

Developing of Higher Order Thinking Skill in Relation and Function to Support Student's Creative Thinking

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Abstract

This study aimed to produce the Higher Order Thinking Skill (HOTS) questions of relation and function material that had validity and practicality and also had potential effect to support student's creative thinking. This research was a descriptive research with design research method and development study type. The questions of relation and function material developed based on characteristics of Higher Order Thinking Skill (HOTS) questions and followed stages of development study, such as: self evaluation, experts review, one-to-one, small group and field test. The subjects of this research were 38 students of eight grader from SMP Negeri 17 Palembang. They participated on one-to-one, small group and field test. Data collected using walkthroughs, interviews, questionnaires and tests. Validity of questions knew form experts review result based on content, construct and language. Practicality of questions knew from small group result about student's understanding of purpose of questions and procedural of answering questions. Potential effect did known by test on field test stage. The result showed the HOTS' questions of relation and function material truly supported student's creative thinking.

Keywords: Design Research, Higher Order Thinking Skill, Relation and Function, Student's Creative Thinking

Abstrak

Penelitian ini bertujuan untuk menghasilkan soal-soal Higher Order Thinking Skill (HOTS) materi relasi dan fungsi yang valid dan praktis serta memiliki efek potensial untuk mendukung kemampuan berpikir kreatif siswa. Penelitian ini adalah penelitian deskriptif dengan metode *design research tipe development study*. Soal-soal materi relasi dan fungsi dikembangkan berdasarkan karakteristik soal *Higher Order Thinking Skills (HOTS)* melalui tahapan *self evaluation, experts review, one-to-one, small group dan field test*. Subjek dalam penelitian ini adalah 38 siswa kelas VIII SMP Negeri 17 Palembang yang berpartisipasi dari tahapan *one-to-one, small group dan field test*. Data dikumpulkan dengan teknik walkthroughs, wawancara, kuisioner dan test. Kevalidan soal dilihat dari hasil experts review untuk menilai dari segi konten, konstruk dan bahasa, Kepraktisan soal dilihat dari hasil small group mengenai pemahaman siswa terhadap pertanyaan yang diberikan dan prosedur pengerjaan soal oleh siswa. Efek potensial untuk melihat apakah soal relasi dan fungsi yang diberikan mendukung siswa untuk berpikir kreatif dilihat dari hasil test pada tahapan field test. Hasil test menunjukkan bahwa soal-soal HOTS materi relasi dan fungsi yang dikembangkan dapat mendukung siswa untuk berpikir kreatif.

Kata kunci: *Design Research, Higher Order Thinking Skill, Relasi dan Fungsi, Berpikir Kreatif Siswa*

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INTRODUCTION

Relation and function material are closely related in everyday life and can be used in solving problems (Van de Walle, 2008). Relation and function can be taught in an innovative way to support students in learning (Rosidah, Nadya, Hasanah, & Sulistiawati, 2019). The innovations that can be used in learning relation and function can be done by providing various problem solving questions and non-routine questions, one of them is the Higher Order Thinking Skill (HOTS) type. Based on

Bloom's taxonomy, the types of HOTS are at the level of analysis, evaluation and creativity (Suryapusparini, Wardono, & Kartono, 2018).

HOTS are metacognitive abilities, namely the ability to connect different concepts, problem solving, choose problem solving strategies, find new methods, argue and make the right decisions (Kemendikbud, 2017). Furthermore, Kemendikbud said the characteristics of HOTS questions are (a) measuring high-level thinking skills, including: analysis, evaluation and creativity, (b) based on contextual problems, which consist of relating, experiencing, applying, communicating and transferring (REACT) (Fanani, 2018). The results of students' answers when working on HOTS type questions show that students can communicate with writing and mathematical symbols well, HOTS questions also support students in reasoning, thinking critically and thinking creatively beside that by answering HOTS type questions, various problem solving strategies will emerge (Utari & Ulya, 2019). Kemendikbud (2017) said the highest level of HOTS is creativity or creative thinking.

In mathematics, creativity or creative thinking is original and reflective think and produces a complex product (Siswono, 2011). Silver said indicator to identify the creative thinking of student were fluency, flexibility and novelty (Siswono, 2011). Creativity or creative thinking skill is an ability that needs to be possessed by students as one of the achievements of material learning so that students can compete with the global community in 4.0 era (Nizam, 2015 (Widaya, Adi, Herdiyanto, Abdi, Marsito, & Istiqomah, 2019). Although it is important, in fact, the creative thinking ability of students in Indonesia is included in the low category, which is shown from the results of PISA in 2015 where Indonesia was ranked 63rd out of 72 countries (Handayani, Sa'idijah, & Susanto, 2018).

The importance of students' creative thinking skills can be supported and trained by being given HOTS type questions. The HOTS problem was also stated as a potential concept to develop students' thinking skill (Sumaryanta, 2018). Mathematics learning using HOTS questions itself has been enforced by the government since the implementation of the Kurikulum 2013 (K13) or 2013 Curriculum and even expanded by being tested on the Computer-Based National Examination or Ujian Nasional Berbasis Komputer (UNBK) in 2018 and 2019 (Suryowati, 2018). Fact in the field, HOTS questions in the 2013 Curriculum (K13) still need to be developed (Suryapusparini, Wardono, & Kartono, 2018). The development of HOTS type questions is useful as a reference and learning resource for students to develop skills in the 21st century so that they can compete with the global community represented in literacy contests both PISA and TIMSS.

Therefore, this study aims to develop Higher Order Thinking Skill questions in relation and function material which valid and practically. In addition, this study also wants to see how HOTS questions that have been developed can support students in creative thinking.

METHODS

This research was qualitative descriptive study using the design research method. The type of design research method used was development study type. The stages used in this research were the preliminary stage, the prototyping stage (formative evaluation) which includes self-evaluation, experts review, one-to-one, and also small group, and the last stage was field tests. The following figure 1 below was the stages of developing of HOTS questions regarding relation and function material.

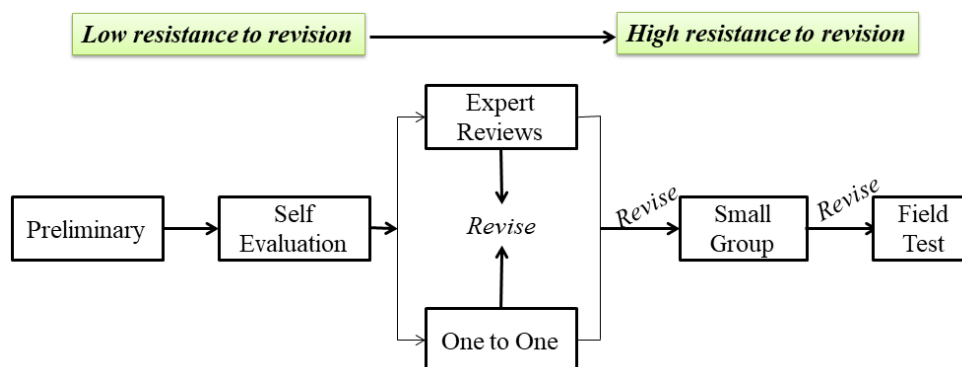


Figure 1. The Flow chart of developing of HOTS questions (Tessmer, 1993; Zulkardi, 2006)

The subjects in this study were 38 students of 8th grade students of SMP N 17 Palembang. They participated on one-to-one, small group and field test Data were collected using walkthroughs, interviews, questionnaires and tests in one to one, small group, and filed test. Walkthroughs were used to collect the suggestions and comments from the expert review to know the validity of the questions based on content, construct and language. Questions said valid based on content if the questions already filled the characteristics of HOTS. From the construct aspect, questions said valid if questions were corresponding to K13 and also were corresponding to student's leveling skill in 8th class. From the language aspect, the questions said valid if the questions corresponded to Pedoman Umum Ejaan Bahasa Indonesia (PEUBI), the questions were not ambiguous, the questions were understood by student. The questions called practicality if the questions were did by students. After small group stage, the question were revised and tested in field test stage. The students answer of field test stage then analyzed and described to see the indicators of creative thinking based on fluency, flexibility and novelty.

RESULTS AND DISSCUSSION

The initial step in this study was a preliminary stage. The researchers conducted a study and determined the research subjects were students of 8th grader from SMP Negeri 17 Palembang. In this stage the researchers also analyzed the 8th grade materials, one of them was relation and function material and the researchers compiled Higher Order Thinking Skill (HOTS) type questions that

supported student's creative thinking and also made subsequent assessment rubrics. The designing questions in preliminary stage were continued to formative evaluation. In formative evaluation, the first stage was self evaluation. In this stage, the researchers conducted research and reviews the HOTS question design along with the assessment rubrics. The results of research at the self-evaluation stage were called prototype 1. Figure 2 below was the result of prototype 1.

Question number 1




Figure 1. List of menus at Soto Rejeki Restaurant.
(Source: https://www.tripadvisor.com/LocationPhotoDirectLink-g2304084-d6949175-i145787219-Warung_Soto_Rejeki-Bantul_Yogyakarta_Region_Java.html)

Doni wants to order food (along with rice) and drinks at Soto Rejeki Restaurant, but the money that Doni has prepared is not more than IDR 13,500. What possible menu can Doni choose? Describe your reason!.

Question number 2

On Sundays, Mother goes shopping at the market to buy vegetables that will be cooked for the next three days (Monday, Tuesday, Wednesday). The vegetables and spices that the mother bought are as follows:

- 500 grams of carrots
- 250 grams of potatoes
- 300 grams of long beans
- 500 grams of cabbage
- 250 grams of cauliflower
- 500 grams of chicory
- 250 ml coconut milk
- 2 pieces of chayote
- 2 pieces of sweet corn
- celery and spring onions
- Soup seasoning
- Sayur Asem seasoning
- Capcai seasoning
- Lodeh seasoning

Here are the ingredients for cooking these vegetables:

Sayur Soup <ul style="list-style-type: none"> • Soup seasoning • 200 grams of carrots • 250 grams of potatoes • 150 grams of cabbage • 100 grams of cauliflower • celery and spring onions 	Sayur Asem <ul style="list-style-type: none"> • Sayur Asem seasoning • 150 grams of carrots • 200 grams of long beans • 100 grams of cabbage • 150 grams of mustard greens • 1 piece of chayote • 1 sweet corn
Sayur Lodeh <ul style="list-style-type: none"> • Lodeh seasoning • 100 grams of carrots • 200 grams of long beans • 100 grams of cabbage • 200 grams of mustard greens • 1 piece of chayote • 1 sweet corn • 250 ml coconut milk 	Sayur Capcai <ul style="list-style-type: none"> • Capcai seasoning • 150 grams of carrots • 250 grams of cabbage • 50 grams of cauliflower • 250 grams of mustard greens

Based on the vegetables that mommy bought and the existing recipes, help mommy determine what menu to cook for Monday, Tuesday and Wednesday by considering the ingredients and vegetables available and what they can't be lacking!

Figure 2. The designing questions of relation and function material

Prototype 1 was corrected by experts to see validity of instruments based on content, construct and language. In terms of content, the questions were suitable with HOTS characteristics. The questions reviewed by experts were HOTS characteristics, namely (a) measuring students' higher order thinking skills and (b) containing contextual problems that exist in the real world, which contain Relating, Experiencing, Applying, Commutating, and Transferring (REACT) (Fanani, 2018). The element of relating was that the questions given were related to the context of everyday life, namely choosing the lunch menu with a set allowance and determining the menu to be cooked with the available ingredients. Experiencing element came from exploring the information on the questions to solve the answer and it involves creativity. The application element was in the application of mathematical concepts, namely relations and functions to solve existing HOTS problems related to everyday life. The commutating element can be seen from how students answer questions in writing and communicate answers in mathematical symbols. The element of transferring is found in the transformation of knowledge concepts in the classroom into new situations or contexts, namely, the problem of determining the menu and making dishes.

In terms of constructs, the questions had already suit too with Curriculum of 2013 and leveling of student's ability in 8th grade. Some suggestions and comments came from language terms, there were sentences that had ambiguous and experts suggested to change the sentences to only have one meaning. Because of the sentences were ambiguous, they had effected to revise the questions, and of course rubrics assessment also were changed. Then the questions had revised based on experts' suggests and comments. Prototype 1 also tried in one-to-one stage used to see how students can understand of meaning of question and answering clearly of question. In these stage, researchers did interview with student to get comments and suggestions about how student understood and finished questions. The result of prototype 1 based on experts review and one-to-one described on table 1.

Table 1. Decision result of prototype 1

No	Validators	Comments	Decisions
1	Mr. YH	<ul style="list-style-type: none"> • Fix the words “no more than” because of they mean less than or equal • Fix the solution in the rubrics • Suggestion : Use word “equal” or “between” to changed word “no more than” 	Question changed to “Doni bought meal with total price no more than IDR 13.500 but Doni usually spent money for meal no less than IDR 12.000”
	Ms. RAA.	<ul style="list-style-type: none"> • Fix sentence “The money that prepared by Doni no more than 	Revised the solution to set possible meal and

No	Validators	Comments	Decisions
		IDR 13.500” changed to “The money that prepared by Doni with the total price IDR 13.500	drink between price IDR 12.000 till IDR 13.500.
	Student	Student understood the question but he only write one solution possible answers meanwhile these question have many possible answers.	
2	Mr. YH	Question “Help mommy determine the menu!” changed to “Set the menu that cooked by mommy!”	Question changed to Set the menu that cooked by mommy!
	Mr. M	Okay	
	Ms. RAA.	No Comment	
	Student	For the answer he only write one possible answer because he said that he can set menu contain sayur lodeh because he didn’t like it.	

Prototype 2 was gotten from revision of experts review and one to one. It was tested in a small group consisting of 5 students with various abilities. At this stage the researchers also provided interviews and questionnaires. Interviews were conducted after students completed the questions to find out how the flow of students' thoughts and understanding during solving the questions. The interview between researcher and students of small group described on Transcript 1 below.

Transcript 1. Conversation in Small Group

- Researcher : “Did the question number 2 make you confused ? How did you think?”
 Student 1 : “No, mam. I Already found the menu. Sayur Sop, sayur lodeh and sayur capcay”
 Researcher : “If I set the menu sayur sop, sayur asem and sayur lodeh. Can’t I?”
 Student 2 : “of course”
 Researcher : “If I set other menu, sayur sop, sayur asem and sayur lodeh. Can’t I?”
 Student 1 : “You can’t mam. There was lacking ingredients”
 Researcher : “Ok, how about Student 3?”
 Student 3 : “Sayur sop, sayur asem and Capcay mom”
 Researcher : “Ok, good job”

Based on transcript 1 above knew that each students had each answer about the menu. They also had the reason when researcher gave wrong possible answer. Student 1 said there was lacking ingredients when sayur asem and sayur lodeh can’t be set together for three days. It showed one of characteristics of creative thinking was fluency. Siswono (2011) said that fluency refers to student’s

ability to find out many solution in the problem. Questioners were given using Google form to find out the clarity of sentences, tables, pictures and other information related to question information while solving the questions given. The results of questionnaires showed that pictures, sentences, and table from prototype 2 were understanding and clear. Table 2 below show the result of decision of prototype 2.

Table 2. Decision result of prototype 2

No	Comment from questionnaires and students' answer	Decisions
1.	Picture was clear, sentences were clear. From Student 1 and Student 2 make menu without rice. Student 3 and student 4 only wrote one menu and also student 5 only wrote 3 possible answers of the menu, even the possible answer more than that.	The question changed from “what are possible answers can Doni choose” to “ How many kind of menu can Doni choose. List all possible answer!
2.	Table was clear, sentences was clear Student 1 and student 3 had same answer. Student 2 had different answer of student 1 and student 3.	No revision

Prototype 2 revised from result of small group and it was being prototype 3. Prototype 3 was then tried out at the field test stage. The field test stage was attended by 32 students of class VII of SMP Negeri 17 Palembang. At this stage, a prototype 3 test result and a questionnaire are given to find out comments, suggestions, and student opinions regarding the questions given. In this case, the focus of the researcher was potential effect of questions to see students' creative thinking ability who arise when spelling out the questions. creative thinking ability included aspects of flexibility, fluency and novelty.

Descriptions of HOTS questions in relation and function problem to support students' creative thinking

Developing of HOTS questions in relation and function problem to support students' creative thinking can be seen from field tests. Relation and function questions had been validity by experts, and had been practicality from small group. Prototype 2 had been known that questions are supporting students' creative thinking. The process of interview (Transcript 1) and students answer of questions showed that students had mathematics cognitive knowledge at creative thinking. Corresponding with Sitorus & Masyarati (2016) said that cognitive knowledge of creative thinking stage, such as: reading, understanding, collecting information, recalling prior knowledge, analyzing mathematics idea, and also verifying mathematics solutions (Sitorus & Masyarati, 2016). Figure 3 below showed the student' answers to question number 1.

A = Soto campur	
B = Soto kuah	
C = Nasi putih	= { (aC,F), (aC,g), (aC,h), (aC,i), (bC,F), (bC,g), (bC,h), (bC,i),
D = Babat	(dC,F), (dC,g), (dC,h), (dC,i), (dC,j), (dC,k), (eC,F), (eC,g),
e = Iso	(eC,h), (eC,i), (eC,j), dan (eC,k) }
F = Jeruk	
g = teh	"Jadi, berdasarkan pengelompokan tersebut kita dapat
H = tape	menyimpulkan bahwa ada 20 menu yang dapat
I = kopi	dipilih Doni."
J = Susu	
k = Kopi Susu	

Jawabannya : Ada 20 jenis menu yang dapat dipilih Doni karena, dapat kita lihat bahwa Doni membawa uang sebanyak RP.13.500 dan ia selalu membeli lebih dari RP.12.000
Dapat kita uraikan menggunakan pengelompokan himpunan.

Figure 3. Student A answer question number 1

Based on Figure 3 above, Student A considered each menu by making alphabet a,b,c,...,k then he made set of consecutive pairs that allow a menu to be made based on the price list in the question. So he got 20 pairs of menu can be ordered by Doni. Based on Saputra (2018) the steps of answering question by Student A already followed step of creative thinking. Steps of creative thinking were exploring, inventing, choosing and implementing (Saputra, 2018). First step was exploring, exploring step showed by rewrite all menu, exploring can be showed by identify question and next what to do. Second step was inventing, inventing was reviewing all methods that possible helping by considering each menu by making alphabet a,b,c,...,k. Third step was choosing, choosing was identify the idea by making set of consecutive pairs. Last step was implementing, implementing had done by making all possible answers. So he got 20 possible answers.

In terms of Siswono (2011) said that student' creative thinking consist of flexibility, fluency and novelty. Based on figure 3, Student A wrote all possible answers. The selected menu consisted of rice, side dishes and drinks. Flexibility in solving questions can be seen when student A was modeling answers by considering the menu with the alphabet a, b, c, ..., k. Fluency had been seen from how students make the menu into a set of consecutive pairs that meet the requirements, and novelty can be seen from how the answers given by students in doing HOTS questions was different from other students. The answer of question number 2, can be seen from Figure 4 below

Bahan	S. Sop	S. Asem	S. Lodeh	S. Capcai	
500 g wortel	200	150	100	150	Menu yang dimasak ibu Sayur Sop, Sayur Asem, Sayur Capcai Sayur Asem dan Sayur lodeh lodeh Dapat dipilih keduanya, hanya salah satu, k. panjang lodeh cukup Kemungkinan: Sayur Menu Hari S. Sop → Senin S. Asem → Selasa S. Capcai → Rabu Sayur Hari S. Sop → Sen S. A → Sel S. C → Rabu Sayur Hari S. S → Sen S. A → Sel S. C → Rabu Sayur Hari S. S → Sen S. A → Sel S. C → Rabu
250 g kentang	250				
300 g k. panjang		200	200		
500 g kol	150	100	100	200	
250 g bunga kol	100			150	
500 g Sawi putih		150	200	250	
250 ml santan			✓		
2 Labu		1	1		
2 Jagung		1	1		
Daur sop & Daun bawang	✓				
B. S. Sop	✓				
B. S. Asem		✓			
B. S. Capcai				✓	
B. S. lodeh			✓		

Figure 4. Student B answer question number 2

Based on Figure 4 above, In terms of Saputra (2018) there were four step. Exploring step showed while Student B making table of the ingredients. Inventing step was showed when she filled the table with the ingredients of each menu. Choosing step was showed when she marked of lacking long been if mommy making menu sayur lodeh and sayur asem. Implementing step showed by set menu, such as : sayur sop, sayur asem and sayur capcai. Last, she tried to make some possible answers make relation between sayur sop, sayur asem and sayur capcai with day Monday, Thursday and Wednesday. In terms of Siswono (2011), it can be seen that student B showed answering question using flexibility, fluency and novelty. Flexibility can be seen from how student restate the ingredients in table. Fluency can be seen from how students restate the answers so that they produce ingredients that can be used to determine the menu that the mother cooks. Novelty showed how the student' answers were unique, had her own reasons.

Developing of Higher Order Thinking Skill questions regarding relations and function material were form of effort to support the government in curriculum development. The questions developed have been declared valid and practical and support students to think creatively. Based on the results of the small group and field test, the HOTS questions were designed to show a variety of student answer strategies, which featured a variety of students' higher order thinking skills, such as the ability to think creatively with different answers to questions from one another. This was consistent with Rahayu's statement, that the results of the development of HOTS-type mathematics problems can also support students in higher-order thinking (Rahayu, Nugroho, Santoso, & Widodo, 2018; Farihah, Imanah, & Hidayati, 2018).

In addition, HOTS questions which were designed by connecting real-world contexts with mathematical concepts show that students must be able to connect, experience, apply, communicate and transform information into real-world contexts into mathematical solutions, this was very good for giving students experience. and the knowledge that mathematics exists and was real in their lives. By providing HOTS questions, this trained students to have soft skills and problem solving, which in

the era of the 4.0 revolution is very important for students as a global community. This was a form of support for the government, so that the learning outcomes of the material were so that students are able to compete with the global community in the era of 4.0 (Nizam, 2015; Widaya, Adi, Herdiyanto, Abdi, Marsito, & Istiqomah, 2019). So the developing of HOTS questions provided many benefits both as support to the government in advancing education in Indonesia and also providing soft skills to students to compete as a global community.

CONCLUSION

Based on the result and discussion of this study that has been carried out, it is concluded that developing of higher order thinking skill questions of the relations and function material are declared valid and practical. The validity of content, construct and language was seen from the expert review process which states that the questions developed are included in the characteristics of HOTS type questions, according to the 2013 competency and curriculum and the language used was understood, did not have multiple meanings and was in accordance with Pedoman Umum Ejaan Bahasa Indonesia (PUEBI) Practicality seen from HOTS questions that are designed can be done by students even in one-to-one and also in small group. Students' answers during the field test showed that the HOTS questions that had been designed supporting students to think creatively where there were indicators of creative thinking, namely, flexibility, fluency and novelty.

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