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**DEVELOPMENT OF STUDENT MATHEMATICS WORK SHEET BASED ON  
A HOLISTIC APPROACH**

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**Abstract**

This research is a development research aimed at producing valid, practical and effective student Mathematics Worksheets based on a holistic approach. Worksheets based on a holistic approach are learning tools in the form of worksheets that contain information for carrying out scientific activities based on a holistic approach for students. The development stages follow the 4-D model with the stages of defining, planning and developing. Based on the expert's assessment of the mathematics worksheet based on a holistic approach using an internal consistency test, the Gregory test device has a valid profile with strong internal consistency in each aspect. Expert judgment is based on format 4.8, language 3.8, for content 4.8 and illustrations obtained 4.7, categorized with an average validation result of 4.53 which is categorized as very valid. The results of limited trials of the developed worksheets were found to have a practical profile with a percentage of 100% implementation of the device. and declared effective with an average student performance score for worksheets an average of 89.5 out of a maximum value of 100, the time for working on worksheets all met the specified criteria limit of 81%. And 86% gave a positive response to the worksheets that were tested. It was concluded that the worksheet has a valid, practical and effective profile. It is expected that the quality of students' mathematics education can be improved by using student mathematics worksheets based on a holistic approach.

**Keywords:** Worksheet, holistic approach, Valid, Practical, Effective.

**Introduction**

Improving the quality of human resources in nation building, especially development in the field of education, is contained in the fourth paragraph of the 1945 Constitution. As for the fragment of the fourth paragraph of the opening of the 1945 Constitution namely "... to promote public welfare, educate the nation's life, and participate in carrying out world order..." which is one of Indonesia's national development goals.

Qualified human resources in the era of globalization will become the main foundation of a nation in competing <sup>[1]</sup>. In this regard, the education sector is one of the main areas in building quality human resources <sup>[1]</sup>. Based on Law number 20 of 2003 which contains the national education system, article 1 paragraph 1 states that education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual qualities, self-control, personality, intelligence, noble character, and the skills needed by himself, the community, the nation and the State.

In line with this, the government is always trying to improve the quality of education, among others by improving the curriculum, providing quality books and increasing teacher knowledge through training and further studies. During the Covid-19 outbreak, the government implemented a transitional curriculum, where learning is carried out online, and currently, in the post-pandemic period, the government is still implementing three curricula that can be applied at the primary and secondary education levels and tertiary institutions, namely, the full 2013 curriculum, transitional curriculum and independent learning curriculum <sup>[2]</sup>. All of this aims to improve the quality of education. However, most of them still use the 2013 curriculum, especially at the elementary and secondary education levels.

Based on the regulation of the minister of education and culture no. 53 of 2013 states that graduate competency standards are criteria regarding the qualifications of graduate abilities which include attitudes, knowledge, and skills . And based on the regulation of the minister of education and culture no. 64 of 2013 states that Process standards are criteria regarding the implementation of learning in educational units to achieve Graduate Competency Standards <sup>[3]</sup>. In accordance with graduate competency standards and content standards, the learning principle used is that students who are told become students who find out.

Based on government regulation number 32 of 2013 article 19, in carrying out professional duties, teachers are obliged to: plan the learning process, implement the learning process, assess learning outcomes, and supervise the learning process for the implementation of an effective and efficient learning process. It was further explained that the learning process in educational units is organized interactively, inspiring, fun, challenging, motivating students to participate actively, and provides sufficient space for initiative, creativity, and independence in accordance with the talents, interests, and physical and psychological development of students <sup>[4],[5],[6]</sup>.

According to <sup>[3]</sup>, learning in Indonesia tends to be theoretical and not related to the environment in which students are located, as a result students are not able to apply what they learn at school, to solve the problems they face in everyday life. Education has distanced students from their environment so that they become strangers in their own society

Based on the results of initial observations of mathematics teachers in Tolitoli district, reference <sup>[7]</sup> concluded that teachers experience difficulties in implementing mathematics learning in class. These difficulties include: most teachers (86.7%) in

junior high schools still use conventional learning models in the process of learning activities. Meanwhile, other teachers use the cooperative learning model, the problem solving model, but they still dominate the learning activities in class. Thus, in teaching mathematics teachers tend to transfer the knowledge they have into students' minds. More students are positioned as people who don't know anything, who are just waiting for the material provided by the teacher. So far, mathematics learning is embedded in habits with the following order of presentation of learning: (1) theory/theorems/definitions are taught first, (2) then examples are given, (3) questions are given practice.

The implementation of mathematics learning in the order of presentation by teaching theory then giving examples and providing practice questions causes student involvement during the learning process to be very lacking, the learning experience obtained is not pleasant [8]. In this case students are no longer active and creative learning subjects but rather as learning objects, thereby reducing students' responsibility for learning assignments. Students should be required to develop their abilities in finding, investigating and expressing all the processed information received in their minds during the learning process. [9], [10], [11]

The learning process is basically the teacher trying so that students learn to achieve the learning objectives that have been set [12],[13]. But changes towards achieving goals have not been maximized. Changes towards achieving learning objectives will appear in changes in student behavior as learning outcomes. [14],[15]

Then according to [15], these changes in behavior can be caused by social activities and individual activities in the learning process in the classroom. The role of the teacher as a giver of knowledge, it is time to turn into a facilitator who facilitates students to be able to learn and construct their own knowledge.

Based on the results of the Program for International Student Assessment (PISA) report for 3 December 2019, Indonesia's reading score was only ranked 72 out of 77 participants, then the math score was ranked 72 out of 78 countries and for the science field ranked 70 out of 78 participating countries. This has decreased from the results of the PISA test in 2015, respectively, reading scores ranked 65<sup>th</sup>, science scores ranked 64<sup>th</sup> and mathematics ranked 66<sup>th</sup> [16]. In general, it is caused by several factors, one of which is that the substance of the subject matter is less related to the life context faced by students, and does not facilitate students in expressing thinking and arguing processes. This is due to the teacher's difficulties in teaching.

Based on the findings [7] teachers in Tolitoli Regency experience difficulties in teaching math techniques in junior high schools, namely: (1) teaching techniques, (2) approaches used by teachers and, (3) learning models used, (4) mathematics teaching methods used in junior high schools, (5) and difficulties in developing teaching materials. Based on the results of an analysis of the difficulties teachers teach junior high school mathematics, 88.9% of teachers use direct learning models, 63.7% have difficulties in instilling concepts, 93.3% have difficulties in managing classes, 66.7% have difficulties in conducting effective communication with students, 73.3% had difficulty motivating

students to like mathematics, 35.6% did not understand student active learning, and 71.3% had difficulty developing teaching materials. The various difficulties faced by the teacher will have implications for the low results of student mathematics learning. However, there are other factors that can also influence, namely learning support facilities and infrastructure, which can be in the form of classroom facilities, teachers, administrative staff, and learning tools.

Learning tools can be in the form of textbooks, learning implementation plans, learning media, and worksheets. Most schools provide textbooks, but the availability of worksheets is still lacking. The Tolitoli 3 Public Middle School is no exception, which is one of the top schools in the Tolitoli district. Therefore it is necessary to carry out a scientific study related to the development of student worksheets based on a Holistic approach.

The holistic approach can be concluded from several expert opinions which is a comprehensive approach, where all parties are involved and also the way it is presented uses various ways that can support each other [17], [11], [18], [19]net Giesen, 2013. The holistic approach to learning in question is one way for teachers to convey their teaching material through contextual principles that are able to attract students' interest and increase learning motivation [20], [18], [6], [21], which is stated in the form of student worksheets that are used by the teacher when learning in class

The worksheet that is generally used by students given by the teacher is a type of worksheet that contains questions that aim to train students in working on questions. The worksheets used by the participants are generally given by the teacher which is made by the worksheet manufacturers [11], [22]. By practicing working on these questions, students are expected to easily solve the questions given when the exam is carried out either during daily tests, middle semester, end of semester, class increase, school exams and even national exams where the exams are question oriented. However, these worksheets have not been able to help students' potential to develop.

Reference [23] gives his view that in order for students' potential to develop and learn mathematics optimally, assumptions about the characteristics of the students' subjects are given, including: 1) students will learn mathematics if they have motivation, 2) students learn in their own way, and 3) students learn mathematics both independently and in collaboration with friends

Then to foster students' interest in learning mathematics, student worksheets that are oriented towards a holistic approach are needed. With the aim of producing valid, practical and effective student-based worksheets. Student worksheets based on a holistic approach are expected to help teachers in learning mathematics.

## METHODS

This type of research is research and development (research and development). The development model used follows is the 4D model development

(define , design, develop and disseminate)by [24]. According to [25], development research or research and development (R&D) is a basic research activity to obtain

information user needs, then proceed with the activity development to produce products and review the effectiveness of the product.

The location of the research and development was carried out at the University of Madako Tolitoli and trials of the draft student worksheets for class VIIa SMPN 3 Tolitoli totaled 35 students in the 2022/2023 school year. This research was carried out for 6 months

**Procedure** The development of student mathematics worksheets based on a holistic approach refers to the 4-D model which consists of four stages, namely define, design, develop and disseminate by making several modifications in developing the worksheets. The description of the development of student math worksheets consists of several stages, namely:

### **1. Define stage**

The purpose of this stage is to plan student math worksheets, namely determining the material and analysis of material limitations on student math worksheets based on the holistic approach that will be developed. In this stage a literature study was carried out which included an assessment of the characteristics of a holistic approach, references to good student math worksheets. The steps taken in this stage are the initial-end analysis, namely the analysis carried out to study the problems faced by Mathematics teachers at SMP Negeri 3 Tolitoli in the process of learning activities. Curriculum analysis, students aim to adapt the current curriculum to the description of the characteristics of student math worksheets. In this case, the characteristics of student mathematics worksheets based on a holistic approach are fully adapted to the demands of the 2013 Curriculum. The results of this curriculum analysis are used as an illustration for developing student mathematics worksheets based on a Holistic approach. And concept analysis aims to identify the main concepts that will be developed in students' math worksheets.

### **2. Design stage**

The purpose of this design stage is to prepare materials that can be used to make student math worksheets based on a holistic approach and to prepare the format of the worksheets to be made.

### **3. Development stage**

This development stage aims to produce student mathematics worksheets based on a holistic approach that has been revised based on expert input

### **4. Stage of dissemination**

This stage is the stage of using worksheets that have been developed on a limited scale. The purpose of this stage is also to test the effectiveness of using valid, practical and effective student math worksheets (final draft) in teaching and learning activities mainly in experimental situations and in research conducted limited trials at SMP Negeri 3 Tolitoli.

The instruments in this study were expert validation sheets, observation sheets and student response questionnaires. analyzing the data on the development of students' math worksheets used descriptive statistical analysis techniques. the activities carried out in the process of analyzing the validity of student physics worksheets are by conducting internal consistency tests on validated learning devices. The internal consistency test model is as follows.

		Expert Appraiser 1	
		Weak relevance (valuable item 1 Or 2)	Strong relevance (valuable item 3 Or 4)
Expert Appraiser 2	Weak relevance (valuable item 1 or 2)	A	B
	2) Strong relevance  (valuable item 3 or 4)	C	D

Figure 1. The model of agreement between raters for the internal consistency test

Internal consistency test requirements, if  $V \geq 0.75$  or  $\geq 75\%$  then it can be declared valid Analysis of the data used to determine the level of reliability by the assessment of two validators against the sheet of learning instruments and research instruments used "interobserver agreement" using statistical analysis "Percentage of Agreement (R)", namely:

$$R = \left( 1 - \frac{A-B}{A+B} \right) \times 100 \%$$

Data analysis on the practicality of student math worksheets was supported by the results of data analysis of the applicability of student math worksheets based on a holistic approach which was collected using observation sheets of the worksheet implementation [26]. The process of analyzing data on the implementation of student math worksheets is to find the average observation result of each aspect of the worksheet that is implemented. The activities carried out in the data analysis process of the implementation of students' mathematics worksheets are to carry out a descriptive analysis of the percentage of implementation of the device with the following formula:  $PKP = (\text{observed aspect}) / (\text{total aspect}) \times 100\%$  [3].

Data analysis of the effectiveness of students' math worksheets is supported by the results of data analysis of the 3 components of effectiveness, namely the performance of

student learning outcomes observed with observation sheets of student learning activities, and student responses collected by distributing questionnaires to students.

## RESULTS AND DISCUSSION

1. **Results Validity**, Results Validity, according to<sup>[27]</sup>, validity relates to a variable measuring what should be measured. For the validity of worksheets based on a holistic approach, after all the learning models (prototype 1) have been completed, then a validity assessment is carried out by several people who are considered experts. This is in line with <sup>[28]</sup>, states that the validity test is used to measure the legitimacy or validity of a questionnaire. What is meant by an expert in this case is a validator who is competent to evaluate worksheets based on a holistic approach. The expert's assessment of the completeness of the worksheet is based on a holistic approach, the assessment is based on a questionnaire sheet which includes: format, language, content, illustrations, and the benefits contained in the instrument validation sheet of learning materials. This is in line with <sup>[28]</sup>, stated that the validity test is used to measure the legitimacy or validity of a questionnaire. From the results of expert assessment, the student worksheets can be summarized as in the following table:

Description of student math worksheet assessment results

experts based on a holistic approach. before and after revision based on input from experts can be seen in the following table below:

Table 1. Description of the assessment of students' math worksheets before and after.

Rated aspect	Before revision	After revision
1 Format	Note the writing of letters	Placement of letters adjusted according to suggestions
2 Language	... determine the surface area of the table or ceramics contained in the image .....	....find the surface area of the table in the picture ...
3 interesting to work on	The appearance of the lines in the rectangular figure is partially colorless	Display pictures are colored to attract students' attention
4 content	Haven't made notes in the form of initial information about the material for each worksheet	Include initial information on each worksheet
5 Time	Already appropriate	No revisions

A description of the results of the experts' assessment of student mathematics worksheets based on a holistic approach is shown in the following table :

Table 2. the results of expert assessment.

Material	Indicator	Assessment
<b>Student math worksheets based on a holistic approach</b>	<b>1.</b> Format	4,8
	<b>2.</b> Language	3,8
	<b>3.</b> interesting to work on	4,8
	<b>4.</b> content	4,7
	<b>5.</b> Time	5,0
<b>Rata-rata</b>		<b>4,6</b>

Source: 2023 expert validation results

The table shows that the students' Mathematics worksheets based on a holistic approach in terms of the indicators are in a very valid category because each aspect averages more than 4, the assessment from the validator has a strong tendency with an average reliability value of  $\geq 0.75$ . In addition, all validators concluded that the student worksheets that had been developed were good and could be used with minor revisions. So it can be concluded that the average assessment of the validation results from experts on the developed student worksheets is in the very valid category. This means that the student math worksheet based on a holistic approach is feasible to apply, after revision based on input from experts (validators) a holistic based student math worksheet is produced (prototype 2), then it can be applied.

The validator also evaluates the expert teacher assessment sheet instrument on the observation sheet instrument which includes: teacher activity observation sheet, individual student activity observation sheet, student social activity observation sheet, learning motivation questionnaire, student response questionnaire to student math worksheets based on a holistic approach related to format, aspects of instructions, scope of activities, and language, which are contained in the observation sheet instrument. From the results of expert assessment of the observation sheet instrument and student response questionnaire, the learning motivation questionnaire can be summarized as shown in Table 3.

Based on table 3 it can be concluded that the average assessment results of validation from experts on the instruments used such as observation sheets observing teacher activities, student activities, student response questionnaires, student math worksheets based on a holistic approach, assessment of learning outcomes, and learning motivation questionnaires students, in terms of the indicators are in the very valid category, with an average value of 4.7 from an ideal score of 5. The observation sheet instrument is feasible to use. However, expert advice still needs to be improved or added. In addition, all validators concluded that the observation sheet and questionnaire instruments that had been developed were good and could be used with minor revisions. From the expert's assessment, corrections, criticisms and suggestions were obtained which then became a consideration for revising the observation sheet instrument on student mathematics worksheets based on a holistic approach.



Table 3. Description of expert assessment results

Instrument	Uraian/Aspek	Penilaian
Observation of teacher activity	1. Instruction	4,7
	2. Activity scope	4,2
	3. Language	4,5
	Average	4,4
Observation of student activity	1. Instruction	4,7
	2. Scope of student activity	4,7
	Average	4,7
Questionnaire of student responses to student math worksheets based on a holistic approach	1. Instruction	5
	2. Scope of student activities	4,8
	3. Language	4,9
	Average	4,9
Student response questionnaire to the assessment of learning outcomes	1. Learning outcomes test material	4,5
	2. Scope of the Question indicators	4,7
	3. Allocation of time	4,0
	4. Language	4,5
	Average	4,4
Learning Motivation Questionnaire	1. Aspects of Motivation	4,4
	2. Construction	4,3
	3. Language	4,5
	Average	4,4
Total Average		4,7

To measure the practicality and effectiveness of students' math worksheets based on a holistic approach, a limited trial was carried out in class VIIa of SMP Negeri 3 Tolitoli, academic year 2022/2023 involving 35 VIIa students, 2 teachers, 1 supervisor, and 1 regional education and culture service instructor. The final objective of the trial was limited to find out the effect of the students' math worksheets that had been developed, with the objectives: 1) To find out how the holistic approach-based student math worksheets were implemented in class, 2) To obtain suggestions from expert teachers and observers regarding the implementation of the worksheets students' mathematics work based on a holistic approach in class as material for improvement, 3) To find out the increase in student motivation and learning outcomes, as a comparison when student worksheets are implemented.

## 2. The practicality of students' math worksheets based on a holistic approach

The acceptance test of students' mathematics worksheets based on a holistic approach is intended to find out whether the worksheets developed are practical to use in the field or not. this is in line with <sup>[28]</sup> who argues that to measure its practicality by seeing whether teachers (and other experts) consider that the material is easy and can be used by teachers and students.

Therefore, before being used, it is necessary to carry out an assessment by a teacher who has teaching experience, hereinafter referred to as an expert teacher. The acceptability of the learning model is measured from the aspects of (1) supporting theory, (2) learning

objectives and learning outcomes, (3) syntax, (4) social systems, (5) reaction principles, (6) learning implementation instructions, environment management of learning and (7) evaluation.

The results of the expert teacher's assessment of the acceptability of students' math worksheets based on a holistic approach were in the good category with the average rating of the three teachers being 4.5 out of the ideal score set at 5, which implies a practical model and can be continued for further development.

### **3. The effectiveness of student math worksheets based on a holistic approach**

In the previous section, the results of the validity test of student worksheets and other instruments have been presented. An important aspect of the effectiveness (potential effect) of an instrument, theory, or model is knowing the level/degree of application of the theory, or model in a particular situation. According to this level of effectiveness, it is usually expressed by a numerical scale based on certain criteria [23].

The effectiveness of students' math worksheets based on a holistic approach is known by analyzing individual activity data, student social activities, learning motivation, and learning outcomes obtained during the implementation of class implementation. It is said to have a positive effect if there is an increase in: (1) student activity, (2) student responses, (3) learning motivation according to predetermined indicators, and (4) classical learning outcomes  $\geq 75$ . Student activity is on a very active rating scale with an average of 3.9. From the results of the analysis and based on the established criteria, it can be concluded that student activity can be increased. In general, individual student learning motivation and social activity in learning mathematics. Student responses to student math worksheets based on a holistic approach obtained a score of 98.58% based on a questionnaire given to students which was filled in by 35 students, so student responses to student math worksheets based on a holistic approach were in the "Positive" category.

In accordance with the results of the percentage which consists of four motivations in learning and consists of 25 statement items, and by looking at the established criteria, students' motivation towards mathematics is in the "high" category. based on the table above also shows that  $\geq 70\%$  of students gave answers as expected The learning outcomes of class VIIa students of SMP Negeri 3 Tolitoli, using student math worksheets based on a holistic approach, obtained an average score of 75.51 out of an ideal score of 100, with a standard deviation of 10.083. The minimum score obtained by students is 48 and the highest score is 100 with a score range of 62. If student learning outcomes are grouped into five categories, the frequency distribution table is obtained as follows:

Table 4. Results of learning mathematics students

score	Category	Frequency	Percentage (%)
0 – 39	Very low	0	0
40 – 59	Low	3	8,6
60 – 74	Currently	14	40
75 – 90	Tall	15	42,8
91 – 100	Very high	3	8,6
Average		35	100

The table shows that the number of students who complete learning achieve individual mastery, namely students who get a score of 70-100 as many as 30 of 35 students or around 85.71%. So the number of students who have not completed, namely students who get a score of 0-69, as many as 5 people out of 35 students or around 14.29%. Based on these data it shows that classical mastery is achieved. Of the four effectiveness criteria, in the application of student mathematics worksheets based on a holistic approach, all aspects were fulfilled, namely: student responses, mastery of learning outcomes, learning motivation and student activity.

Based on the effectiveness criteria, it can be concluded that the worksheet is effective because it fulfills 4 indicators of effectiveness including indicators of mastery of learning outcomes. The results obtained above indicate that the application of which carried out, student mathematics worksheets based on a holistic approach have met the criteria of validity, practicality, and effectiveness. So it can be concluded that the results of developing student mathematics worksheets based on the holistic approach used by the teacher in learning activities can improve the quality of learning mathematics.

## CONCLUSION

The students' math worksheets based on a holistic approach developed meet high validity criteria based on the results of expert assessments, so theoretically they can be used to improve learning outcomes and motivation to learn mathematics. The student math worksheet based on a holistic approach also fulfills the practicality criteria as a student worksheet based on the results of an expert teacher's assessment of the acceptability of student worksheets in the good category, so that student math worksheets based on a holistic approach are classified as practical and easy to use by students in the field. Student mathematics worksheets based on a holistic approach when implemented are able to increase student learning motivation, individual and social activities, positive student responses shown through the results of the questionnaire answers given, and student learning outcomes classically increase thereby fulfilling the requirements for effectiveness. Based on the discussion of research

and development results, it is suggested that student mathematics worksheets based on a holistic approach are proven to be able to increase learning motivation, individual activity and student social activity in terms of working together, sharing ideas and communicating, so that it has implications for improving student learning outcomes in mathematics. Therefore it is suggested for teachers to implement student math worksheets based on this holistic approach in a broader scope. The development in this research is limited to field implementation, therefore it is suggested for further researchers to develop student mathematics worksheets based on a holistic approach at the primary and secondary education levels and even higher education.

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