

Developing Higher Order Thinking Skill (HOTS) Mathematic Problem Using That Quiz Application

Ririn Faridah, Tatag Yuli Eko Siswono, Endah Budi Rahaju

Mathematics Department, Universitas Negeri Surabaya, Ketintang, Surabaya 60231, East Java, Indonesia

ririnfafah@gmail.com

Abstract—This study aims to describe process, responses, and effectiveness of applying HOTS problem using That Quiz application in the learning of Sequence and Series. Based on the analysis of ADDIE model, it was obtained that HOTS questions were in good quality because they meet valid, reliable, and objective criteria. The results of the questionnaire responses of students' responses, the development of HOTS questions using That Quiz received a positive response from students. While based on the analysis of formative test results in the implementation class, students' post-test scores were better than the pretest scores. Pre-test and post-test data are both normally distributed data. After the data has been tested using the statistical test t , the value of the pretest to post-test increases more than 40 points. So the development of HOTS questions using That Quiz is said to be appropriate in supporting learning. Based on the teacher's response questionnaire, HOTS questions using That Quiz are also practical. Therefore, the development of HOTS questions using That Quiz can be said to be effective. Furthermore, based on the results of analysis, HOTS questions using That Quiz can be used by mathematics teachers in Sequence and Series lesson.

Keywords— *Instrument, HOTS, That quiz*

I. INTRODUCTION

Mathematics is a subject needed to be delivered to all learners from elementary to high school level. It is to equip learners to become logical, critical, analytical, creative, and meticulous so as to not easily give up in solving problems. Those competencies are needed, so that learners can have the ability to acquire, manage, and utilize information to live better in an ever-changing, uncertain, and highly competitive state. In implementing mathematics learning, it is expected that learners should be able to feel the benefits of learning mathematics. It means that one of the goals of learning mathematics is to train reasoning and problem-solving skills. Therefore, in preparing the test questions, teachers should be directed at least into the realm of cognitive analysis. This is similar to the form of PISA (Program for International Students Assessment) problems. The problems presented a stimulus from the real life and expected the learners to analyze the problem.

Meanwhile, the rank of average score of Indonesian students in PISA (Program International for Student

Assessment) 2015 was in position of 63 out of the 70 participating countries [1]. It indicated that the performance of Indonesian students was still relatively low. Thus, to improve students' competence in reasoning, logical thinking, it is still needed a hard work to train students to literacy, critical thinking, solving problems and applying their knowledge in real-life context and to situation especially in the field of mathematics. One of the government's efforts to overcome this situation is by directing people to arrange questions of Higher Order Thinking Skills (HOTS) using computer-based. The domain of HOTS uses the thinking phase of the analysis phase included ability to think in specifying aspect of a certain context, evaluation phase included ability to think in making decisions based on fact, and create phase included ability to think in building ideas / ideas thinking skills in building ideas / ideas [2]. According to Rubin and Rajakaruna [3], HOTS with clicker application can improve the students' responses and abilities to think critically and creatively. Tanujaya [4] stated that the HOTS instrument measures the ability of high school students in math subjects in higher-order thinking more valid. Apino and Retnawati [5] also said that the development of the HOTS problem is very important in mathematics learning. In fact, there are still many teachers who are reluctant to make a problem and just use the ready-made questions.

Assessment is the process of collecting and processing information to measure the achievement of learners' outcomes [6]. Assessment refers to the collection of information and synthesis by the teacher regarding the learners and the class [7]. Thus, assessment can be interpreted as the process of collecting and processing information that referred to a process and conducted by a teacher. Assessment is also used as a reference to determine the level of progress of learners. The success or failure of a lesson can be measured through assessment. Since the teacher applied a new concept or new skill, the teacher should know that the children have the concepts and skills to be developed [8]. So, this assessment is an instrument of a successful learning. The judgment will be meaningful if the assessment is promptly given feedback. Teacher can use this to know the extent of their students' understanding.

This is in a line with Hattie, that is, "what makes a difference to student achievement the single powerful influence was feedback" [9]. In Indonesia, it can be written that "giving feedback can exert a powerful influence to make a difference in the achievement of learning outcomes". This means that teachers should immediately correct the student's work in the assessment in order to know the extent of student ability.

The HOTS questions were instruments which used to measure high-level thinking skills, such as: 1) transfer one concept to another, 2) process and apply information, 3) look for links from different information, 4) using information to solve problems, and 5) reviewing ideas and information critically [2]. Stein and Lane [10] defined the Higher Order Thinking Skill that provides complex thinking, no algorithm to accomplish a task, some unpredictable, using different approaches to existing tasks and different from those examples has been given.

Judging from the dimensions of knowledge is generally a matter of HOTS measuring the metacognitive dimension rather than simply measuring factual, conceptual, or procedural dimensions. The metacognitive dimension describes the ability to connect several different concepts, interpret, solve problems, choose problem-solving strategies, discover new methods, reasoning, and making informed decisions. The dimensions of thought processes in Bloom's Taxonomy as perfected by [11] were consisted of the ability to know (Remember-C1)), understand (understand-C2), apply (C3), analyze (analyze-C4), evaluate (evaluate-C5), and create (create-C6). HOTS problems generally measured the ability to analyze (analyze-C4), evaluate (evaluate-C5), and create (C6).

According to Munadi [12], Learning Media is anything that could deliver messages from the source in a planned way so as to create a good learning environment where recipients can perform the learning process efficiently and effectively. Media is a tool to facilitate a process of activity. In this case, it will be used media in the assessment of That Quiz. That Quiz is a web-based medium for a quiz. It is easier and more efficient because the media of That Quiz can facilitate with equation, symbol of mathematics, and available to insert object or picture. Using That Quiz, we can also random the questions which will be used as instrument of assessment.

Based on that background, the researchers tried to do the development of computer-based HOTS with the application That Quiz. The purpose of this study is to develop HOTS-based problems that Quiz. The assessment instruments developed based on the HOTS indicator include the ability to analyze (C4), evaluate (C5), and create (C6). The result of this research is to describe the process and result of HOTS based application development that Quiz

II. METHOD

Based on the research questions that had been established, this study was categorized into research development. The result of this research was a matter of High Order Thinking Skill based on the application that quiz, which could be used by mathematics teacher in practice about assignment, assignment or formative assessment on the topic of sequences and series. In the application-based problem development path, the quiz was used the ADDIE model, which was a development model consisted of the stage analyze, design, develop, implement, and evaluate [13]. Data collection used in this research was included test result, observation sheet, questionnaire and researcher's notes from the implementation of research with ADDIE model. Data analysis was used to see the level of validity of HOTS problems that had developed, if the validator gives a minimum value of 3 at least 80% of the indicator and the result of the calculation of the validity of the criterion showed the correlation coefficient of minimum validity in the medium criterion then the HOTS was said to be valid. Interpretation of the problem item coefficient of correlation was presented in the following table.

TABLE I. INTERPRETATION OF THE COEFFICIENT CORRELATION OF PROBLEM'S ITEM

Coefficient of Correlation	Interpretation
$0,80 < r_{XY} \leq 1$	Test validity is very high
$0,60 < r_{XY} \leq 0,80$	Validity about high test
$0,40 < r_{XY} \leq 0,60$	Medium test validity
$0,20 < r_{XY} \leq 0,40$	Problem validity is low
$0,00 < r_{XY} \leq 0,20$	Test validity is very low
$r_{XY} \leq 0,00$	Invalid

III. RESULTS AND DISCUSSION

The design of this development research was using ADDIE which developed model consisted of analyze (A), design (D), develop (D), implement (I), and evaluate (E). In the explanatory analysis, the researcher conducted basic competence analysis, indicators of achievement of competence and ability of learners. Students were analyzed based on academic ability on math subjects. From the results of the analysis, basic competencies and indicators of achievement of its competencies were prepared as follows:

TABLE II. INDICATORS OF HOTS PROBLEMS

Indicator	Problems	Cognitif Level
Finds the pattern of sequence	A sequence of natural numbers is written as follows: 123456789123456789123456789 ..., so the 10th number is 1, the 15th number is 6, and so on. Then the number to 2018 is	C4

Indicator	Problems	Cognitif Level
Determines the number of first tribes of the arithmetic sequence	In sports games, a sports teacher holds a race for his students. Technical competition is to move the balls to be placed in a large basket to 10 small baskets are available. If there are 10 baskets in the big basket, the competitor must move the ball one by one into the small basket (not allowed at once) starting from basket A to basket J, the competitor start from the specified line, then how far is the distance traveled by each competitor?	C4
Determine the elements of sequence	The fourth tribe of arithmetic is 19 and the seventh tribe is 31. If between each adjacent tribe is inserted 3 numbers to form a new arithmetic sequence, then determine the new sequence of rows	C4

From the grid that had been compiled, the validator assigned 3 and 4 values to the 90% indicator that had been given. This means that the HOTS were valid. Then, the problem was applied to that quiz with the following steps:

- 1) Opened the application that quiz by entering on www.thatquiz.org
- 2) Logged in with email and password, if not have an account then must list first



Figure 1: Early Appearance of That Quiz Application

- 3) Entered student data by click New Class tab and entry student names

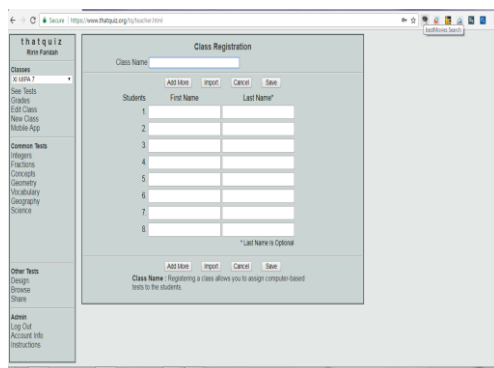


Figure 2: View Of New Class

- 4) After the class data was saved, then entered the edit menu to add each student's password
- 5) Designed a matter of *HOTS* by arranging the grille first
- 6) Once the *HOTS* question was validated, then the HOTS question could be designed in the Quiz application by click Design

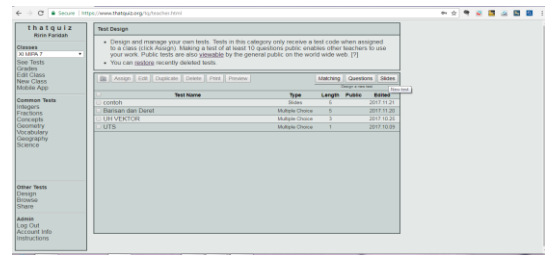


Figure 3: Test Design

- 7) In That Quiz, there were 3 choices of test forms: Matching, Questions and Slides. In order for us to provide a stimulus in the form of images or graphics we can choose the Slides design form
- 8) Input the problem on slides, and saved it.

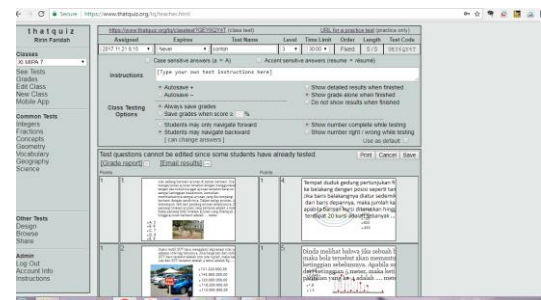


Figure 4: Test Name

- 9) Selected test and set time allocation, then add instructions, and more.



Figure 5: Test and set Time

- 10) To use the test question, activated the problem in the target class by selecting Design-check the problem to be used-select Assign

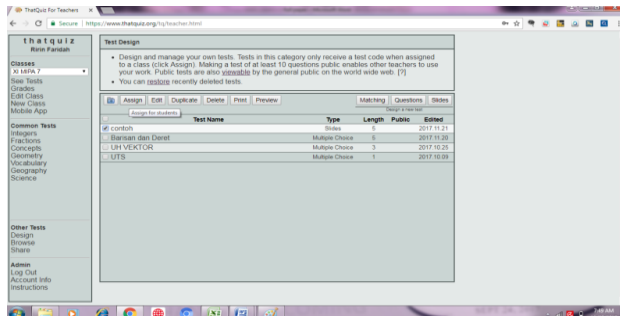


Figure 6: Assign Test

- 11) Problem HOTS-based applications That Quiz was ready to be used.

The criterion of validity was calculated by using the formula of correlation with crude numbers [14]:

$$r_{XY} = \frac{n \sum_{i=1}^n X_i Y_i - (\sum_{i=1}^n X_i)(\sum_{i=1}^n Y_i)}{\sqrt{\left\{ n \sum_{i=1}^n X_i^2 - (\sum_{i=1}^n X_i)^2 \right\} \left\{ n \sum_{i=1}^n Y_i^2 - (\sum_{i=1}^n Y_i)^2 \right\}}}$$

obtained correlation coefficient data between scores obtained by students i (X_i) and the total score obtained by each student i (Y_i) is as follows:

Table III. Correlation Coefficient of Criterium Validity

Q1	Q2	Q3
0.806	0.607	0.883

From the summaries of validity and correlation coefficient, it could be said that the level of validity is relatively high. Student response from HOTS-based apps That Quiz was quite good. It could be seen from the summaries of the questionnaire filled by the students was 82% stated about HOTS-based That Quiz easy to operate, 81% shown that it was easier to understand, and 81% stated that with the HOTS-based problem That Quiz could motivate them to compete and improve their learning.

IV. CONCLUSION

Development of HOTS-based problems That Quiz received positive response from students and teachers. It was also relatively easy and effective to be used for learning in the classroom. Development of HOTS-based problems using That Quiz was actually easy, but takes a long time. It also required a strong internet connection. The researcher recommended that the effectiveness of this study was developed in a larger scope to be tested.

REFERENCES

- [1] A. Gurria, PISA Result in Focus, (www.oecd.org/pisa), 2015.
- [2] L. B. Resnick, Education and Learning to Think, Washington, DC: National Academy Press, 1987.
- [3] J. Rubin and M. Rajakaruna, "Teaching and Assessing High Order Thinking in The Mathematic Classroom With Clickers", Jounal Mathematic Education of Union College, vol. 10, issue. 1, 2015.
- [4] B. Tanujaya, "Development of an Instrument to Measure Higher Order Thinking Skills in Senior High School Mathematic Instruction", Journal of Education Practice, vol. 7, no. 21, 2016.
- [5] E. Apino and H. Retnawati, "Developing Instructional Design to Improve Mathematical Higher Order Thinking Skill of Students", IOP Conf Series: Journal of Physics, vol. 812, no. 1, 2017.
- [6] Kemendikbud, Panduan Penilaian Untuk Sekolah Menengah Atas, Jakarta: Pendidikan Menengah Atas, 2015.
- [7] R. Arends, Learning to Teach (9th ed), New York, NY: McGraw-Hill, 2012.
- [8] B. J. P. C. Arthur, Test, Measurement, And Evaluation, Philipinnes: Addison-Wesley Publishing Company, 1979.
- [9] G. G. Hing and C. Simpson, Condition Under What Assessment Supports Students Learning, Learning And Teaching In Higher Education, (<https://sydney.edu.au/education-portfolio>), 2004.
- [10] T. Thompson, "Mathematic Teacher's Interpretation on Higher Order Thinking in Bloom's Taxonomy", International Electronic Journal of Mathematic Education, vol. 2, 2008.
- [11] L. W. Anderson and D. R. Krathwohl, A Taxonomy for Learning, Teaching, and Assesing: A Revision of Bloom's Taxonomy of Educational Objectives, New York : Longman, 2001.
- [12] Y. Munadi, Media Pembelajaran, Jakarta: Referensi (GP Press Group), 2008.
- [13] M. B. Robert, Instructional Design: The ADDIE Approach, New York : Springer, 2009.
- [14] T. G. Raturmanan dan T. Laurens, Penilaian Hasil Belajar Pada Tingkat Satuan Pendidikan, Surabaya: Unesa University Press, 2015.