking students to describe the Borobudur temple from a certain height.



CANDI BOROBUDUR

1. Kompetensi Dasar : menyelesaikan masalah yang berkaitan dengan modus, median, dan mean dari data tunggal dalam penyelesaian masalah.
   Deskripsi soal : menentukan mean dari data pengunjung Candi Borobudur
   Level : 4
   Soal :

Candi Borobudur atau Candi Budha adalah cagar budaya Indonesia yang sudah diakui oleh UNESCO sejak tahun 2008, sehingga banyak sekali wisatawan asing dan domestic yang berkunjung setiap harinya. Perhatikan data pengunjung berikut ini.

Hari	Senin	Selasa	Rabu	Kamis	Jumat	Sabtu	Minggu
Wisatawan Asing	125	135	185	140	255	375	435
Wisatawan Domestik	560	670	600	550	760	890	1250
Jumlah	685	805	785	690	1015	1265	1685

Rata – rata pengunjung Candi Borobudur setiap harinya adalah ...

Table 2. Comment from expert and students

Validation	Responds	Revision
Expert review	the question is not clear	- Replace the question with realistic question - Used different context or content
	This is not realistic problem	
	Change the question with "something" which is closed with students	
Students	I can solve this problem because I can't draw it	
	This question is so easy but I can't answer it because I don't know the way to draw it	

Task after revision

Figure 4. Task after revision

Based on the result of the expert review and one-to-one phase, the prototype-1 becomes prototype-2 and will testing to students by a small group phase. The small group phase consists of 10 students with various abilities. From the small group test, showed the task has a coefficient of high reliability of 0.70 and some tasks were empirically invalid. For the invalid items, the researcher (1) giving a questionnaire to the students and ask students' opinions regarding the task they have done; (2) examining the distribution of student's answers; and (3) interviewing the students in the small group to investigate the way they solve the task.

The output from a small group test becomes prototype-3 and will testing in the field test. The field test consists of 120 students from four elementary schools with different backgrounds and abilities. The outcome of field tests will use to know the potential effect of the task to the mathematical literacy of students.

3.2 Potential Effect of The Task

The potential effect of mathematics tasks with HOT type used Indonesian Heritage as context shown by the result of the fileds test. In addition, the researcher shares the questionnaire to all students' and interviewed six students'. An interview conducted to find out the abilities of students' when they solve the problems.

The students' selected for an interview are students with different abilities. The students' responses regarding the questionnaire are shown below.

Table 3. The Students' response

No	Mathematical Capabilities	Respons
1	Recognizing problems	91 %
2	Formulate the problem mathematically	35 %
3	calculate with mathematical procedures	50 %
4	interpret the result	45 %

Based on Table 3, shown that students weak in formulating the problems mathematically, they said that the task is hard and unfamiliar, so they can not use mathematic formulas to solve the problems.

Moreover, the ability of students in recognizing the problems is good. They read the problems well, and they know how to solve the problems, even though the abilities to calculating with mathematics procedure and interpret the result only done by 50% and 45% of students'.

Table 4. The Students' response

No	Mathematical Capabilities	Respons
1	I am interested in all the task	64 %
2	I am only interested in a certain task	10 %
3	I am not interested in the task at all	8 %
4	I am working seriously in all task	11 %
5	I am not working seriously in all task	5 %

Table 4 shown that students interest and woking serious in all tasks as much as 75 % and only 13% of students' not interest and serious with the task. Consider the following picture below, the picture showed the students activities when they solve the task.

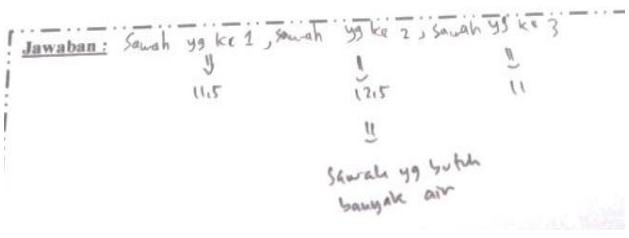


Figure 5 . Students' Answer

Figure 5 shown that students can solve the task well. He recognizing the task well, and formulate and calculate the problems mathematically properly.

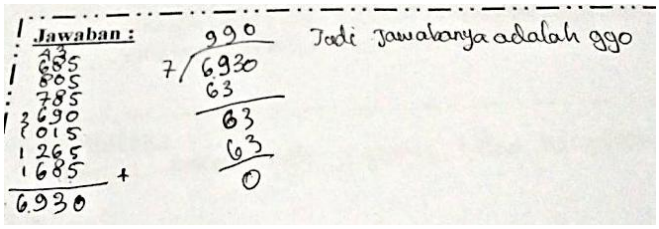


Figure 6. Students' Answer

Figure 6 shown that students recognizing the task well. students solve problems with strategies they find themselves based on the experiences they have experienced. Students solve problems by measuring rice fields with a ruler. Students outline the edges of the fields then add them up. Students believe that the largest sum is the largest rice field and requires the most water.

However, a lot of students answer the task with wrong answer. They wrong because they can not find the mathematics formula, or have a problem with calculation process. The students' also said that they never work on HOTS problem.

But, over all the students' enjoyed with the task. They feel exited and interest to solve the task, sometimes they discuss with their friends about the answer.

4. CONCLUSION

This research produced a set of tasks with HOT type used Indonesia Heritage as context which valid and practical. Based on the result of field tests, the mathematics task has a potential effect on asses the mathematical literacy of students'. The potential effect of the task shown by students' answers, questionnaires, and interviewed by students'. Almost 75 percent of students' interests and serious solve all tasks. Although, nearly all students said that they unfamiliar with the task and felt the task is so hard. Lastly, suggest for teacher especially teachers in elementary school should give students HOT tasks with various contexts to improve students' abilities on mathematical literacy.

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