5th International Symposium on Mathematics Education and Innovation (ISMEI)

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The 5th International Symposium on Mathematics Education and Innovation (ISMEI) 2018

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Preface

The Southeast Asian Ministers of Education Organization (SEAMEO) Regional Centre for Quality Improvement for Teachers and Education Personnel in Mathematics (QITEP) in Mathematics organized the 5th ISMEI 2018 with the theme "Preparing Future Generations through Transdisciplinary Learning".

ISMEI is a biennially event which aims to foster the exchange of innovative ideas and strategies for mathematics teaching and learning in modern classrooms. This international forum also provides an opportunity for mathematics educators to foster collaboration and partnership.

We had five keynote speakers, namely Prof. Lew Hee Chan, Chaiwuti Lertwanasiriwan Ph.D, Prof. Dindyal Jaguthsing, Dr. Lynda Ball and Prof Yoshisuke Kumano, Ph.D. Also, we had four invited speakers for Parallel Workshop session. They were Mr. Wahid Yunianto, Dr. Lynda Ball, Prof. Allan White and Prof. Lew Hee Chan. Furthermore, there were 60 paper presenters and 25 non paper presenter participants. The 5th ISMEI has successfully attracted delegates from many countries. There were five countries participating in this conference including South Korea, Thailand, Singapore, Australia and Japan.

Finally, we would like to extend our great gratitude for everyone who has contributed in this symposium.

The Committee of the 5th International Symposium on Mathematics Education and Innovation (ISMEI)

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Keynote Speakers:

Name	Affiliation
Prof. Lew Hee Chan	Korean National University of Education, South Korea
Chaiwuti Lertwanasiriwan Ph.D	Institute for the Promotion of Teaching Science and Technology, Thailand
Prof. Dindyal Jaguthsing	National Institute of Education, Singapore
Dr. Lynda Ball	University of Melbourne, Australia
Prof. Yoshisuke Kumano Ph.D	Shizuoka University, Japan

Pictures:

Figure 1. Prof. Lew Hee Chan, from Korean National University of Education, delivering his keynote talk

Figure 2. Opening ceremony

Figure 3. Participants attending a keynote session

Figure 4. A participant presenting his paper in a parallel session

Figure 5. Dr. Lynda Ball, from University of Melbourne, delivering her topic in workshop session

Developing mathematics task with indonesian heritage as context to asses HOTS of students

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Developing mathematics task with indonesian heritage as context to asses HOTS of students

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Abstract. The aim of this research is produce the set of mathematics task which is valid and practical. The mathematics task develop with Indonesian Heritage as context, and to measure the high order thinking skill of students. This is design research using type development study with formative evaluation. This research produced 12 mathematics task and reviewed by the expert in mathematics education and PISA. Technique of the data collection is walkthrough, documentation, and test. The subject is students from SMP Negeri 1 Palembang grade IX. The result is, the mathematics task with Indonesia Heritage as context which are valid and practical, and have potential effect on high order thinking skill of students.

1. Introduction

These High Order Thinking Skill (HOTS) of students can be promoted by problem solving, because it involves various action such as ability to search information, analyze situations, and identify problems with the aim of producing alternative solution to make the right decision [9]. Therefore, teacher should apply problem solving by giving students a chance to practice regularly, as it can develop high order thinking skill in process of understanding, exploration and mathematical concept [10].

In Indonesia, HOTS is important part in curriculum development especially in mathematics subject. Curriculum 2013 expected that mathematics subject is not only to equip students with the ability to use formula in solving the problem, but also to be able to involve their reasoning and analytical abilities. Because of that, the mathematics question in curriculum 2013 mostly use HOT type. Problems with HOT type are questions that require high level thinking skill and involve reasoning process to train critical, logical, reflective, metacognitive, and creative thinking skill of students [4]

In fact, the ability of students to solve mathematics problem with HOT type is low. It is because students rarely work on problems that train high thinking skill, and also teacher never associate mathematics with real life context [11]. Sudrajat [1] indicated that HOTS of students' are low because most students make mistakes in solving problems, such as: (1) error in mathematics operation, (2) error in translating problems to mathematics question, (3) error in writing down what is known and what is asked of question, (4) error in shorting, grouping, and present data, and (5) error in mathematical manipulation and make a conclusion. Therefore, the latest PISA and TIMSS mathematics survey and UN (Ujian Nasional) results shows that the ability of Indonesian students to solve problems with HOT type is low.

Additionally, the outcome of this study is a mathematics task with Indonesia Heritage as context which are valid, practical and able to development the high order thinking skill of students. Indonesia heritage chosen as context because the process of learning and teaching mathematics should be conditioned on each culture, this is intended to cherish and preserve the culture [8]. Hence, socio – culture perspective can be used as an alternative in innovative mathematics learning approach [6]. In this research, Indonesian Heritage that's used as context is Indonesia Natural Wealth such as Gunung Bromo and Subak in Bali, Traditional Houses such as Karo from Sumatra Utara and Mbaru Niang from Flores and Batik.

2. Higher Order Thinking Skill (HOTS)

High Order Thinking Skill (HOTS) is a level of thinking that emphasize the application of knowledge that has been received, problem solving, making decision and formulating a new thing [15]. HOTS concept comes from Bloom's taxonomy in cognitive realm that involve the intellectual skill and develop the way of thinking form concrete to abstract [12].

Bagarukayo [3] define HOTS include: (1) making decision, (2) problem solving, (3) critical thinking, (4) analysis, (5) synthesis, and (6) interpret. The mathematics task with HOTS type is an instrument used to measure high level thinking ability, not only to recall but also to restate or recite. In the context of assessment, the mathematics task with HOTS type measure abilities: (a) the way to transfer from one concept to another concept, (b) processing and applying information, (c) compile from various information, (d) use the information to solve the problem, and (e) critically review ideas and information [7].

Anderson and Krathwohl [2] classifying the dimensions of thinking process, and it shows in Table 1.

Table 1. Anderson and Krathwohl [2] classifying the dimensions of thinking process

HOTS	Creating	Generating : hypothesizing Planning : designing Producing : constructing
	Evaluating	Checking : coordinating, detecting, monitoring, testing Critiquing : judging
	Analyzing	Differentiating : discriminating, distinguishing, focusing, selecting Organizing : finding coherence, integrating, outlining, structuring Attributing : deconstructing
MOTS	Applying	Executing : carrying out Implementing : using

	Understanding	Interpreting : clarifying, translating Classifying : categorizing Explaining : constructing model
LOTS	Remembering	Recognizing : identifying Recalling : retrieving

The characteristics of higher order thinking skill: higher order thinking skill encompass both critical thinking and creative thinking [3]. While, Resnick [14] claim that mathematics task with HOTS type among non-algorithmic, complex, multiple solutions, involves a variety of decision making and interpretation, multiple criteria, and effortful.

3. Method

The purpose of this research to know the potential effect of the task on participants thinking skill focusing on applying, analyzing, evaluating and creating. Therefore, this study develops mathematics task with Indonesian Heritage as context. Design research with type of developmental study was used in this study. The formative evaluation stage in this study involve preliminary phase and prototyping phase consist of self-evaluation, expert reviews, and one-to-one, small group and field test [16].

The preliminary phase is a first step of development process. In this phase, the researcher arrange the concept and theory of mathematics task with HOTS type and used Indonesian Heritage as context, and then mention it as a prototype. Before entering to the next step, the researcher conduct the self-evaluation activities. After that, the prototype is sent to ten expert reviewers to correct the language, content, construction and concept of mathematics task.

Then, four students evaluate the task by the information provided in the question clear or not, and evaluated picture, diagrams, etc. This phase is called one-to-one phase. The result of one-to-one phase gave important suggestion to revise the task before the small group phase.

The small group phase put 10 students with different abilities to solve the task in 75 minutes. At this phase focus on students' performance in solving the task. The data used to view the performance of students in the field test. The field test phase, involve 20 students of grade IX from SMP Negeri 1 Palembang. This is to know the potential effect of mathematics task to measure HOTS of students.

4. Sections, subsections and subsubsections

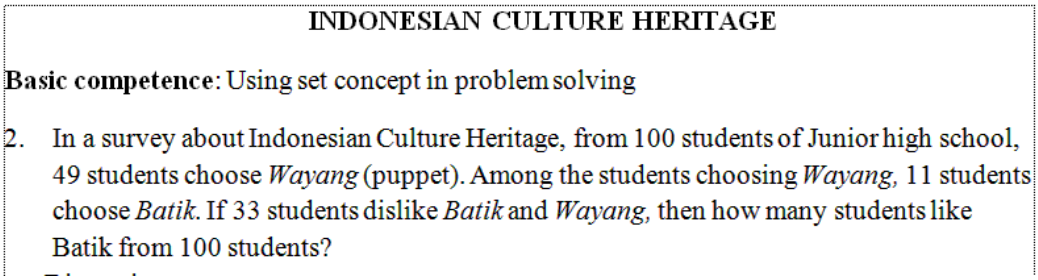
4.1. Style and spacing

Preliminary phase is the first step to develop mathematics task. The steps are; (1) review the literature on developing task, the characteristic of HOTS item, and Indonesian Heritage, (2) designed prototype and scoring, (3) determine the validator, (4) ensure the research subject. At this phase produce a set of mathematics task called prototype 1.

The prototype 1 evaluated by experts and students (one-to-one phase). The experts was assessed and evaluate about content, construct, context, and language. The ten experts joined in the reviewer team, some of them are Prof. Kaye Stacey and Dr. Ross Turner from Mathematics Expert Group of PISA and the PMRI lecturers. The prototype 1 was given individually (one-to-one) to 4 students SMP Negeri 1 Palembang grade IX.

This paper can describe and elaborate the mathematics task about Subak in Bali, Traditional House from North Sumatra, and Batik.

Before revision



INDONESIAN CULTURE HERITAGE

Basic competence: Using set concept in problem solving

2. In a survey about Indonesian Culture Heritage, from 100 students of Junior high school, 49 students choose *Wayang* (puppet). Among the students choosing *Wayang,* 11 students choose *Batik*. If 33 students dislike *Batik* and *Wayang,* then how many students like Batik from 100 students?

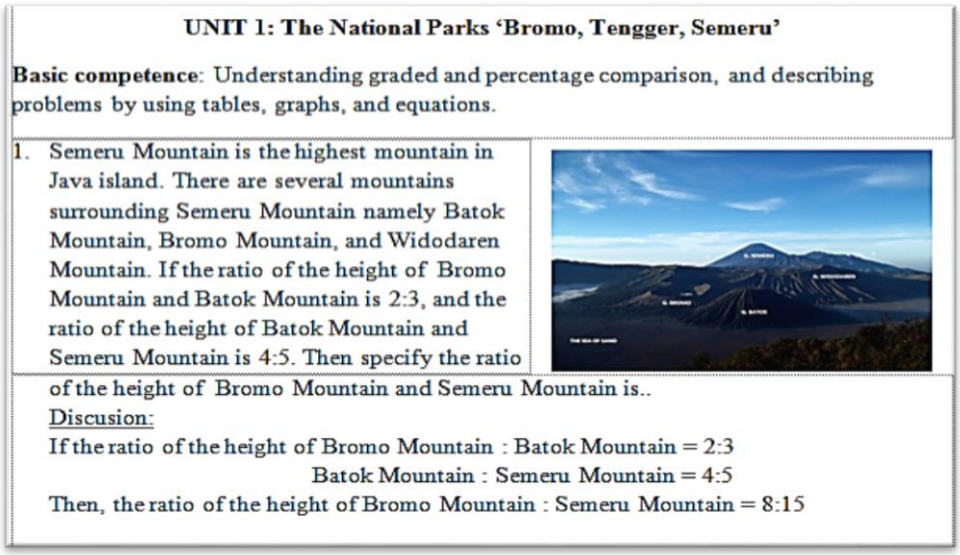
Figure 1. Task 1 before revision

Figure 1 shows that the questions uses Wayang and Batik as context. In this problem, students are required to calculate the total of students who like Batik.

Table 2 . Comment from expert and students on prototype 1

Validation	Comments/Responds	Revision
Experts review	Change the question because there is no reason why anyone want to know this problem	• Delete the question • Make a new problem with another context
	Students cannot solve this problem	
	Make the realistic problems	
	Change the question because it is not open ended question	
Students	I know the answer but I can't write down the way to find the answer	
	The sentence make me confused	

The comment and responds from validation show that the question not realistic and the question is not open ended. So, the researcher decided to delete the question and make a new question with another context.



UNIT 1: The National Parks 'Bromo, Tengger, Semeru'

Basic competence: Understanding graded and percentage comparison, and describing problems by using tables, graphs, and equations.

1. Semeru Mountain is the highest mountain in Java island. There are several mountains surrounding Semeru Mountain namely Batok Mountain, Bromo Mountain, and Widodaren Mountain. If the ratio of the height of Bromo Mountain and Batok Mountain is 2:3, and the ratio of the height of Batok Mountain and Semeru Mountain is 4:5. Then specify the ratio of the height of Bromo Mountain and Semeru Mountain is..

Discusion:

If the ratio of the height of Bromo Mountain : Batok Mountain = 2:3

Batok Mountain : Semeru Mountain = 4:5

Then, the ratio of the height of Bromo Mountain : Semeru Mountain = 8:15

Figure 2. Task 2 before revision

Figure 2 shows that the question use Bromo Mountain as context. In this problem, students are required to analyze the comparison of several mountain to find the height of Bromo Mountain.

Table 3. Comment from expert and students on prototype 1

Validation	Comments/Responds	Revision
Experts review	Change the question because there is no reason why anyone want to know this problem	• replace the question with the realistic question • keep using the same context but with different question
	Change the question with realistic problems	
	The question does not contain various answer, change with open ended question	
Students	I cannot solve this problem, because I must compare 3 mountain, and it is to hard for me	
	The picture cannot help me to solve the problem	

After receiving revision from experts review and students, the researcher revised the question become prototype 2.

After revision

UNIT 1: Tourism Spot 'Mt. Bromo Crater'

1. Andi, who comes from Surabaya, is planning to spend holiday to the National Park 'Bromo Tengger Semeru' with 9 of his friends by renting cars. The distance from Surabaya to Mt. Bromo is 150 KM. The following is the list of rental cars.

No	Type of vehicle	Capacity	Rental cost per-24 hour	Fuel consumption	Fuel tank capacity
1	Car A	4 people	Rp 200.000	10 km/ liter	35 liter
2	Car B	7 people	Rp 300.000	14 km/ liter	45 liter
3	Car C	6 people	Rp 250.000	12 km/ liter	43 liter

The price of fuel is Rp 6.600 per liter. Try to help Andi to decide which car he should choose, so that he has comfortable and low-cost trip. Give your reason!

Figure 3. Task 1 after revision

The task 1 after revision called prototype 2 and it was tested on small group consisting 10 students in IX grade with various academic ability. The small group phase shows that the coefficient of reliability is 0,70 and some task were empirically invalid. The decision based on the results are: (1)

giving questionnaire to the students to asking about the students opinion on the task; (2) examining the students answer; (3) interviewing subjects of small group.

Following the result of small group, the researcher revised the task and it called prototype 3, then used in a field test. The 20 students were involved in the field test. The goal of field test is to know the potential effect of mathematics task with Indonesian Heritage as context to measure the high order thinking skill of students.

4.2. Potential effect of the task

The task designed to find the potential effect of high order thinking skill on students. In the field test phase, the researcher shared questionnaires to the students, and interviewed 4 students who have various academic ability, high-middle-low.

Table 4. Students Response

No	Activity	Students Response
1	Constructing mathematical models, such as creating mathematical equations, making the pattern sequence number (creating)	48%
2	Testing the mathematical argumentation/ calculation correctly (evaluating)	30%
3	Designing model representation and utilizing images, table, graphs, and the like to help find the answer (creating)	50%
4	Selecting the strategies to solve the problem (analyzing)	45%
5	Find the linking of information with the existing experience (analyzing).	81%

Table 4 shows that students have skill to solve the high order thinking problems. Based on observations, 48% of students constructing mathematical model such as mathematical equation after reading the question. Then, 30% of students tried to calculate to find the solution. When students can't find the solution, almost all students or 50% of students tried another way such as make patterns, picture, or graphics. After finding the right answer, all students tried to check or testing the last answer with formula. These steps are stages or phase of the high order thinking skill process.

Mathematics task with high order thinking type require students to have analyzing skill, evaluating skill and creating skill to solve the problems. As shown in the picture below.

Figure 4. The problem about Subak in Bali

The question in figure 4 want students to determine the area from irregular shape. Because the area have effect to harvest. The following are example of students answer from that question.

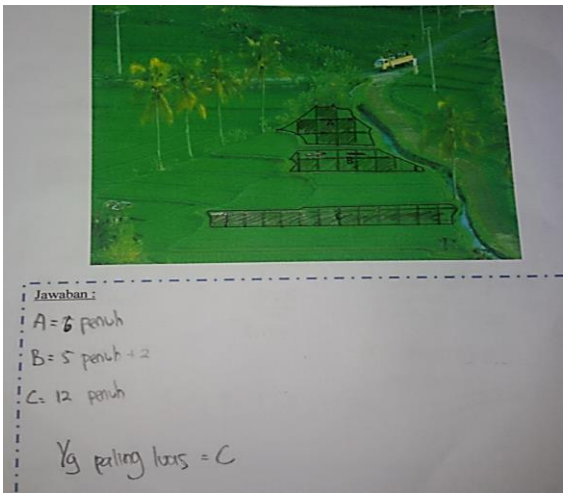


Figure 5. Student answer for task 10

The figure 5 show that student estimate the area by draw a units square for each shape. It is assumed that each square has the same size. To determine the area, the student calculate the number of intact square, for small square or square that are not intact, the student ignore it.

Different with the other, this student solve the task 10 with copying the picture in paper with the same size. To find the area, he compare the paper that has been drawn. The paper with the narrowest side is the large area. The student answer show in figure 6.

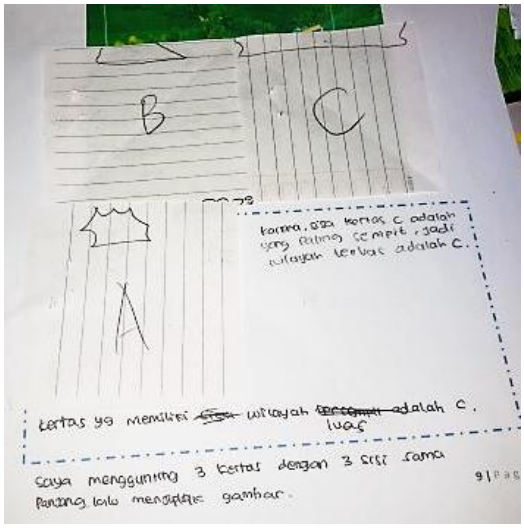


Figure 6. Student answer for task 10

In Task number 4, students are asked to find the number of poles from the picture. After reading the task, student draw the pattern to find the solution. Student answer is show in the figure 7.

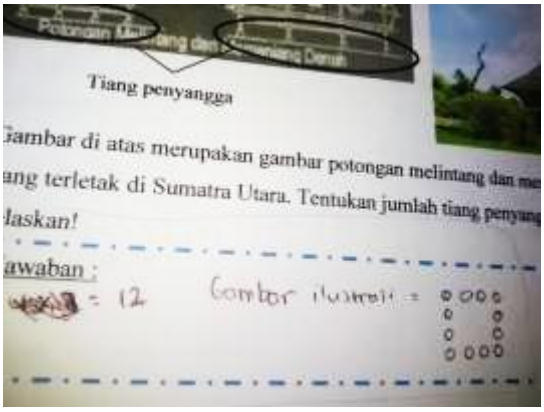


Figure 7. Student answer for task 4

The same way was done by students to solve the task 7. In task 7 students should find the 100th colour of batik, and the way they get the colour with drawing the pattern by colour or number. It show in the picture bellow.

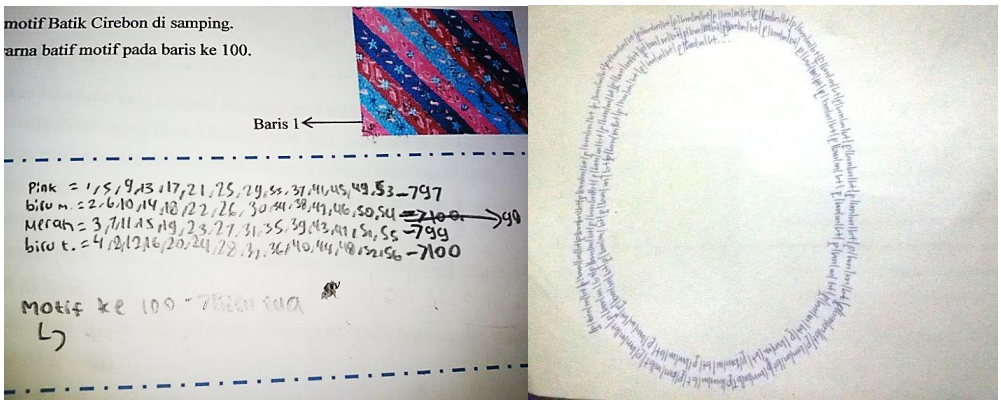


Figure 8. Student answer for task 7

Based on the figure above, shows that students already have the high order thinking skill, but they need more time to solve the problems. Because to find the answer, they need to analyze the question first, then finding the formula or the pattern and decided the conclusion.

5. Conclusion

This study produced a 12 mathematics task with Indonesia Heritage as context which valid and practical. Based on the result at field test phase, the mathematic task (prototype 3) has potential effect to develop high order thinking skill of students. It shown by the students answer and interviewed the students after test. Seriousness and students interesting when solving the task be the other indication of the effect. After all, suggest to mathematics teachers and other to use this task as tools to develop HOTS of students.

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