

Developing of Student Worksheets HOTS-Based for System of Two Variables Linear Equation Learning Topic in Junior High School

M. Agustarina

Mathematics Education Department
Universitas Sriwijaya
Palembang, South Sumatera, Indonesia.
nys_aisyah@yahoo.co.id

N. Aisyah

Mathematics Education Department
Universitas Sriwijaya
Palembang, South Sumatera, Indonesia.

E. Kurniadi

Mathematics Education Department
Universitas Sriwijaya
Palembang, South Sumatera, Indonesia

Abstract— The revised 2013 curriculum in Indonesia emphasizes HOTS-based learning and HOTS is highly related to problem solving ability in mathematics. Therefore, it is necessary to develop student worksheets HOTS-based in mathematics learning. This type of research is development method of ADDIE models. The study aims to develop student worksheets HOTS-based. The method consists of five stages: self evaluation, expert review with three expert, one to one, small group, and field test. Data collection techniques in this study are: walkthrough, interview, and test. The subject of study were 30 student in 33 Palembang State Junior High School. Based on the research results obtained a set of valid and practical of students worksheets HOTS-based in the topic system of two variables linear equation and has a potential effect. The validity of student worksheets can be seen at the expert review and one to one phase. Practicality of student worksheets is seen when students work on student worksheets at the small group activity. The student worksheets presented some contextual problem HOTS-based and it can help students practice higher order thinking skills in mathematics learning in the topic system of two variables linear equations.

Keywords: *development, student worksheets, HOTS, system of two variables linear equations*

I. INTRODUCTION

Higher-order thinking skills (HOTS) is one of the abilities to solving a problem that requires analysis, evaluation, and creation [1-3]. Students need this ability to face the demands of 21st century [4-8]. To face the demands of the 21st century, curriculum 2013 are also requires students to have high order thinking skills (HOTS) [9]. Higher-order thinking skills (HOTS) are also related to problem solving, because to solve

high-level problems, students must have capability to solve the problem[10].

High Order Thinking Skills (HOTS) of Indonesian students are still low, this is show from the result data of PISA and TIMMS. In the PISA result data, Indonesia is at the number 64 of 72 participant countries, and in the TIMMS result data, Indonesia is at the 44 of 49 participant countries [11-12]. Students can't solve high level problems in PISA and TIMMS questions.

In the 2009 PISA results, algebra topic had the lowest percentage compared to other topic, only 41.4% of students were able to answer correctly [13]. And in the previous research data the activities of students on algebra topic are also included in the low category [14]. One of the reasons is because education in Indonesian still implements Low Order Thinking Skills (LOTS) learning [15]. One way to practice the higher order thinking skills of students is to develop teaching topics in the form of student worksheets [16]. Based on the previous problem, researchers are interested in developing HOTS-based student worksheets on a system of two-variables linear equation learning topic to apply higher-order thinking skills (HOTS) so that it can train students in analyzing, evaluating, and creating from contextual problems.

II. METHOD

This study aims to produce the student worksheets based on a higher order thinking skills in system equation of two linear variables learning topic. It can be showed the worksheet is valid, practical and have potential effect. The subject of this research are students in grade VIII of 33 Palembang State Junior High School. This type of research is development

method of ADDIE model's. The ADDIE model have 5 stages ; Analysis, Design, Development, Implementation and Evaluation [17].

In analysis phase, researchers consider several aspects to being develop of student worksheets, including curriculum analysis, topic analysis, and student analysis. Curriculum analysis is carried out to see the compatibility of student worksheets with the curriculum in the school. In the topic analysis, is carried out to see and determine the indicators to be achieved in student worksheets according to the topic chosen. The last is student analysis, at this stage the researchers examined the character and ability of students to be able to develop a student worksheets based on higher order thinking skills. In designing phase of student worksheets, it start from choosing covers and pictures that are appropriate to the character of the students in grade VIII and determining the problems that exist in the student worksheets according to the ability of the students in grade VIII of 33 Palembang State Junior High School.

In the development phase of student worksheets, it starts from make student worksheets. Then, the student worksheets will be validated by 3 experts , two of them were mathematics education lecturers and 1 mathematics Mathematics teacher. After validating with 3 experts, student worksheets was revised and trialled to 3 students and produced a valid second prototype of student worksheets. Furthermore, student worksheets was tested in a small group by 6 students which is divided into 3 small groups. The results of the student worksheets in the small group are called the third prototype student worksheets.

The next stage is Implementation, at this phase, the third prototype of students worksheet was tested on students in grade VIII of 33 Palembang State Junior High School. At this phase, a test is also conducted to see the effectiveness of the student worksheets that has been developed to see the learning outcomes of students on system equation of two linear variables.

The last is the evaluation phase, this phase consists of expert review, one to one, and small groups. Comments and suggestions that are given by experts and students it will be revised to develop student worksheets based on higher order thinking skills.

III. RESULTS AND DISCUSSION

This study produced a product in the form of a student worksheets HOTS-based for learning topic system of two variables linear equations in grade VIII of 33 Palembang State Junior High School. This research is a development research with the ADDIE model that uses 5 stages: analysis, design, development, implementation, and evaluation.

A. Analysis Phase

The analysis phase is carried out by the researcher analyzing the curriculum, topic, and students. Curriculum analysis is carried out by researchers looking for core competencies, basic competencies, indicators of competency achievement, and time allocation applied in Palembang State Junior High School has implemented the 2013 curriculum, mathematics learning grade VIII used 2013 revised 2017 curriculum. In the 2013 revised 2017 curriculum the system of two variables linear equation topic was in semester 1 in grade VIII and basic competencies contained in the 2013 revised 2017 curriculum accordance with the basic competencies that researchers used in student worksheets. Mathematics learning grade VIII at 33 Palembang State Junior High School is conducted in 5 lesson hours.

Based on the results of the analysis topic and students at 33 Palembang State Junior High School, the subject was selected based on the results of the interview with mathematics teachers, that many student's scores in grade VIII have only reached the standard of minimum completeness and students at 33 Palembang State Junior High Schools are not accustomed to high-level problems so, when students are given higher-order thinking problems they will have difficulty in solving the problem. Also, the learning process only using print books provided by schools and no other resources..

B. Design Phase

Student worksheets are designed in accordance with basic competencies and Indicators that have been analyzed. The image picker available at student worksheets is adjusted for junior high school students. And the problems that exist in student worksheets are adjusted to the ability of grade VIII students.

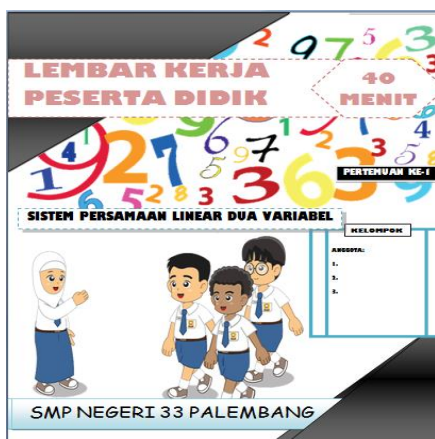


Fig. 1. cover of students worksheets

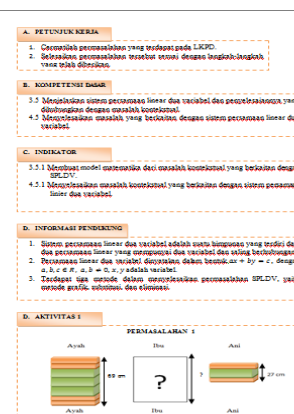


Fig. 2. Page 1 of students worksheets

Figure 1 and figure 2 are the design of students worksheets HOTS-based for system of two variables linear equation learning topic to student grade VIII at 33 Palembang State Junior High School.

C. Development Phase

This stage is related to manufacturing products in the form of HOTS-based student worksheets. The student worksheets are designed HOTS-based by using the steps of solving the problem in the settlement contained in student worksheets. The characteristics of this student worksheets are (1) cover, (2) title, (3) work instructions, (4) basic competencies and indicators, (5) supporting information, (6) activities that contain issues HOTS-based, (7) resolution contained in this student worksheets uses problem solving steps. Student worksheets

that have been designed are called student worksheets prototype 1. There are 3 steps in the development stage, namely expert review, one to one and small groups.

1) Expert Review and One to One

In this step the student worksheets prototype 1 was validated by 3 experts to looking for the content, constructs, and language. After being validated by experts, student worksheets was tested to three students. Students are asked to solve the problems that exist in student worksheets and provide comments and suggestions about student worksheets prototype 1. The revised results in this step produce a valid student worksheets and are called student worksheets prototype 2. The following are the results of revisions in the expert review and one to one steps.

TABLE I. COMMENTS/ SUGGESTIONS AND REVISION DECISIONS AT STEP EXPERT REVIEW & ONE TO ONE

Comments / Suggestions	Revision Decision
<i>Student Worksheets 1</i>	
Student worksheets problem. must contain C4 and C5	Revised
Students have problem with activity 1	Picture in activity 1 there is no high line, so a high line is added.
<i>Student Worksheets 2</i>	
Student worksheets problem. must contain C5 and C6	Revised
Students lack understanding of equations that are not systems in activity 2	The point in activity 2 is changed to form an equation that is not a system and the question is made a and b

After completing the trial phase one to one. The researcher improved the student worksheets that was developed by considering the difficulties experienced by students when working on student worksheets prototype 1 through comments written on the comments sheet and the results of researchers'

interviews with students. The results of the student worksheets prototype 1 improvement resulted in the student's worksheets prototype 2. The following are the results of improvements from the student worksheets prototype 2.

TABLE II. RESULTS OF THE ONE TO ONE STEP REVISION

Student worksheets prototype 1	Student worksheets prototype 2
<p>b. Merencanakan Pemecahan Masalah</p> <p>Buatlah model matematika dari permasalahan di atas dan tentukan strategi yang akan digunakan untuk menyelesaikan permasalahan di atas.</p>	<p>b. Merencanakan Pemecahan Masalah</p> <p>Buatlah bentuk matematika dari permasalahan di atas dan tentukan strategi yang akan digunakan untuk menyelesaikan permasalahan di atas.</p>

2) small group

Student worksheets prototype 2 was then tested on 6 students who were divided into 3 groups. The students selected in this step are not the research subjects and are not the students who have been used in the one to one step. Student selection categories for this step are students who have high, medium, and low abilities. Learners are asked to solve the problems that exist in student worksheets prototype 2 in group

discussions. After the students finish working on the student worksheets prototype 2, the students are asked to write comments and suggestions on the comments sheet that has been given by researchers. The results of the revision of student worksheets prototype 2 are valid and practical, this product is called student worksheets prototype 3. The following is a table of revision results from student worksheets prototype 2:

TABLE III. DECISION RESULTS OF SMALL GROUP STEP REVISIONS

Comments / Suggestions	Revision Decision
The completion step of choosing a strategy is combined with the step of solving the problem	Has been fixed for issues 1 and 2 for student worksheets 1, and problem 1 for student worksheets 2. For problem 2 student worksheets 2 is maintained
In the graph problem, it is difficult to determine the point	Revised
Added pictures and colors so as not monotonous	Added a picture of happy working on student worksheets

D. Impelementation Phase

This stage is the field test stage. Field tests were carried out to see the potential effect of using student worksheets on the ability of students to solve HOTS problems on the topic system of two-variable linear equations. Field tests were carried out for 3 meetings, 2 learning meetings using HOTS-based student

worksheets, the last meeting conducted tests to see students' abilities in solving HOTS problems. The first and second meeting of students was divided into several discussion groups in the use of HOTS-based student worksheets. From the first and second meetings seen the potential effect of using HOTS-based student worksheets on students.

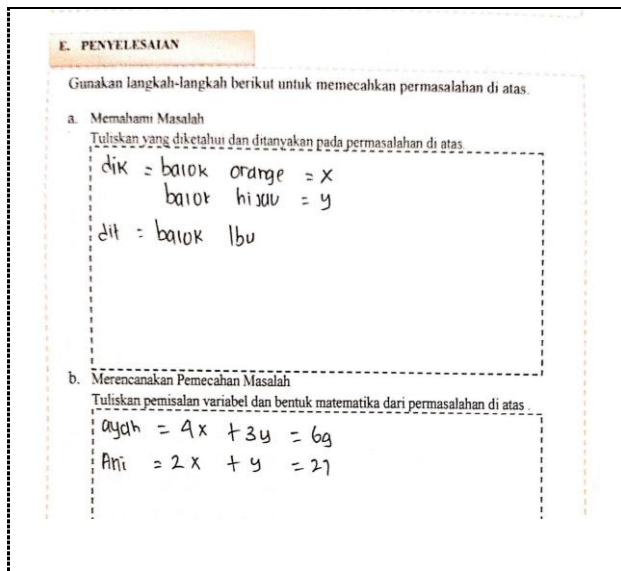


Fig. 3. Answers group 4 first meeting

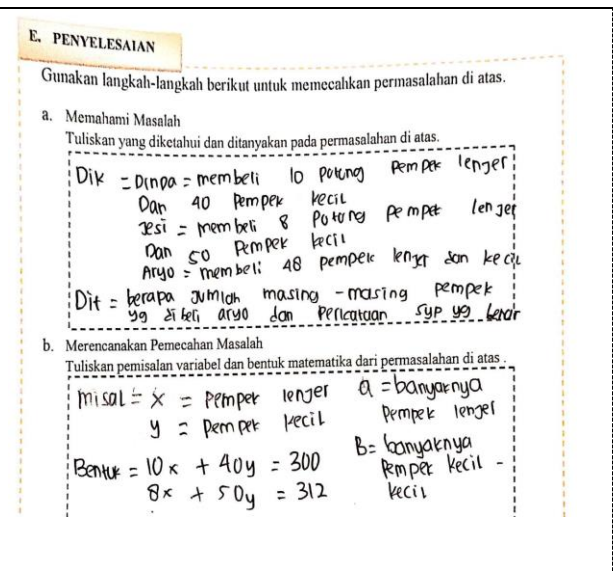


Fig. 4. Answers group 4 second meeting

Figure 3 is the result of the answers from group 4 at the first meeting on the use of HOTS-based student worksheets. From Figure 1 the ability of students to analyze is still relatively low. It can be seen from the first step of completion, students can't analyze the information that is on the problems contained in the student worksheets. In the first step of completing the students write an example of variables that should be written in the second steps.

Figure 4 is the result of the answers from group 4 at the second meeting using HOTS-based student worksheets. From figure 2 the ability of students to analyze the problems that exist in student worksheets is better than the first meeting. Students can analyze the information contained in the problems in student worksheets and write answers by following the predetermined completion steps [18].

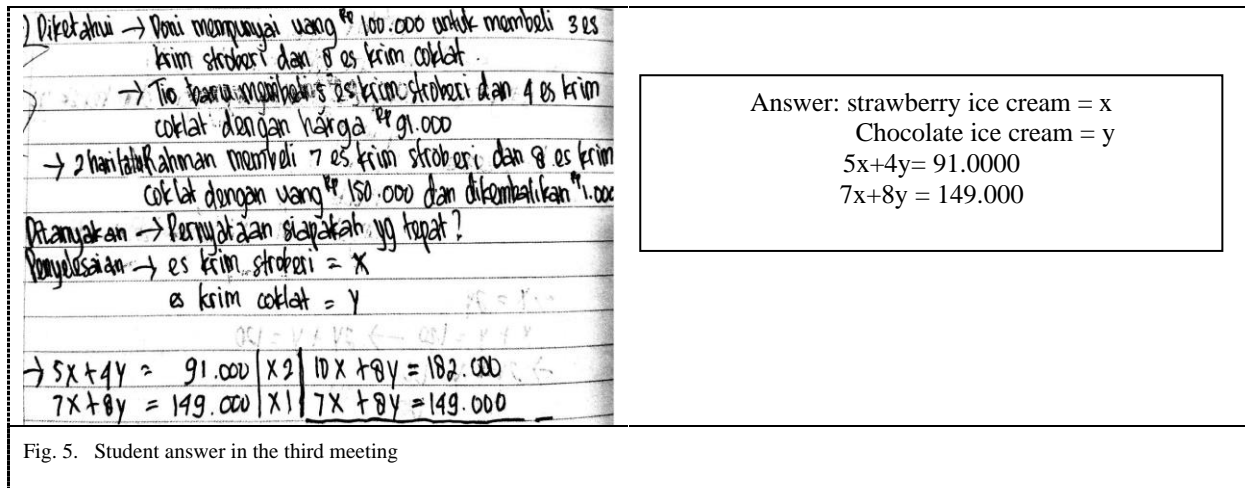


Fig. 5. Student answer in the third meeting

Figure 5 is the answer of one of the students to the evaluation question during the exam at the third meeting. It can be seen the ability that appears at the third meeting is the ability to analyze. Based on student answer sheets, the researcher concludes that the most dominant ability of students to emerge is the ability to analyze.

Based on the data above, the student worksheets that are applied to mathematics learning can direct students in solving problems that exist in student worksheets through the completion steps that have been given [19] this is in agreement with the results of previous studies which say that the development of student worksheets can improve students' high-level thinking skills [7,16,20]. Meanwhile, based on the results of research conducted by Lewy [21] regarding the development of HOTS questions, there is a potential effect on higher order thinking skills in both categories.

E. Evaluation Phase

At this stage the researcher revised:

- Inappropriate language is used for grade VIII students.
- Correct the completion steps.
- Correcting questions that are following the ability of students grade VIII at 33 Palembang State Junior High School.
- Add picture of happy working to increase the appeal of work on the HOTS-based student worksheets.

IV. CONCLUSION

This research is a development research with the ADDIE models. This research produces learning products in the form of HOTS-based student worksheets for the learning system of two variables of linear equations. Researchers validated student worksheets with 3 experts on content, construction, and language. To produce valid and practical student worksheets are trialed in step one to one and small groups. The result of comments and suggestions are used to revise student worksheets so that the HOTS-based student worksheets for the system of two-variable linear equations of learning topic.

Answer: strawberry ice cream = x
 Chocolate ice cream = y
 $5x + 4y = 91.000$
 $7x + 8y = 149.000$

Based on the results of the analysis conducted by the researcher when using HOTS-based student worksheets and test results show that the higher-order thinking skills students are the most dominant analytical ability. So it can be concluded that the use of student worksheets has a potential effect on student's ability to solve HOTS problems in the topic system of two-variable linear equations.

REFERENCES

- [1] Krathwohl D R 2002 A Revision of Bloom's Taxonomy : An Overview Theory Into Practice 41:4 212-218
- [2] Ramos J L S Bretel B D & Brenda B V 2013 International Journal of Innovative Interdisciplinary Research issue 4
- [3] Fanani A & Dian K Jurnal Pendidikan Dasar
- [4] Yen T S & Siti H H 2015 The Online Journal Of Distance Education and e-Learning vol 3 p 235
- [5] Istiyono E Mardapi D & Suparno 2014 Jurnal Penelitian dan Evaluasi Pendidikan
- [6] Nadhiroh N 2018 Pengembangan Lembar Kerja Peserta Didik (LKPD) Berbasis Higher Order Thinking Skills (HOTS) Pada Materi Termodinamika
- [7] Kusuma M D Undang R Abdurahman & Agus S 2017 IOSR Journal of Research & Method in Education vol 7
- [8] Pratama G S & Retnawati H 2018 Journal of Physics: Conference Series vol 1097 p 012147
- [9] Suwarsi Zaenal M & Ardhi P 2018 PRISMA Prosiding Seminar Nasional Matematika vol 1
- [10] Bernard M Nuni N Shinta M & Nadila R 2018 Supremum Journal of Mathematics Education vol 2 PP 77-83
- [11] OECD 2016 PISA 2015 Results In Focus
- [12] Mullis M O 2016 TIMSS 2015 International Results In Mathematics IEA TIMSS & PIRLS.
- [13] Aini R N & Tatag Y E S T 2014. Jurnal Ilmiah Pendidikan Matematika vol 3
- [14] Sari A N Rika W & Rosmiyadi 2016 Jurnal Pendidikan Matematika Indonesia vol 1
- [15] Pratiwi W & Johar A 2018 Prosiding Seminar Nasional Unimus vol 1
- [16] Mufidah S & Ariyadi W 2017 Jurnal Pendidikan Matematika vol 6
- [17] Aldoobie N 2015 American International Journal of Contemporary Research vol 5
- [18] Kurniati D Romi H & Nur A J 2016 Jurnal Penelitian dan Evaluasi Pendidikan vol 20 142- 155
- [19] Novita D Darmawijoyo & Nyimas A 2016 Jurnal Pendidikan Matematika vol 10 1-12
- [20] Musfiqi S & Jailani 2014 Jurnal Pendidikan Matematika vol 9
- [21] Lewy Zulkadi & Nyimas A 2009 Jurnal Pendidikan Matematika vol 2