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Research Article

The development of mathematical HOTS questions based on Banten culture

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ABSTRACT

The resulted of a survey conducted by the Organization for Economic Cooperation and Develop-ment based on the 2018 Program for International Student Assessment were obtained from 78 countries, Indonesian students ranked 72nd in math ability. The reason is that the 2013 curricu-lum that has been implemented in Indonesia is eurocentric. The transformation sought in the field of education is the improvement of high order thinking skills and mathematical abilities. Educa-tion and culture cannot be separated from regular daily life because culture covers all aspects of life while education is a primary need for everyone. This study used the Research and Develop-ment (R&D) method with the Martin Tessmer (1993) model, which is formative research. The validity of the values obtained above 0.80 means that the questions are valid. The level of practi-cality of the questions obtained is 96.25%, very practical category. The reliability coefficient of 0.891, reliable. The level of difficulty is known to be 80% of the items in the medium category, 20% of the items in the difficult category. The discriminatory power of the question is known to all items (100%) in good category, meaning that good questions are used to classify the level of stu-dents thinking abilities.

Keywords: Development; Banten; Culture; Mathematical

1. INTRODUCTION

One of the toughest challenges in the world of 21st century education is the rapid development of human civilization around the world. Indonesian children must be able to compete in various aspects. Competition in the era of globalization requires Indonesian human resources to be supported by competence, skills, and sensitivity to rapid changes. These human resources will be born through transformation in the field of education. One of the efforts is to improve high order thinking skills, namely cognitive processes that require students to process various ideas and information with certain mechanisms that can provide the latest meanings and consequences (Istiqomah, 2018). Students must have the ability to carry out mathematical activities called mathematical abilities to achieve higher order thinking skills. Mathematical ability according to NCTM (in Maulyda, 2020) is the ability that is used to deal with various problems, both in mathematics or in daily activities. The Organization for Economic Cooperation and Development (OECD) conducted a survey using the Program for International Student Assessment (PISA) 2018 and it was found that out of 78 countries, Indonesian students ranked 72nd on the math ability test. The average score obtained by Indonesian students is 379, while the average score deter-mined by the OECD is 487. Referring to the statement submitted by the Ministry of Education and Culture (2014: 2) that the achievement of Indonesian children is low because most of the material studies presented in PISA are not available in learning in Indonesia. One of the elements in PISA is the HOTS-based questions in the 2013 curriculum. The problem that arises is that the 2013 curriculum has been implemented, but the questions tested are not able to train students' high-er-order thinking skills (Farihah, et al, 2018).

The results of research conducted by Supriadi (Supriadi, et al, 2016) produced data that most (80%) students did not un-derstand the culture presented when learning mathematics activities were carried out. The facts on the ground state that learning mathematics in schools often does not integrate cul-ture into learning. Meanwhile Bishop (in Supriadi 2016: 54) stated that the problem was caused by mathematics learning activities in the education sector which were considered to be less integrated with culture as a context in learning. The Indonesian curriculum is still eurocentric, which is in-clined to Western civilization and is considered incompatible with the culture and personality of Indonesian students. De-veloped countries have used their own culture to study mathematics for a long time. So that their country can progress in all fields. According to Kurumeh, the success of Japan and China in learning mathematics is due to the use of ethno-mathematics in their mathematics learning (Supriadi, 2016).

Education and culture cannot be avoided from real life. Because culture is integral and holistic in society. In this regard, education is a primary need for every individual in society. Besides that, one of the cultural expressions is education (Zulfah, 2018). Banten is a province located at the western tip of Java Island, Indonesia. Banten culture has a plural potential.

Culture can be a variety of mathematical ideas that can be researched and studied in every cultural activity carried out so that it can become a source of contextual mathematics teaching and learning activities (Sutrimo, et al, 2019).

The results of observations before the study obtained in-formation that so far the teacher had carried out routine evaluations at the end of each lesson by giving questions to class V semester 1 students according to the material that had been studied. Some of the questions presented include the criteria for HOTS questions obtained from various sources such as mathematics textbooks, Student Worksheets (LKS), the internet, and other sources. However, the HOTS questions presented are not based on Banten culture even though the geographical location of SD is in the province of Banten. In fact, by incorporating Banten cultural content, it can produce meaningful learning in all activities carried out, so that it has a function as a reference for contextual teaching and learning activities in mathematics. (Kusmaryono, 2012). Research and development has the aim of knowing how to develop questions, knowing the feasibility of questions and the character-istics of HOTS questions based on Banten culture.

2. RESEARCH METHOD

The method used is Research and Development (R&D) re-ferring to the Martin Tessmer (1993) model, namely formative research including the pleminary stage and formative evalu-ation stage which includes the self-evaluation stage, the pro-totyping stage (expert review, one-to-one, small group), and field test. The preliminary stage is the beginning of the development process. Researchers carry out evaluations on several reference materials related to the research process, determining the location and research subjects. Then there is the prototyping stage which includes the expert review, one-to-one, and small group stages. The instrument validity test was carried out to 3 experts (validators) which included 1 mathematics teacher at SD Negeri Karawaci Baru 3 and 2 mathematics lecturers, then an experiment was conducted on 3 students to deal with HOTS questions and then provide comments or reactions at the one-to-one stage. Based on the results of the reaction or response in the one-to-one stage, the next question instrument is a small group trial, namely on 6 students. Based on the questionnaire that has been analyzed from the small group stage, the question instrument can be forwarded to the next research stage.

The Field Test stage, is a field test to determine the ability of students to correctly answer the HOTS questions based on Banten culture, the value of reliability, the level of difficulty, and the distinguishing power of the items that have been made. The test subjects are fifth grade students in the 2021/2022 odd semester at SD Negeri Karawaci Baru 3, Tangerang City. The research instruments were interview guidelines, validation, students' questionnaire sheets, and question instruments. Data accumulation techniques used are documentation, walkthroughs, questionnaires, interviews, and tests.Data analysis techniques in this study are as follows:

2.1 Eligibility Test of HOTS Questions Based on Banten Culture

2.1.1 Validity Test

Content validity according to Aiken were said to be valid or suitable for use with a rating of 3 and a scale of 4, so the Aiken V index was at least 0.80 (in Azwar, 2012):

$$V = \Sigma s/[n\,(c-1)]$$

Description:
s : r-lo
lo : Minimum validity score
c : Maximum validity score
r : Score from expert

2.1.2 Practical Test of HOTS Questions Based on Banten Culture

$$P = \frac{R}{SM} \times 100\%$$

(Source : Zainal Arifin, 2006:50)
Description:
P : Practical value
R : Earned value
SM : Maximum value

Table 1. Practical Score Category

Practical Score (%)	Category
85 ≤ P ≤ 100	Very Practical
75 ≤ P ≤ 85	Practical
60 ≤ P ≤ 75	Enough Practical
55 ≤ P ≤ 60	Less Practical
0≤ P ≤ 55	Not Practical

2.2 Characteristics of HOTS items based on Banten culture

2.2.1 Reliability Test

$$r_{11} = \left[\frac{k}{k-1} \right] \left[1 - \frac{\sum \sigma_b^2}{V_t^2} \right]$$

(Source: Sugiyono, 2013: 121)

Description:

r_{11} : Reliability
k : Amount of questions
$\sum \sigma_b^2$: Amount of variance
V_t^2 : Total variance

Table 2. Reliability Score Category

Reliability Score	Category
$0,90 < r_{11} \leq 1,00$	Very high
$0,70 < r_{11} \leq 0,90$	Tall
$0,40 < r_{11} \leq 0,70$	Currently
$0,20 < r_{11} \leq 0,40$	Low
$r_{11} \leq 0,20$	Very low

2.2.2. Question Difficulty Level

$$IK = \frac{n_A + n_B}{N_A + N_B}$$

(Source: Lestari & Yudhanegara, 2017)
Description:
IK: difficulty index
n_A: the number of correct answers is upper class
n_B: the number of correct answers lower class
N_A: amount of upper class students
N_B: amount of lower class students

Table 3. Difficulty Level Category

IK	Category
IK = 0,00	Too Difficult
0,00 < IK < 0,30	Hard
0,30 < IK < 0,70	Currently
0,70 < IK < 1,00	Easy
IK= 1,00	Too easy

2.2.3. Power of Differing Questions

$$DP = \frac{(\bar{X}_A - \bar{X}_B)}{SMI}$$

(Source: Lestari & Yudhanegara, 2017)

Description:

DP : power of differing questions
$\bar{X}_A$: the average score of upper class students
$\bar{X}_A$: the average score of lower class students
SMI : maximum value

Table 4. Power of Differing Category

Power of Differing	Category
0,70 > DP ≤ 1,00	Very Good
0,40 > DP ≤ 0,70	Good
0,20 > DP ≤ 0,40	Enough
0,00 > DP ≤ 0,20	Bad
DP ≤ 0,00	Very Bad

3. RESULTS AND DISCUSSION

3.1 Development of Banten Culture-Based HOTS Questions

3.1.1 Pleminary Stage

This stage is the initial stage. It begins with some reference materials related to research activities, namely the development of Banten culture-based High Order Thinking Skills (HOTS) questions to measure the mathematical abilities of elementary school students. From various references obtained several theories that have been submitted by experts and related to this research. One of the references in this research is the HOTS theory according to B. S. Bloom which produces Bloom's Taxonomy where High Order Thinking Skills (HOTS) consists of analyzing, evaluating, and creating. Based on existing references, the location and subject of the research were determined.

The location of the trial in this research process is SD Negeri Karawaci Baru 3, Tangerang City. While the subjects in this study were grade 5 students in semester 1 at SD Negeri Karawaci Baru 3. The study was held on October 27, 2021 - December 24, 2021. The schedule of research implementation can be seen in the table 5.

Table 5. Research schedule

Research Stage	Execution time
Preliminary Stage	October 2021
Self-Evaluation Stage	November 2021
Prototyping Stage	November-December 2021
Field Test Stage	December 2021

3.1.2 Self-Evaluation Stage

This stage aims to develop High Order Thinking Skills (HOTS) questions based on Banten culture based on the results of the preliminary stage, the question instruments to be developed consist of HOTS question grids, HOTS questions, answer keys, and scoring guidelines. At this stage there are several stages, including analysis and design. This analysis phase consists of curriculum analysis, student analysis, and material analysis. The results of the curriculum analysis showed learning using K-13 which has the aim of increasing students' High Order Thinking Skills (HOTS) which refers to the assessment of attitudes, skills, and knowledge. The results of the analysis of students in class V semester 1 as the subject of this research and development trial, it was found that the number of students was 30 students. It is also known that the mathematical knowledge and mathematical ability of class V SD Negeri Karawaci Baru 3 varies. Based on the results of the fifth semester homeroom interview, this is because students' enjoyment of each subject is different.

The results of the material analysis obtained information that the learning material that will be used as a reference in the research and development process on High Order Thinking Skills (HOTS) questions is based on the material in K-13 for mathematics subjects in class V SD semester 1. The mathematics material for class V semester 1 covers the operation of counting fractions, scale, speed and discharge material. At the design stage, the researcher designed 10 items representing each grade 5 mathematics material in semester 1. The items were designed in such a way based on indicators of higher-order thinking skills and indicators of mathematical reasoning integrated with Banten culture. The result of this stage is prototype 1.

3.1.3 Prototyping Stage

3.1.3.1 Expert Review

Expert review or assessment by experts is used as a foundation in revising or repairing prototypes that produce prototypes 2. Instrument validation by experts is carried out by the process of providing validation sheets for HOTS question grids, HOTS questions, answer keys, and scoring guidelines for validators, consisting of two mathematics lecturers at the Indonesian Education University, Serang Regional Campus. Based on the expert review validation stage, the general results are as follows: Validator 1 stated that the Banten culture-based HOTS questions were fairly good and fit to be used without any corrections or revisions. Validator 2 stated that the Banten culture-based HOTS questions were fairly good and deserved to be used with minor improvements or revisions. Validator 3 stated that the Banten culture-based HOTS questions were fairly good and feasible to use with minor improvements or revisions. Experts (experts) were asked to evaluate and give an assessment of all instruments about High Order Thinking Skills (HOTS) based on Banten culture. After the analysis activities are completed on the validation sheet by the experts, the validity test is carried out. One of the questions before and after the revision based on the validator can be seen in the table 6.

Table 6. Questions before and after revision

Before Revision	After Revision
2. Take a look at the two pictures of the baduy batik motifs that have been shaded below!  llustrate a fraction that is equivalent to the number of fractions in the image above on the Baduy batik motif below by shading it… 	2. Take a look at the two pictures of the baduy batik motifs that have been shaded below!  The yellow part is the shading. Add the fractions in the two pictures above...

3.1.3.2 One-to-one

At this stage a trial was carried out on several students who were in class V semester 1 of SD Negeri Karawaci Baru 3. The question of High Order Thinking Skills (HOTS) based on Banten culture was tested on 3 students who were the subject of research and students submitted their comments on the High Order question. Thinking Skills (HOTS) are on the student response questionnaire given. The research subjects at this one-to-one stage consisted of students who had high, medium, and low-level thinking skills. The results obtained from the one-to-one stage are that students feel that the material for question number 2 is in accordance with what has been studied in class 5 semester 1 of SD Negeri Karawaci Baru 3 in mathematics, students have difficulty understanding the questions in item number 2 which contains material for counting fractions operations, and there are suggestions from students to add a plus sign to the images presented so that they are easy to understand. The response becomes a reference for improvement or revision of the prototype. The results of the 0ne-to-one stage can be seen in the table 7.

Table 7. One-on-one results

Before Table 7 **Revision**	**After Revision**
2. Take a look at the two pictures of the baduy batik motifs that have been shaded below!  The yellow part is the shading. Add the fractions in the two pictures above...	2. Take a look at the two pictures of the baduy batik motifs that have been shaded below!  The yellow part is the shading. Add the fractions in the two pictures above...

3.1.3.3 Small Group

An experiment was conducted in small groups with 6 students from class V in semester 1 of SD Negeri Karawaci Baru 3. The characteristics of the research subjects consisted of students with high-level, medium-level, and low-level thinking abilities. Each characteristic consists of two students from class V. Students who are the subject of research trials at the small group stage are assigned to work on the Banten Culture-Based HOTS questions. In order to assess the practicality of the items and determine student responses or responses, students are assigned to fill out student response questionnaire sheets related to the HOTS questions that have been done. The results of the small group stage are students feel that the questions are easy to understand, the questions presented have a special attraction for students, especially in the pictures and story texts that are presented, the items presented have varying levels of difficulty depending on the individual students

themselves, students like story questions. which is integrated with Banten culture, and students feel they know new things about Banten culture after reading the questions presented. The response is used as a reference for repair or revision of the prototype and produces prototype 3.

3.1.4. Field Test Stage

The prototype that has passed the validation process and is repaired or revised, is then carried out on a trial run on grade 5 students in semester 1 at SD Negeri Karawaci Baru 3 with 30 students. The Banten culture-based High Order Thinking Skills (HOTS) test was held for 2 x 45 minutes. Students are assigned to work on the Banten culture-based High Order Thinking Skills (HOTS) question which consists of 10 questions in the form of a description. In the implementation of the High Order Thinking Skills (HOTS) field test activity, the researcher provided question sheets and answer sheets to students. The process of working on or solving High Order Thinking Skills (HOTS) questions begins with the researcher delivering guidelines for solving the Banten culture-based High Order Thinking Skills (HOTS) questions. Each of these students completes the HOTS questions on the student answer sheets that have been given. The results obtained from the student's answers were then analyzed to determine the value of reliability, level of difficulty, discriminating power of questions, and the ability of students to correctly answer the High Order Thinking Skills (HOTS) question based on Banten culture.

3.2. Eligibility of Banten Culture-Based HOTS Questions

The results of the validity test showed that the HOTS questions based on Banten culture were said to be valid or suitable for use with a rating of 3 and a scale of 4, so the Aiken V index was at least 0.80 (in Azwar, 2012). validity results in the table 8.

Table 8. Validity results

Items	Expert Review			s1	s2	s3	∑S	n(c-1)	V	Results
	I	II	III							
1	4	3	4	3	2	3	8	9	0.888888889	Valid
2	4	4	3	3	3	2	8	9	0.888888889	Valid
3	4	4	4	3	3	3	9	9	1	Valid
4	4	4	4	3	3	3	9	9	1	Valid
5	4	4	4	3	3	3	9	9	1	Valid
6	4	4	4	3	3	3	9	9	1	Valid
7	4	4	4	3	3	3	9	9	1	Valid
8	4	4	4	3	3	3	9	9	1	Valid
9	4	4	4	3	3	3	9	9	1	Valid
10	4	4	4	3	3	3	9	9	1	Valid

Expert validation results were obtained from 10 HOTS questions based on Banten culture, all of which had an AIken score above 0.80. This means that the Banten culture-based High Order Thinking Skills (HOTS) test questions have valid criteria and are ready to be used. Based on the results of the student response questionnaire there is a practicality test, the results obtained are as follows in the table 9.

Table 9. Practical Results

Items	Students	Practicality Score
1	AM	92.5
2	AP	97.5
3	CW	97.5
4	DA	97.5
5	ML	95
6	S	97.5
	Average	96.25

The practical value obtained is 96.25%. This means that the Banten culture-based High Order Thinking Skills (HOTS) that has been developed is in the very practical category according to the practicality criteria according to Zainal Arifin (2016: 50).

3.3. Characteristics of HOTS Question Items Based on Banten Culture

3.3.1. Question Reliability Test

The reliability test of HOTS questions based on Banten culture was calculated using the Alfa Cronbach formula. The instrument reliability value is 0.891. Then 0.70 < r_11 0.90. This means that the HOTS questions based on Banten culture are declared to have high reliability criteria according to the reliability criteria according to Jihad and Abdul (2013: 181).

3.3.2. Question Difficulty Level

Each HOTS item based on Banten culture can be declared appropriate or good if each HOTS item meets the criteria for a minimum level of difficulty with a value of 0.31 (Lestari & Yudhanegara, 2017).

Table 10. Difficulty Level Results

Items	Difficulty Level	Category
1	0,542	Medium
2	0,233	Difficult
3	0,483	Medium
4	0,575	Medium
5	0,250	Difficult
6	0,592	Medium
7	0,558	Medium
8	0,525	Medium
9	0,550	Medium
10	0,500	Medium

The results of the difficulty level test found that 8 items (80%) entered the level of difficulty with the "Medium" criteria. This means that there are many students whose answers are correct and whose answers are wrong, or it can be said to be a draw. While 2 items (20%) entered the level of difficulty with the "Difficult" criteria, meaning that many students answered incorrectly. In the research of Alfarisa, et al (2019), it was stated that the items that entered the accepted criteria were the medium difficulty category, those that entered the revised criteria were the difficult and easy difficulty categories, the rejected criteria were the very difficult and very easy categories. This can be interpreted that the majority of questions are accepted, while two items that have a difficult category need to be corrected or revised. This is in line with the statement of Amalia & Widayati (2012) on the results of the research they have done that the questions that fall into the category are not so easy and not so difficult, or it can be said that they are good items.

3.3.3. Power of Differing Questions

HOTS question items based on Banten culture can be declared good or good if the HOTS items have a minimum distinguishing power of 0.2 (Lestari & Yudhanegara, 2017). This states that the High Order Thinking Skills (HOTS) item is declared good if it has sufficient discriminatory power. Different power test results in the following table 11.

Tabel 11. Power of Differing Results

Items	Power of Differing
1	0,486
2	0,747
3	0,633
4	0,622
5	0,782
6	0,770
7	0,650
8	0,442
9	0,576
10	0,631

The results of the discriminatory power test found that 10 items (100%) were included in the discriminatory criteria, which means that the HOTS questions are good for classifying the level of students' thinking abilities. The test results are in line with the theory presented by Mardapi (2017) and Kartowagiran (2012) that the items are of good quality and deserve to be accepted if the discrepancy index is more than 0.30. This means that all items of High Order Thinking Skills (HOTS) based on Banten culture tested are of good quality and deserve to be accepted. The results of the analysis carried out on the ability of students to correctly answer the High Order Thinking Skills (HOTS) questions based on Banten culture found that the ability to answer questions on the HOTS C4 criteria was mostly (26%) at a sufficient score. Most of the HOTS C5 criteria were in the sufficient and less scores (26%). And most of the HOTS C6 criteria (30%) are at a very low score. It states that the higher the criteria for High Order Thinking Skills (HOTS) students face difficulties in working on questions. This is in line with the purpose of Bloom's taxonomy (in Munzenmaier & Rubin, 2013) to classify cognitive levels C1-C6 which describes the level of students' thinking abilities, the higher the cognitive level, the higher the difficulty level.

4. CONCLUSION

The development of HOTS questions based on Banten cul-ture to measure the mathematical abilities of elementary school students through several stages based on the Research and Development (R&D) method with the Martin Tessmer (1993) model, namely formative research which includes pleminary stages and formative evaluation stages. The development of the questions resulted in 10 mathe-matical description questions. The value of validity 0.80 for each item, meaning that the item is feasible to use. The level of practicality of the questions obtained a value of 96.25% with a very practical category. The reliability of the question obtained a reliability coefficient of 0.891 and declared reliable. Based on the difficulty level test, it was found that 8 items (80%) entered the "medium" diffi-culty level criteria. this means the number of students who answered right and wrong, balanced. Meanwhile, 2 items (20%) are included in the criteria for "difficult" level of diffi-culty. This means that most of the students answered the questions incorrectly. Based on the discriminatory power test, it was found that 10 items (100%) were categorized as good discriminating power. This means that the HOTS questions are good and good for classifying the level of students' thinking abilities. Based on the results obtained from this study, it can be stated that the following suggestions: for students in learning mathematics, they must be able to improve higher-order thinking skills so that the dimensions of students' knowledge also increase, teachers are expected to be able to provide cul-ture-based questions that contain the dimensions of students' high order thinking skills in learning so that students are ac-customed to solving these questions, and to find out further whether or not the question instrument that has been devel-oped, it is recommended for further researchers to be able to try it out on a wider trial subject.

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AUTHOR'S CONTRIBUTIONS

The author discussed the results and contributed to from the start to final manuscript.

CONFLICT OF INTEREST

There are no conflicts of interest declared by the author.

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