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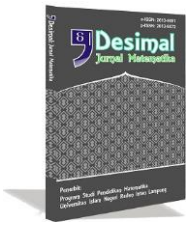

Development of student worksheets for algebra material based on an open-ended approach to support reasoning skills

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ABSTRACT

The Open-Ended approach allows students to develop mathematical reasoning abilities. Using an Open-Ended approach allows students to find various solutions to their problems. This study aims to develop mathematics Student Worksheets based on Open-Ended approaches to valid and practical algebra material and to discover that the mathematics Student Worksheets created can support students' reasoning abilities. This development research is based on the 4-D development model. The study subjects were in the 7th grade at Muhammadiyah 3 Sambungmacan Junior High School. Research data was obtained through observation, questionnaires, and reasoning ability tests. Data analysis techniques include validity tests, practicality tests, and effectiveness tests. The results of the data analysis show that the quality of Student Worksheets seen from the aspect of validity is included in the valid category with an average score of 3.11, based on expert assessment. From the practicality aspect, the Student Worksheet is declared practical based on the results of teacher responses with an average score of 3.00 and student responses with an average score of 3.22. The effectiveness of Student Worksheets based on the results of the reasoning ability test obtained a score of 57.65%, including being in the category of quite effective. Therefore, the Student Worksheet is feasible, practical, and quite effective to use.

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INTRODUCTION

Education plays an important role in life. Education is a place for character building that allows individuals to develop according to their abilities. Education is also a means of interaction between humans with each other and with the surrounding nature. The goal of education is to have a well-balanced instructional experience for both teachers and students with a central focus on learning (Ananga, 2020). In addition, it is stated that education aims to attract qualified individuals. The qualities of individuals

can reflect the progress of a nation. This is reflected in the quality of education. A high quality of education leads to the advancement of a country in various spheres of life.

One of the most important subjects is mathematics education. Mathematics is important and is used in everyday life. The importance of learning mathematics cannot be doubted. Therefore, starting in elementary school and continuing through middle school, the emphasis must be placed on learning mathematics. Other important parts of mathematics education are affective factors such as students' motivation, beliefs, and attitudes towards mathematics and its teaching, as these factors can have a significant impact on students' mathematical skills and their future mathematical learning (Vankúš, 2021). Along with the changes and developments of the times, mathematics learning also continues to experience changes under the influence of the development of science and technology. Based on the Education Unit Level Curriculum (2006), according to Regulation of the Minister of National Education of the Republic of Indonesia Number 22 of 2006 (Menteri Pendidikan Nasional, 2006) concerning Content Standards, mastery of mathematics through mathematics subjects has the aim of encouraging the development of abilities that include concluding patterns and properties, the ability to perform mathematical operations, collecting evidence logically, and explaining mathematical ideas and statements from students.

To ensure that mathematics learning in schools can be appropriate in real-life situations, it is necessary to provide teaching materials such as Student Worksheets to facilitate the mathematics learning series. Student worksheets are material that is practical, useful, and economical for use in educational activities (Mahtari, Wati, Hartini, Misbah, & Dewantara, 2020). Judging from previous real-life practice, using Student Worksheets in schools needs to be reviewed because they are still formulas without a deep understanding of mathematical concepts. Also, despite the effort required by students, they still need to develop their ideas from the material. Thus, Student Worksheets are necessary to help students identify and apply mathematical concepts based on real-world problems. This can emphasize the meaning of learning for students and apply mathematical topics to everyday life rather than giving formulas and definitions directly. According to Prastowo (2014), Student Worksheets can be created by yourself and changed to be more interesting and contextual depending on the conditions and situations of the school or the socio-cultural environment of students.

To create an attractive, practical, and motivating learning environment, the teacher needs to develop a Student worksheet (Hasja, Halim, & Musman, 2020). Developing teaching materials in the form of Student Worksheets is necessary in the world of education. The Student Worksheets development process is the key to achieving the desired learning outcomes. Apart from that, using Student Worksheets can support reasoning abilities.

The reasoning process helps one think directly, precisely, and systematically because then truth can be achieved. Man is never free from problems; solving human problems requires reasoning. The reasoning process attempts to relate known facts or evidence to form a conclusion. Reasoning refers to a way of thinking by associating another statement with another and reaching a conclusion as a new statement. Reasoning can be in the form of a person's ability to think about logical concepts that are already known based on logical proof to obtain information that is not yet known

(Sari, Mayasari, & Sasono, 2020). For the knowledge acquired by reasoning to be correct, a certain method must follow the reasoning process.

Indicators of reasoning include: (1) the ability to express mathematical descriptions orally or in writing using pictures and diagrams; (2) the ability to make relevant assumptions or hypotheses related to a mathematical problem; (3) the ability to perform basic and complex mathematical operations precisely; (4) the ability to collect evidence and provide reasons or evidence that the solution obtained is correct; (5) the ability to draw logical conclusions based on statements and information; (6) observing the validity of mathematical ideas; and (7) obtaining and generalizing the forms and characteristics of mathematical phenomena (Utami, 2019).

On the other hand, according to Bukhori (2018), mathematical reasoning abilities include (1) the ability of students to find a pattern in mathematical phenomena; this means the student's ability to find patterns or ways of an existing question so that they can develop it into a mathematical sentence; (2) the ability of students to consider an assumption; this means the student's ability to formulate various possible solutions to problems is based on the knowledge he has; (3) the ability of students to conclude a valid argument; in this stage, students are expected to be able to conclude patterns formed in the solutions they write.

Mathematics requires reasoning skills to develop and build systematically organized ideas and knowledge. Mathematical reasoning has often been connected to mathematical proving and the logical process that comes with it (Hjelte, Schindler, & Nilsson, 2020). Students are expected to develop their reasoning rather than memorize the material given when learning mathematics. Teacher skills help develop improved reasoning abilities. In order to facilitate the process of learning mathematics, a teacher must be able to create potential, interests, and talents in his students. Therefore, considering that poor reasoning can hurt students' academic achievement, reasoning ability is a crucial skill that must be improved.

The data collection results of Indonesian students obtained through the Programme for International Student Assessment (PISA) indicate that the reasoning ability of students still needs to improve. Indonesia received math scores of 386 and 379 in 2015 and 2018 (OECD, 2019). This indicates that Indonesia is still unable to master mathematical reasoning skills. On that basis, this study applies a learning style to support students' reasoning abilities, namely applying Open-Ended approach-based learning.

Solving problems that are considered to have the potential to foster imagination and development in students' mathematical thinking in a more diverse way can use a learning approach, namely the Open-Ended approach (Rudyanto et al., 2019). The Open-Ended approach is done by presenting questions with many correct answers or in various ways to get the right answers, thus giving flexibility to students to use their skills, ideas, and mathematical skills freely. In addition, an Open-Ended approach can be used to reason and communicate their ideas by providing explanations and reasons related to their chosen answers (Mursidik & Ambarwati, 2021). Based on this opinion, the Open-Ended approach allows students to hone mathematical reasoning skills.

In developing Student Worksheets, researchers used the Open-Ended approach, which is expected to support reasoning abilities. Learning algebra requires understanding concepts, symbols, operations, and rules. Such capabilities are explored in the reasoning, including skills in understanding patterns

and making generalizations. This research and development aims to create learning tools for algebra learning materials in mathematics subjects based on the Open-Ended approach.

METHOD

The development model used in this development research is the 4-D development model. The model was proposed by Thiagarajan, with stages including defining, designing, developing, and disseminating.

Below are the stages of the 4-D model of Thiagarajan. The first is defining, which involves analytical activities to identify and decide learning needs by analyzing learning objectives and limitations. This stage consists of (1) Beginning-End analysis, carried out by analyzing the main problems faced during teaching and learning activities to improve the quality of learning practices; (2) analysis of students by establishing their characteristics; (3) Concept analysis aims to determine material for the development of Student Worksheets by taking into account the Core Competencies and Basic Competencies of algebraic material; (4) task analysis is a procedure for identifying learning content in algebraic material, has a scope to determine content, learning activities, and learning indicators, and formulates objectives listed in the independent curriculum; and (5) defining learning objectives based on the analysis that has been carried out, then formulating the objectives of preparing Student Worksheets.

The design stage is the preparation stage of Student Worksheets, which includes: (1) instrument preparation; instruments are made according to the results of student analysis in defining; (2) media selection has the aim of facilitating learning activities; (3) format selection, in other words, selection of learning designs that are by the method students are interested in; and (4) preliminary design: the preliminary design is used to compile the preliminary product or product design.

The development stage includes Student Worksheets and instrument validation by expert lecturers and mathematics teachers. An important stage also occurs in this stage of development, namely the field trial stage.

The dissemination stage is the last step in the series of developing teaching materials that have been prepared. In this dissemination, teaching materials, namely Student Worksheets, will be used and set on a larger scale.

The subjects of this development research were 15 students in the 7th grade at Muhammadiyah 3 Sambungmacan Junior High School.

Data collection instruments include evaluation and measurement tools. The following are the instruments: (1) Student Worksheets Assessment Sheet, prepared for validators or expert lecturers as an evaluation tool to assess the feasibility of the developed Student Worksheets. (2) Test instruments determine the learning effectiveness of the products produced. (3) Student and teacher response questionnaires and product assessment questionnaire sheets will be used to obtain data on the development of Mathematics Student Worksheets based on the Open-Ended approach and the feasibility of learning media.

It must have quality characteristics, including validity, practicality, and effectiveness, to be considered a good learning tool. The following analysis is carried out to assess the quality of learning tools that have been made using an Open-Ended approach and are prepared to focus on the reasoning ability of students. First, analyze its validity. The assessment sheet contains four answer choices, numbered 1 through 4. Then, create an assessment data table by validators or expert lecturers.

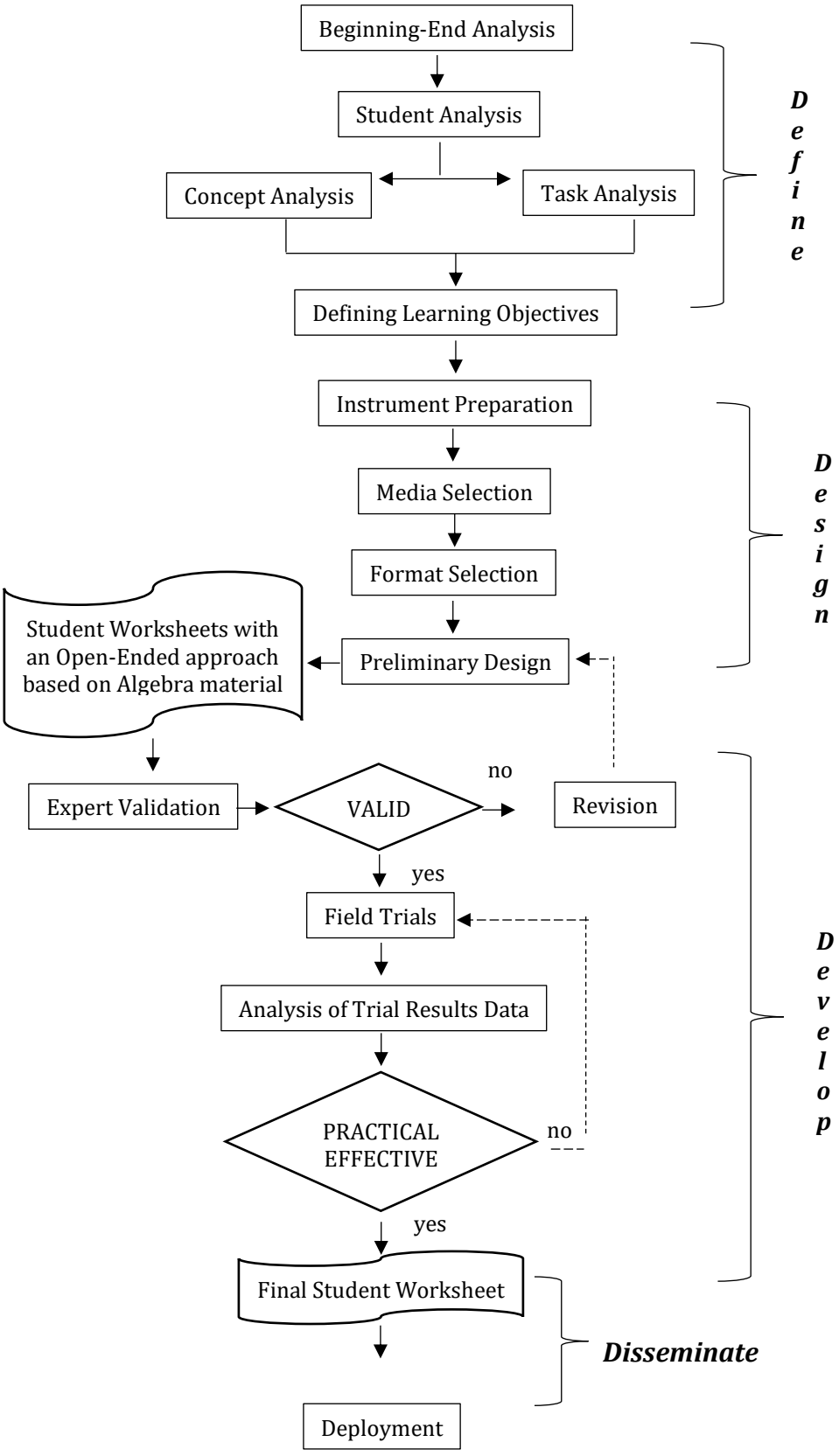


Figure 1. Flow of the 4-D Research Model

Table 1. Assessment Score by Validator

Information	Score
Very Good	4
Good	3
Less	2
Very Less	1

After that, the criteria for Student Worksheets products to be developed are determined based on the results of the assessment of expert lecturers.

Table 2. Product Assessment Criteria

No.	Interval	Criteria
1.	$3.26 \leq X \leq 4.00$	Very Good
2.	$2.51 \leq X \leq 3.25$	Good
3.	$1.76 \leq X \leq 2.50$	Pretty Good
4.	$1.00 \leq X \leq 1.75$	Not Good

Next, analyze the validity of the resulting product. A product that has been produced is considered valid if the minimum product criteria achieved are good.

Secondly, practicality analysis. Data from student and teacher response questionnaires were tabulated with Likert scales. The statement items in the questionnaire are categorized according to the aspects of concern, as shown in Table 3.

Table 3. Likert Scale

Alternative Options	Value
Strongly Disagree	4
Disagree	3
Agree	2
Strongly Disagree	1

After that, product criteria are determined based on the responses of students and teachers by converting the total average value data to qualitative data.

Table 4. Student and Teacher Response Assessment Questionnaire Criteria

No.	Interval	Criteria
1.	$3.26 \leq X \leq 4.00$	Very Worth It
2.	$2.51 \leq X \leq 3.25$	Worthy
3.	$1.76 \leq X \leq 2.50$	Less Decent
4.	$1.00 \leq X \leq 1.75$	Not Worth It

Next, an analysis of the practicality of learning tools is carried out. A product under development is considered practical if the minimum criteria the product must achieve are feasible.

Third, analyze effectiveness. This step assesses the level of effectiveness of the developed product. Effectiveness data is obtained through the results of reasoning ability tests. The reasoning ability test is carried out twice, through the pre-test and post-test. To assess the improvement of students' reasoning ability, use the paired sample t-test and calculate the N-Gain value. The t-test aims to determine the significance of the difference between the average score obtained from the pre-test and post-test. So that it can help identify the impact before and after treatment. The normalized gain (N-Gain) test measures the increase or difference in scores between the pre-test and post-test. Obtaining value through N-Gain analysis can determine the effectiveness of the results of mathematical Student Worksheets development with an Open-Ended approach. To determine the criteria for improving understanding, see the requirements in Table 6.

Table 6. *N-Gain* Category Restrictions

No.	Limitation	Category
1.	$g \geq 0.7$	High
2.	$0.7 > g \geq 0.3$	Medium
3.	$g < 0.3$	Low

While in percentage form, *the N-Gain* value can be categorized as in Table 7.

Table 7. Categories Interpretation

Percentage (%)	Interpretation
< 40	Ineffective
40 – 55	Less Effective
56 – 75	Quite Effective
> 76	Effective

Next, analyze the effectiveness of the learning tool. A product to be developed is considered effective if the minimum product category to be achieved is medium.

RESULTS AND DISCUSSION

This research was conducted to develop mathematics Student Worksheets on algebra material based on *an Open-Ended* approach to support reasoning skills. The development model is 4-D, including define, design, develop, and disseminate.

Define

The early-final analysis stage aims to identify problems that arise during mathematics teaching and learning activities. It is known that learning remains focused on the teacher, who gives explanations in front of the class. This situation makes students passive and unable to participate actively in learning activities. This hurts the development of reasoning abilities. It also causes many students not to be interested in or even dislike learning mathematics. This problem aligns with research (Djadir & Sahid, 2015), which shows that mathematics subjects are difficult to understand and less preferred. Dissatisfaction with these subjects can affect learning achievement. In addition, the reasoning ability of students still needs to improve, and the availability of learning devices such as Student Worksheets still needs to be improved. This is in line with research (Pratiwi, 2022), which shows that the availability of teaching materials in schools has minimal or little negative impact on students, does not allow them to learn independently, and only focuses on learning resources provided by teachers. The impact is that students are less active in classroom learning, so learning tools that can increase student interest in the teaching and learning process are needed. Thus, it is necessary to choose the right approach and development model to create Student Worksheets that can meet the needs of students.

Analysis of students aims to determine the characteristics of students as the focus of product development, especially Student Worksheets. The characteristics of students can be observed through their sincerity when paying attention to mathematics learning, student learning skills, and learning encouragement from the students themselves. This finding shows the importance of introducing students to using mathematics Student Worksheets based on an Open-Ended approach in the learning process.

Concept analysis aims to recognize material concepts needed to be the focus of product development by considering basic competencies. This ensures an understanding of mathematical concepts, such as algebraic material. Therefore, researchers decided to focus on algebraic material, which became the basis for developing Student Worksheets. Researchers have developed various subchapters on algebraic material based on the results of concept analysis. The subchapter covers the introduction of algebraic forms, addition and subtraction operations in algebraic form, and multiplication and division operations in algebraic form, which will be discussed in the development of Student Worksheets. The concept analysis conducted in this study has included an Open-Ended approach to support the reasoning abilities of students.

Task analysis refers to the basic competencies that will be compiled and analyzed by the main task. Based on this analysis, each Student Worksheets can be divided into several parts to help students

master Student Worksheets. The analysis results show that Student Worksheets are needed to meet the needs in the form of students' reasoning abilities. They must solve problems using reasoning indicators, which include considering how to solve them, using structures and relationships to analyze mathematically, constructing valid ideas with systematic steps, and making logical conclusions. In addition, the need for Open-Ended concepts is also important to implement in the learning process, especially in mathematics, so students have different perspectives when solving a problem. According to research by Apertha, Zulkardi, & Yusup (2018), open-ended problems allow students to gain expertise in obtaining, knowing, and solving problems using various possible solutions. This is related to the principle of scientifically based learning in the 2013 curriculum, which emphasizes diverse solutions with many truths.

The stage of defining learning objectives is key to determining the limits of learning objectives based on concept analysis. Some of the learning objectives that must be achieved by students in mathematics Student Worksheets through the Open-Ended approach are: it is expected to be able to solve addition, subtraction, multiplication, and division operations in the form of algebra after learning mathematics Student Worksheets based on the Open-Ended approach.

Design

The test preparation stage includes an important step in evaluating the reasoning ability of students. Test instruments are tests of students' reasoning abilities in the form of description tests. This test will be done twice, beginning before using mathematics Student Worksheets and ending after being treated with mathematics Student Worksheets. Tests are used to assess reasoning ability in the context of algebraic material.

At the media selection stage, researchers must choose appropriate media that presents the characteristics of learning materials that suit the needs of students. Researchers chose Student Worksheets development media in this study based on the Open-Ended approach. In this context, Microsoft Word 2013 and Canva applications were selected as supporters in developing Student Worksheets. This Student Worksheets was chosen because it facilitates students to learn algebra material at school and home with clear and easy-to-use instructions.

The format selection stage in the development of Student Worksheets is very important in determining the product format that will be used as the basis for making mathematical Student Worksheets. The format chosen when developing mathematics Student Worksheets includes titles, instructions for use, core and basic competencies, achievement indicators, learning objectives and activities, and summaries. Meanwhile, the author has developed technical formats to attract students' attention, including color choices, shapes, and writing styles. This aspect can increase the visual appeal of Student Worksheets and make them more attractive.

In the initial design stage, researchers make a preliminary design before conducting trials that includes a plan of all activities that need to be carried out. The result of this stage is the first draft of Student Worksheets based on the Open-Ended approach. In addition, researchers also compile assessment instruments. Researchers collect Student Worksheets validity assessment instruments, including instruments for media expert validators and material expert validators.

Develop

The development stage in the development of Student Worksheets has the main objective of producing Student Worksheets products after they have been improved according to validator comments and recommendations, as well as test result data. Product development includes the implementation of feasibility tests by validators as well as mathematical Student Worksheets product trials.

The draft Student Worksheets made in the planning stage will be validated by validators who master mathematical materials, understand the making of Student Worksheets, and can contribute to improving teaching material products. The validation test process needs to be carried out so that the feasibility and quality of Student Worksheets can be known. Media experts and material experts assess due diligence. Validation is done by one validator each. Validator 1 is a media expert, while Validator 2 is a material expert. The results of the Student Worksheets feasibility validation can be observed in Table 8.

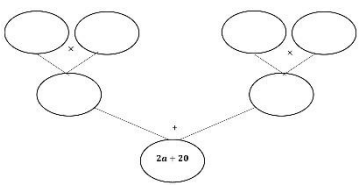
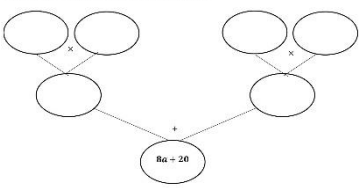
Table 8. Student Worksheet Feasibility Validation Results

Media Expert					
Content Size		Content Cover Design		Content Design	
Average Score	Criteria	Average Score	Criteria	Average Score	Criteria
3.00	Good	3.00	Good	3.00	Good
Average					**3.00**
Criteria					**Good**

Material Expert					
Content Feasibility		Feasibility of Presentation		Language Feasibility	
Average Score	Criteria	Average Score	Criteria	Average Score	Criteria
3.43	Very Good	3.00	Good	3.20	Good
Average					**3.21**
Criteria					**Good**
Overall Average					**3.11**
Criteria					**Good**

Based on Table 8 on the content design aspect, with an average score of 3.00 given input by media experts, Table 9 shows improvements to aspects of content design.

Table 9. List of Student Worksheet Improvements on Content Design Aspects

Suggested Improvements	**Before Repair**	**After Repair**
Change from $2a + 20$ to $8a + 20$	Isilah bagian yang kosong dari diagram di bawah ini dengan bentuk aljabar yang sesuai dan uraikan bagaimana kalian mendapatkan bentuk aljabar tersebut! 	Isilah bagian yang kosong dari diagram di bawah ini dengan bentuk aljabar yang sesuai dan uraikan bagaimana kalian mendapatkan bentuk aljabar tersebut! 
Writing symbols using equations	**Penjumlahan dan Pengurangan Bentuk Aljabar:** Operasi penjumlahan dan pengurangan pada bentuk aljabar hanya dapat dilakukan pada suku-suku yang sejenis. Dalam penjumlahan dan pengurangan bentuk aljabar yang dijumlahkan atau dikurangkan adalah koefisien dari suku yang sejenis. Penjumlahan: $an + bn = (a + b)n$ Pengurangan: $an - bn = (a - b)n$ Keterangan: a dan b = koefisien n = variabel	**Penjumlahan dan Pengurangan Bentuk Aljabar:** Operasi penjumlahan dan pengurangan pada bentuk aljabar hanya dapat dilakukan pada suku-suku yang sejenis. Dalam penjumlahan dan pengurangan bentuk aljabar yang dijumlahkan atau dikurangkan adalah koefisien dari suku yang sejenis. Penjumlahan: $an + bn = (a + b)n$ Pengurangan: $an - bn = (a - b)n$ Keterangan: a dan b = koefisien n = variabel

The feasibility aspect of the content received an average score of 3.43, given input from material experts. Input from material expert validators can be observed in Table 10.

Table 10. List of Student Worksheet Improvements on Content Feasibility Aspects

Suggested Improvements	Before Repair	After Repair
Changes in the concept of the question in Problem 2	MASALAH 2  Di sebuah pasar, Afifah membeli 15 buah apel dan 10 buah jeruk. Di sisi lain ada temannya yang bernama Bunga dan Cindy, mereka berdua membeli apel dan jeruk dengan jumlah yang berbeda. Setelah Bunga dan Cindy menggabungkan apel dan jeruk yang telah mereka beli ternyata hasilnya sama dengan jumlah apel dan jeruk yang dibeli oleh Afifah. Jika jumlah apel dilambangkan x sedangkan jumlah jeruk dilambangkan y, maka tentukan kemungkinan buah apel dan buah jeruk yang dibeli oleh Bunga dan Cindy!	MASALAH 2  Terdapat sebuah keranjang buah yang dapat memuat dengan perkiraan 15 buah apel dan 10 buah pisang, dimana rata-rata berat per apel adalah a kg dan berat per pisang adalah b kg. Suatu hari Bunga dan Cindy membeli apel dan pisang yang kemudian akan diletakkan di keranjang tersebut. Jika Bunga hanya bisa membeli tidak lebih dari 13 buah, maka tentukan kemungkinan jumlah buah apel dan buah pisang yang dibeli oleh Bunga dan Cindy agar memenuhi keranjang buah tersebut!
Changes in units of measure	Rio ingin membuat papan berbentuk persegi panjang dari kayu. Dia berencana untuk membuat tiga buah papan dengan ukuran yang berbeda. Salah satu papan sudah ditentukan ukurannya yaitu $4x \times y$ satuan luas dengan kelilingnya adalah $8x + 2y$. Jika dua papan lainnya tidak memiliki ukuran panjang $4x$ maka berapa keliling papan-papan tersebut? Diketahui: Rio ingin membuat tiga buah papan dengan ukuran yang berbeda. Ukuran salah satu papan adalah $4x \times y$ satuan luas. Keliling salah satu papan tersebut adalah $8x + 2y$. Ditanya: Keliling dua papan lainnya jika panjangnya bukan $4x$. Jawab:	Rio berencana membuat empat buah papan berbentuk persegi panjang dari kayu. Salah satu papan sudah ditentukan ukurannya yaitu $4xy$ satuan luas dengan kelilingnya adalah $8x + 2y$, dan lebar papan adalah y. Jika papan-papan tersebut memiliki ukuran panjang yang berbeda dan ukuran lebarnya tetap sama maka berapa keliling papan-papan tersebut? Diketahui: Rio berencana membuat empat buah papan dengan ukuran panjang yang berbeda dan ukuran lebarnya tetap sama. Ukuran salah satu papan adalah $4xy$ satuan luas, dengan kelilingnya adalah $8x + 2y$. Lebar papan adalah y. Ditanya: Keliling papan-papan tersebut? Jawab:

Based on the validation results, the validators got an average score of 3.11; meeting the assessment criteria is good, with some suggestions for improvement.

The following will present a revised view of the student worksheet.

Figure 2. Display of Cover

Figure 3. Display of Group Identity, Core Competencies, Basic Competencies and Competency Achievement Indicators

Figure 4. Display of Learning Objectives and Instructions for Use

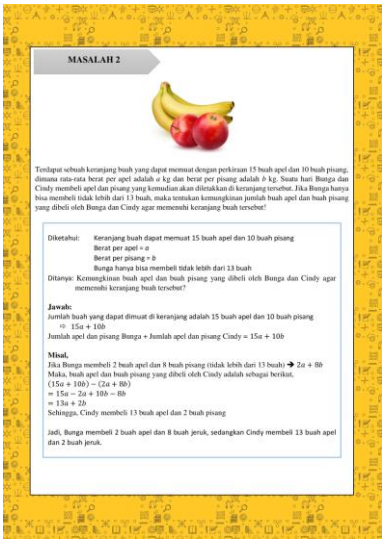


Figure 5. Display of One of the Problems in the Student Worksheet

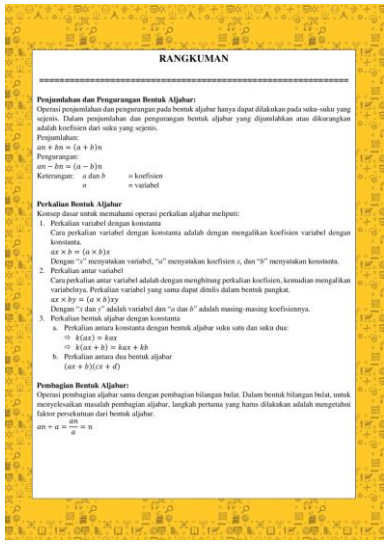


Figure 6. Display of Summary

After it has been validated and revised again, the next step is for the Student Worksheets to be tested by a mathematics teacher at Muhammadiyah 3 Sambungmacan Junior High School. This test will help evaluate the quality of practicality of Student Worksheets from the teacher's side. Table 11 presents the results obtained from teacher response questionnaires.

Table 11. Practicality Based on Teacher Response Questionnaire

Aspects	Average	Criteria
Contents/Materials	3.00	Good
Appearance/Design	3.00	Good
Language	3.00	Good
Overall Average	**3.00**	**Good**

The results of the feasibility of the Student Worksheet on the trial presented in Table 11 display an overall average score of 3.00 and meet the criterion of good.

Then, a trial of the practicality of Student Worksheets was carried out for students to get responses from the product user side. The trial was held once in the 7th grade at Muhammadiyah 3 Sambungmacan Junior High School. The practicality of Student Worksheets is assessed based on aspects of content and material, appearance and design, and language.

The trial aims to determine the quality of the Student Worksheet's contents from the student's perspective. In the trial, a simulation of all activities in the Student Worksheet was carried out. Then, students are directed to fill out a response questionnaire. Table 12 below shows the results of the response questionnaire.

The practical results of the Student Worksheet in the trial based on Table 12 showed good criteria, and the overall average score was 3.22.

Furthermore, an assessment of the effectiveness of the Student Worksheet is determined by the student reasoning ability test. The effectiveness test of Student Worksheets is based on obtaining pre-test and post-test results. The paired sample difference test is used to measure the significance of the difference between the average pre-test and post-test scores.

Table 12. Practicality Based on Student Response Questionnaire

Aspects	Average	Criteria
Contents/Materials	3.08	Good
Appearance/Design	3.39	Very Good
Language	3.20	Good
Overall Average	**3.22**	**Good**

Table 13. Test Results Paired Sample T-Test with SPSS

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Pre-Test – Post-Test	-46.50000	22.82112	5.89239	-59.13792	-33.86208	-7.892	14	.000

Based on Table 13, the calculation results presented show that Sig. (2-tailed) obtained a value of 0.000, which is smaller than 0.050. In addition, it is also known that the t value is 7.892, greater than the t_{table} value of 2.145 obtained from the value distribution table. Therefore, there is a difference between the average pre-test and post-test scores before and after being treated when applying mathematical Student Worksheets to algebraic material based on the Open-Ended approach. From the results of the analysis above, it shows that H_0 was rejected because of Sig. (2-tailed) = 0.000 < 0.050 and t = 7.892 > t_{table} = 2.145. Thus, mathematics Student Worksheets on algebra material based on the Open-Ended approach can provide significant differences related to reasoning ability.

Another analysis carried out is the N-Gain test. Furthermore, the N-Gain test analysis results can be observed in Table 14.

Table 14. N-Gain Test Results with Ms. Excel

Test	Average Grade	N-Gain (%)	Category
Pre-Test	24.00	57.65	Quite Effective
Post-Test	70.50		

Based on the analysis of student learning outcomes, an N-Gain percentage of 57.65% was obtained and included in the assessment category, which is quite effective. So, the mathematical Student Worksheets developed in this study meet the criteria of being quite effective.

Disseminate

The dissemination stage is carried out by disseminating products in the form of Student Worksheets produced previously at the development stage. The

initial stage of product dissemination is carried out by validating the product with experts, namely media and material experts who are lecturers from the University of Muhammadiyah Surakarta. Then, after validation, the product was given to a mathematics teacher who was a teacher at the school where the research was conducted, namely at Muhammadiyah 3 Sambungmacan Junior High School, to see the level of practicality of the Student Worksheets product that will be used in the learning process carried out at school. After the product was declared practical, this Student Worksheet was distributed to Muhammadiyah 3 Sambungmacan Junior High School students in mathematics lessons.

CONCLUSIONS AND SUGGESTIONS

This research produces Student Worksheets, which will be applied in mathematics learning activities, after a validity test by media and material experts. The results of the feasibility test by the two experts resulted in an average score of 3.11 with a maximum value of 4.00, which in interpretation, it showed the "good" category. The average score from the teacher response questionnaire was 3.00, with the interpretation results showing the "good" category. Meanwhile, class VII students as Student Worksheets users gave assessments through student response questionnaires and got an average score of 3.22, and the interpretation showed the "good" category. The effectiveness of Student Worksheets is seen from the results of the reasoning ability test, with the average value of the pre-test being 24.00 and the average value of the post-test being 70.50. So, the N-Gain calculation value is 57.65%, which is included in the category of quite effective. Thus, mathematics Student Worksheets on algebra material based on the Open-Ended approach are feasible, practical, and effective enough to use.

Further development research is expected to be able to carry out more development of other mathematical Student Worksheets using different modifications to create more effective and stimulating mathematical Student Worksheets for students and make students more inspired and interested in understanding mathematics.

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