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Development of Student Worksheets Based on Constructivism in Mathematics Learning for Grade VII at SMP Pertiwi 2 Padang

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ABSTRACT

This research is motivated by the still low level of attention and participation of students during the process mathematics learning and in learning that only used the mathematics handbook for class VII Kurikulum Merdeka. Based on these problems, researchers developed mathematics Student Worksheets based on constructivism on two dimension figure quadrilateral material for class VII SMP Pertiwi 2 Padang. The aim of the research is to produce a valid and practical constructivism-based mathematics worksheet on rectangular plane material. In this research, researchers used modified development research steps according to Sugiyono, namely potential and problems, data collection, product design, product validation, product validation, product trials and the final product. Data used to assess the validity of the media were obtained from validation sheets by worksheets characteristic and language experts and design experts, while the data used to assess practicality is obtained from the sheet student practicality. The worksheets developed contains two-dimension figure quadrilateral. The product validity assessment was carried out by two lecturers and declared valid for use from the aspects of worksheets characteristics, language and design. Practicality assessment from students' practicality questionnaire at the test stage try with practicality criteria of 77.46% based on easiness of use, easiness of understanding, , and time required. Thus, it can be concluded that constructivism-based LKS is valid and practical to be used as a mathematics learning media in increasing student motivation and participation. Based on the results of this study, the researcher suggests that this LKS can be used as an alternative media by teaching staff.

Keywords: worksheets, constructivism, valid and practical.

Keywords: geometry, learning media, nearpod, visual – spatial

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Introduction

Mathematics is still considered a difficult subject understood by students. One reason is because mathematics has objects that have properties an abstract whose real form cannot be seen and is difficult for students to imagine direct and requires a good understanding of concepts in understanding the material (Nurzazili et al., 2018) . According to Kase, S.K. et al (2023: 120) students' low understanding of mathematical concepts is due to the abstract nature of mathematical concepts and students are not given the opportunity to construct their own knowledge. This can be realized through a constructivist approach, because the principle of constructivism is to compile or build students' own knowledge when they try to organize their new experiences based on the cognitive framework that already exists in their minds.

Based on the results of the researcher's interview with a grade VII mathematics teacher at SMP Pertiwi 2 Padang, information was obtained that mathematics learning uses the Independent Curriculum and the tools used are textbooks. When learning, students often forget mathematical concepts, such as those related to two-dimensional figures. They frequently forget the formulas for calculating the area of a quadrilateral. Additionally, students are often reluctant to ask questions about material they do not understand. As a result, their understanding of the learning material is not optimal. Some of the worksheets developed for Grade VII are limited in their objective to help students grasp only basic mathematical concepts. Based on these reasons, it is necessary to develop a learning tool that can help students be more active in constructing their knowledge, specifically grade VII junior high school students.

According to (Wandari et al., 2018) teaching materials are important in helping the teaching and learning process, one of which is the Student Worksheet. Student Worksheets are a form of teaching material and function as a learning guide for students so that they can facilitate students in the learning process. (Fatmawati et al., 2017). According to (Partasiwi et al, 2017) Student Worksheets must have 8 elements which include; (1) Title, (2) Study instructions, (3) Basic competencies or main material, (4) Completion time, (5) Equipment and materials, (6) Brief information about work steps, (7) Tasks that must be completed. implemented, and (8) Assessment. In developing worksheets, learning methods approaches are also needed as learning tools (Sari & Ma'rifah, 2020). Therefore, in this research, a more comprehensive constructivism-based worksheet will be developed. Therefore, in this research, a more comprehensive constructivism-based worksheet will be developed.

Previous research on the development of constructivism-based LKS has been widely conducted by researchers (Novita et al., 2020; Hibatullah, 2018; Auliya et al., 2017; Andriani, Yustina, & Suryawati, 2016; Apriani, 2017; Ardy, 2018; Indriastuti et al., 2012; Nurzazili et al., 2018; Syahrudin, Herawati, & Sutiarso, 2023; Effendi et al., 2021). However, previous studies have stated that there are still weaknesses, namely that the LKS created still do not have the characteristics of a comprehensive constructivist approach. According to (Iswadi, 2020) he characteristics of a learning process carried out in a constructive manner are: a) Providing opportunities for students to learn new knowledge through direct interaction in the real world; b) Promote questions or ideas expressed by students and use them as a guide for designing teaching; c) Helping the overall learning process in adopting students' attitudes and characteristics; d) Estimate students can get ideas during the learning process; e) Accepting various student efforts and autonomy; f) Allow students to ask questions and then discuss together; g) Consider the learning process as a process that is as important as the learning outcomes; h) Involve students in the form of experiments.

Other research has also been conducted by (Mida & Agam, 2023) to determine the effect of using constructivism-based worksheed on geometric transformation material (translation and reflection) on student learning outcomes. The research results also show that the use of constructivism-based worksheets has an effect on increasing student motivation and learning articipation.Furthermore, (Sidiq, Herpratiwi, & Perdana, 2022) conducted research on the development of constructivism-based student worksheets to improve student learning outcomes. The research results also show that constructivism-based worksheet is very feasible and effective for improving the learning outcomes of fifth grade elementary school students. Meanwhile (Rohmiatin, Erviyenni, & Haryati, 2019) conducted research on the development of constructivism-based worksheet in acid-base subjects in class XI SMA/MA. The results of this research show that the worksheet developed is valid and based on a limited trial that was carried out on 12 students, a response of 94.45% was obtained which was in the positive criteria.

Based on the problems above, researchers will develop worksheets based on constructivism in class VII mathematics learning Junior High School Pertiwi 2 Padang which is characterized by constrictivist learning with the steps as previously explained. Researchers limited the problems in this research to creating valid and practical worksheets. Researchers hope that the development of this worksheets can overcome problems in mathematics learning for class VII students at SMP Pertiwi 2 Padang.

Methods

This research model is research and development. According to (Sugiyono, 2019), research and development (R&D) methods are research methods that produce new product designs, test the effectiveness of existing products, and develop and create new products. Researchers limit the research and development steps to seven steps in accordance with the development procedure according to (Sugiyono, 2019) which has been modified namely:

1. Potential problems: Potential students tend to prefer to be directly involved in learning and working independently. Meanwhile, the problem found in the field is that students' attention and participation is still low during the mathematics learning process, the media used to support learning only uses the Class VII mathematics package in the independent curriculum and learning is still centered on the teacher.
2. Data colection: Researchers collected information from the syllabus and subject teachers. From the syllabus, core competencies, basic competencies and learning achievement indicators are obtained. And there are also other sources, namely books related to worksheets which will be developed by researchers.

3. Product design: At the worksheets design stage, there are several steps taken, namely: (a) making the worksheets cover design, (b) foreword, (c) table of contents, (d) supporting information, (e) instructions for using the worksheets, (f) core competencies , basic competencies and indicators, (g) main material, (h) evaluation, and (i) reference list
4. Product validation: Product validation is carried out by expert education lecturers in their field of study, consisting of expert tests on worksheets and language characteristics and design experts. For the expert test of worksheets and language characteristics, one expert is used, namely a mathematics education lecturer, and for the design expert test, one expert is used, namely a mathematics education lecturer who is an expert in design.
5. Product trial: The use trial will be carried out on a small scale group trial, namely 19 class VII students. At this stage a practicality test is also carried out.
6. Final product: The final product is a product that has passed validity and practicality tests

A validation sheet is also created based on the validation sheet grid as in Table 1.

Table 1. *Grid Based worksheets Validation Sheet Constrictivist Approach*

No.	Rated aspect	Indicator	Statement Number
1	Characteristics of worksheets	1) worksheets made in accordance with *RPP*	1, 4
		2) Has distinctive characteristics of constructivism	2, 3, 6
		3) Writing worksheets in accordance with worksheets elements and easy to understand learners	5
2	Language	1) Sentences/statements in the worksheets can generate motivation students learn	1
		2) The sentences used are appropriate with Indonesian language rules	2, 3
3	Design	1) The presentation of the worksheets content on rectangular material is made neatly and attractively	1, 2
		2) Use letter shapes and sizes that are appropriate to the level of development of students	3

The instrument used is a practicality questionnaire sheet made with a grid as in Table 2.

Table 2 . *Practicality Sheet Grid for Students*

No.	Rated aspect	Indicator	Statement Number	
			Positive Statement (+)	Negative Statement (-)
1	Ease of using worksheets	1) Instructions for use clear worksheets	1	2
		2) worksheets helps discover the concept of matter	3,4	5
		3) Image appearance worksheets helps find concepts	8	9
2	Ease of understanding	1) Material in worksheets easy and clear	6	7
		2) Sentences in the worksheets easy to understand	11	10
		3) Explanation on student activities easy	12	13
3	Required time	1) Learning time and understand material more effective and short	14	15

In Table 2 there are positive and negative statements. Criteria for positive and negative statements are as in Table 3.

Table 3 . *Evaluation Criteria for Positive and Negative Statements*

Criteria	Positive	Negative
Strongly Agree (SS)	4	1
Agree (S)	3	2
Disagree (TS)	2	3
Strongly Disagree (STS)	1	4

Practicality analysis to determine practical criteria, determining practicality is calculated using the formula below:

$$practical\ value\ =\ \frac{score\ obtained}{score\ maximun}\ x\ 100\ \%\qquad(1)$$

Then calculate the total scores obtained according to the indicators, by providing a practicality assessment using the criteria as stated by Purwanto (2012) :

a. 86% - 100% = very practical

b. 76% - 85% = practical

c. 60% - 75% = quite practical

d. $\leq$ 54%= very impractical

Research and development researchers use two types of data, namely quantitative data and qualitative data. Quantitative data, namely data that is processed by formulating numbers. Quantitative data was obtained from validator assessment questionnaire scores (validity test) and student assessments (practicality test). Qualitative data, namely data in the form of descriptions in sentence form. This qualitative data is in the form of validator criticism and suggestions for the product being developed and a description of the implementation of small-scale product trials at SMP Pertiwi 2 Padang.

The final product . The final product is a product that has passed validity and practicality tests. Further discussion about the final product will be discussed in the research results.

Results and Discussion

The main results of this research and development were carried out using development procedures according to Sugiyono which were carried out f rom stage 1 to stage 7. Data on the results of each stage of the research and development procedure were carried out as follows:

Potential problems . At this stage, it is based on the results of observations made by researchers at SMP Pertiwi 2 Padang and subject teachers. Based on the potential and problems above, it is necessary to develop learning media, namely worksheets, which is useful in overcoming the above problems.

Data collection . Researchers collect information from various sources, namely from core competencies, basic competencies, books, research journals and various other information related to the product that the researcher will develop. Core competencies and basic competencies for the materials on Processing, organizing, and thinking in the real world context (utilizing, dissecting, putting together, altering, and generating) and the theoretical context (composing, interpreting, computing, sketching, and constructing) based on knowledge acquired from educational institutions and other consistent references.and procedural) and understand it and (4) Processing, presenting, and reasoning in the concrete domain (using, parsing, assembling, modifying, and creating) and the abstract domain (writing, reading, calculating, drawing, and composing) according to what is learned in schools and other sources that are the same in point of view/theory. Basic competencies: (3.4) Identify rectangular flat shapes and (3.5) Please provide the area formulas for different types of quadrilaterals (square, rectangle, rhombus, parallelogram, trapezoid, and kite) and triangles. Analysis of Core Competencies and Basic Competencies produces indicators of learning competency achievement in this material, namely: (1) Explaining the meaning of square, rectangle, parallelogram trapezoid, kite, rhombus, according to their properties and shapes, (2) Determining the properties square, rectangle, trapezoid, parallelogram, kite and rhombus in terms of sides, angles and diagonals, (3) Find the formula for the area of a trapezoid, rhombus and kite and (4) Solve contextual problems for the area of a trapezoid, rhombus and kites in everyday life.

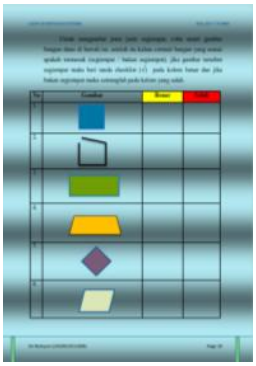
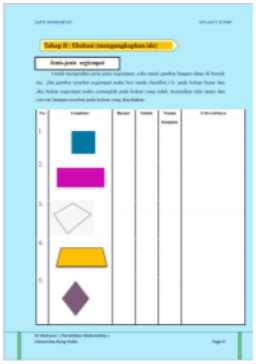
Product design . At this product design stage, several steps are taken, namely: (a) Cover of the worksheets based on constructivism with the help of *Microsoft Word*, (b) the foreword is written on the first page after the cover as the opening words of the worksheets, (c) the table of contents in the worksheets aims to make it easier to find the material that students will study, (d) supporting information briefly explains the meaning, characteristics and steps of constructivist learning so that students know about constructivism, (e) learning instructions in worksheets aim to direct students in using worksheets and the things they will do, (f) core competencies, basic competencies, and indicators in constructivism-based worksheets in point sixth after the learning instructions, (g) the main material is presented in the form of questions that will be answered by students. This aims to make students active in learning and guide students to discover the concepts being studied for themselves. Display of the main material, (h) evaluation of practice questions in the worksheets which aims to make students better understand the material being studied, and (i) reference list containing the bibliography in the worksheets.

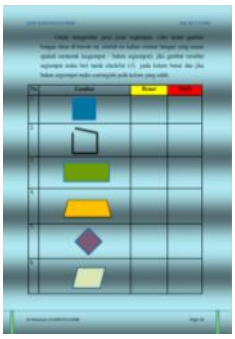
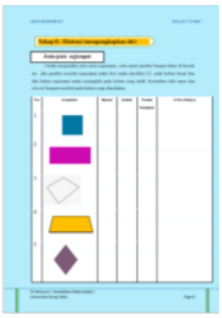
Product validation. Constructivism-based worksheets on two dimension figure quadrilateral that has been designed and discussed with the supervisor, then validated by the worksheets validator. Validators consist of expert validators on worksheets characteristics and language and design expert validators. researchers discuss directly with validators to improve worksheets. Validation activities are

carried out in the form of filling in the worksheets validation sheet and discussions until a valid worksheets is obtained. The validation sheet was filled in by 2 lecturers from the Mathematics Education Study Program. Expert validation of worksheets and language characteristics was carried out 4 times. The design expert validation was carried out 3 times.

Product revision . Product revisions are carried out based on suggestions from validators. The characteristics and language expert validator's suggestions for constructivism-based worksheets are as shown in Table 4.

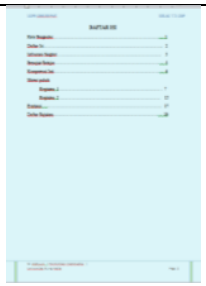
Table 4 . *Suggestions and Comments as well as Improvement Results of Expert Validator Characteristics of worksheets and Basaha*

Validation	Before Results	Suggestions and Comments	Improvement Results
First validation (June 23, 2023)		2) At the contextual problem orientation stage, page 7 is less interesting.	
		3) The table on page 8 should add another table column for students to write the characteristics of flat shapes.	
Second validation (July 4, 2023)		4) At the table restructuring stage, page 10 of the answer column is still lacking. There should be two columns for independent	

		5) At the elicitation stage on page 8, students should first identify the types of quadrilaterals and then express ideas about the objects around them.	
Third validation (July 10, 2023)		6) The size of the crown used is used in contextual problems according to existing reality, such as 30cm x 30cm	
Fourth validation (11 July 2023)	7)	8) In the fourth validation it was declared valid by the validator.	

Design expert validation was carried out 3 times. Suggestions given by design expert validators are as shown in Table 5.

Table 5 . *Suggestions and Comments as well as Results of Design Expert Validator Improvements*

Validation	Before Results	Suggestions and Comments	Improvement Results
First validation (June 21, 2023		9) There are no pages in the table of contents yet. It would be better to have a page.	
		10) The images used in the worksheets are too childish. Adapt it to the student.	

Second validation (June 26, 2023)		11) The color of the worksheets is too soft, making it less attractive and lackluster	
Third validation (July 3, 2023)		12) In the third validation the validator declared the worksheets valid	

Product trial . Product trials were carried out after the researchers validated the characteristics and design, after the product was declared valid the researchers then carried out product trials. Product trials were carried out at SMP Pertiwi 2 Padang. After testing the product, the researcher gave a practicality questionnaire sheet to class VII students. The practicality questionnaire was given to 19 students in class VII.2 of SMP Pertiwi 2 Padang who were product trial subjects. In general, the results of the practicality questionnaire for students can be seen in Table 6.

Table 6 . *Results of worksheets Practicality Questionnaire Analysis for Participants Educate*

No.	Practicality aspect	The Value of Practicality	Category
1	Ease in use	76.32%	Practical
2	Ease in understanding	78.51%	Practical
3	Required time	78.23%	Practical
Overall Practicality Score		77.46%	Practical

In Table 6 it can be seen that the practicality value of the worksheets is 77.46%. It can be concluded that Constructivism-based worksheets is practically used by students.

The final product . After a trial was carried out on students to find out the response to the constructivism-based student worksheet worksheets material on flat rectangular shapes, the worksheets was said to be valid and practical so no re-testing was carried out. So that the worksheets can be used properly and correctly.

In the expert validity of worksheets characteristics and language, validation was carried out 4 times because researchers often made mistakes in understanding the validator's intentions and researchers were not careful in revising worksheets so they made the same mistakes at the next validation stage. After revisions were made, in the fourth validation the validator stated that the constructivism-based worksheets was valid. The constructivism-based worksheets was declared valid by the validator because it was in

accordance with the applicable independent curriculum. The material contained in the worksheets is in accordance with the principles of constructivist learning which prioritizes student activity in discovering concepts. Based on the principles of constructivism, the worksheets developed has helped students construct knowledge through learning activities and increased the role of students as facilitators in learning. And also the language used is appropriate to the level of students' understanding, simple and use terms appropriate to the learning material. The language used can be understood by students. Therefore, constructivism-based worksheets can be used as a learning medium in the learning process in class VII SMP.

In the validity of constructivism-based worksheets design experts, validation was carried out 3 times. During expert design validation, researchers were also less careful and inconsistent in the use of letters in the worksheets. The resulting worksheets is also declared valid by the validator because it meets the design requirements. This shows that the appearance of the worksheets is correct both in terms of font size, font type and images. The images and illustrations used have helped students to construct their knowledge. The display in the worksheets is clear, making it easier for students to understand the concept.

From the results of the discussion that has been presented, it can be concluded that constructivism-based worksheets on rectangular plane material has been declared valid for use in mathematics learning.

Product trials were carried out in class VII.2 of SMP Pertiwi 2 Padang. Before starting the lesson the teacher opens the lesson and prays. After that the teacher distributed constructivism-based worksheets to each student. During the learning process, students actively work on the questions and exercises in the worksheets, although there are still some students who find it difficult to construct their knowledge. Based on the results of the analysis of student work, it was found that 15 of the 19 students who completed the worksheet obtained a score above the *KKM*, namely above 80.

The practicality of the results of the student response questionnaire reveal the worksheets. The results of the practicality questionnaire data processing on student responses indicate that this constructivism-based worksheets has met the practical criteria. This shows that constructivism-based worksheets is practical in terms of ease of use, ease of understanding and time required. However, in learning there are still several obstacles encountered, such as students still having difficulty constructing their own knowledge so it takes a long time to work on worksheets.

Based on the discussion that has been put forward regarding the practicality of worksheets, it can be concluded that constructivism-based worksheets is practically used in mathematics learning. This can be seen from readability, implementation and the time required for learning.

This research has research limitations. The limitations of this research are: the product trial was only carried out in class VII.2 of SMP Pertiwi 2 Padang with 19 students due to the time crunch during

the trial, so the researcher does not know whether constructivism-based worksheets is practical or not in other classes that have standards. and the abilities of students are different from SMP Pertiwi 2 Padang. This happens because of limited time in product testing.

Conclusion

Based on the research results, it can be concluded that the constructivism-based worksheets developed on rectangular material is valid based on the criteria of worksheets characteristics, language and design and the worksheets developed is practically used by students. Based on the practicality of constructivism-based worksheets, it is declared practical and the average score is 77.46% with practical criteria.

Based on the development of Constructivism-based worksheets that the researcher has carried out, the researchers suggest that the constructivism-based worksheets that has been created is expected to be used in the learning process as an alternative medium by mathematics educators and other researchers can conduct research similar to product trials in other classes with different student standards and abilities.

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