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Development of Integer Number Learning Devices Using Moluccas Local Wisdom

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abstract

An Integer is one material that is still considered difficult by students, even junior and senior high school students. Therefore it is necessary to prepare a learning media that can help students to master integers well. Various media have been developed to make it easier for students to understand and operate integers. However, the media is still far from the reach of students. This study aims to develop learning media for integers based on local Maluku wisdom as well as learning tools, namely the Lesson Plan, teaching materials and student worksheets that serve as a guide in learning. This research is a development research using the ADDIE development model which consists of stages, namely: Analysis, Design, Development, Implementation and Evaluation. The research begins by analyzing the students' abilities on integer material and teaching materials and the media used in learning. Then the researcher designed the media and learning tools which were then submitted to the experts to be validated and to students for their implementation. Based on the results of the validation of experts and student learning outcomes, it can be concluded that the resulting learning tools are valid and can be used.

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Keywords:

Integer Numbers; Local Wisdom



Open Access

INTRODUCTION

Based on the curriculum 2013, mathematics learning demands an active role of students in constructing their knowledge while the teacher only acts as a facilitator. Hosman (2014) explained some of the characteristics of the scientific approach in the curriculum 2013, including student-centered, involving science process skills in constructing concepts, laws, or principles, and applying cognitive processes that can stimulate intellectual development, especially students' high-level thinking skills. Thus, students will avoid verbalism, and student self-concepts will occur and allow students to assimilate and accommodate concepts, laws, or principles. This shows that the teacher should not transfer knowledge but facilitate and guide students to discover and validate mathematical concepts.

In implementing the role of the teacher as a facilitator, learning resources are needed to complement, maintain and enrich learning properties (Mulyasa, 2013) as well as an increase learning activity and creativity, which is very beneficial for both teachers and students. Teaching materials and student worksheets (LKS) are learning resources that can be a strength in learning mathematics. Fan, Zhu, & Miao (2013) explained that Mathematics textbooks, as supporting materials for teaching mathematics, have existed since ancient times. Therefore, selecting teaching materials and worksheets needs to be considered to help students learn easier, smoother, and more directed. In addition, teaching materials and teaching worksheets should also help students think creatively and provide opportunities for them to analyze and construct their own knowledge using teacher guiding. Reza (2010) said the mathematics textbook was and still is considered to be one of the most important tools. However, the mathematics textbooks used are still not contextual in accordance with the characteristics of students, especially students in Maluku.

Maluku is an archipelago province with many 3T areas (outermost, frontier and underdeveloped). One of the districts in Maluku which is directly adjacent to the state of Timor Leste is Southwest Maluku Regency. Students in this district find it difficult to access information via the internet or television. The teaching materials and worksheets used must be in accordance with the student's prior knowledge.

Integer numbers are a material that is difficult for most elementary and even junior high school students to understand. Research results showed that integer material is still one of the most difficult materials for students (Pranata & Respati, 2019; Ilma & Putri, 2012; Distari, 2018; Astuti & Mustadi, 2014). Pranata & Respati (2019) as well as Ilma & Putri (2012) explained that the causes of difficulty in integer material are (1) abstract integers; (2) Elementary and junior high school students are still at the stage of concrete thinking; and (3) Teachers have not used the media properly.

If students in the city have difficulties, more over the students in the 3T area, they have difficulties if they teacher do not make students more creative in learning. In the student book published by the Ministry of Education and Culture of the Republic of Indonesia, integer material is presented using objects and stories that are far from the reach of students, for example to introduce negative integers, a thermometer is used as well as stories about western countries with temperatures below zero degrees. This of course will confuse students because they have never seen and know the examples given.

Several previous studies have produced media in learning integers, including Pranata & Respati (2019) using number cards; Ilma & Putri (2012) using the traditional game of arrogance; Astuti et al., (2014) using electrical charges. These media require a cost to manufacture and some are far from the reach of students in the 3T area in Maluku. In fact, around the students various local pearls of wisdoms that can help students understand integers and their operations.

Therefore, teaching materials and worksheets are needed that can accommodate students' initial knowledge by using various local wisdoms from the community. According Eggen & Kauchak (2012) there are several things that teachers must do related to the availability of teaching materials namely (1) providing various examples and representations of subject matter to students; (2) encouraging a high level of interaction in the process learning; and (3) connecting the subject matter with the real world. The material that has been developed can be organized into teaching materials to make it easier for students to learn it.

Maluku has a wealth of local wisdom that can be used as a learning resource. Media of local wisdom can be used in developing teaching materials and worksheets. Local wisdom is something that is close to students and it is even well known, so that when teachers use local wisdom as a learning resource and are guided in a structured manner in teaching materials and student worksheets, students will easily understand what is being said and can provide maximum learning outcomes. This is in line with Even & Schwarz (2002) which stated that the focus of research in mathematics education has expanded from cognition and knowledge of individual students to contextual, socio-cultural and learning aspects and mathematical knowledge. The socio-cultural perspective, practice and culture of the class community "is not merely a special interest but the artifact of the study of mathematics classes and their use. Depdiknas (2008) explained that teaching materials can be developed in various forms adapted to the needs and characteristics of the material to be presented.

Local wisdom used in this research is the kulibia (cochlea) and fish archer activity. As an archipelago province, Maluku has beautiful beaches with various forms of kulibia obtained for free around the coast. In addition, people often catch fish with 'arrows'. Usually they dive into the sea carrying fish arrows and shoot fish and then rise again to the surface of the air. These two local pearls of wisdoms will be used to introduce integers and their operations.

The learning syntax uses realistic mathematics education (RME) learning syntax, which provides opportunities for students to construct their knowledge based on learning activities designed using local Malay wisdom. Based on Freudenthal's view, mathematics must be connected to real life, close to students and related to human social life. The learning process of mathematics should allow students to be "guided" to "re-invent" mathematics by doing it Van den Heuvel-Panhuizen (2001). Marpaung (2007) mentions mathematics as constructing mathematical concepts and active problem solving strategies through an activity. Rediscovering arises by converting contextual problems into mathematical problems (horizontal mathematization) and then structuring the problem at different levels. This is known as progressive mathematization, which is the process of rediscovering mathematical understanding, knowledge and procedures.

This study aims to produce valid learning tools for integer material using Maluku local wisdom. The device developed was a learning plan according to the RME syntax, teaching materials and worksheets.

METHODS

This research is a development research using the ADDIE model by Molenda and Reiser (2003). The ADDIE model consists of 5 stages, namely: Analysis, Design, Development, Implementation and Evaluation. The subjects in this study were seventh grade students of SMP Negeri 1 Tiakur, Southwest Maluku Regency. The data collected were qualitative data during the development process and quantitative data in the form of expert validation results and student and teacher responses to learning.

The criteria for the quality of the learning tools developed refer to Nieveen's (1999) criteria: validity, practicability, and effectiveness. To determine the validity of the tools that have been developed, a Likert scale is used, namely: '1' means very not good, '2' means not good, '3' means good enough, '4' means good and '5' means "very good". The learning device is valid if the average validator (x) assessment is at least good or $4 \leq x \leq 5$. Practicability is determined based on the implementation of the device in learning, which is at least 80% of the indicators implemented and the responses of teachers and students. Effectiveness is determined based on the increase in student test scores before and after using the device.

Student test results will be analyzed using benchmark reference guidelines according to Ratumanan & Laurens (2015)

Table 1
Student Learning Outcomes

Qualification	Score
Very high	$x \geq 85\%$
High	$70\% \leq x < 85\%$
Moderate	$55\% \leq x < 70\%$
Low	$40\% \leq x < 55\%$
Very Low	$x < 40\%$

RESULT AND DISCUSSION

In developing a learning model in *the* first stage, the researcher conducted an analysis of students, textbooks used and the local wisdom of the community. The student's analysis of the student's ability to compare and operate two integer is shown in Table 2.

Table 2
Analysis of Students' Initial Ability

No	Criteria	Score	Number of Students	Percentage (%)
1.	Very High	$x \geq 85$	2	3,45
2.	High	$70 \leq x < 85$	2	3,45
3.	Moderate	$55 \leq x < 70$	10	17,24
4.	Low	$40 \leq x < 55$	28	48,28
5.	Very Low	$x < 40$	16	25,58

Table 2 explains that, more than 70% of students scored less than 55 in the low and very low category and only 20% scored more than 55. This result is truly astonishing because integer material has been studied since elementary school in grade IV, but even though it has been in class VII students still have difficulties. This becomes a problem that, if not resolved, will cause a bigger problem when students have to learn advanced material that requires mastery of integers.

These results are in line with Wildaniati's research results (2015) state that the level of mastery of integer concepts and operations, especially in elementary schools, is still very low. Muslimin, Putri, and Somakim (2012) researching the reduction of integers is a material that is classified as difficult for most students in low grades, especially those whose subtraction results are negative integers.

Initial analysis was also carried out on student books. The results of the student book analysis are like the following two examples:

Explanation of negative integers

The explanation of negative integers is presented in the form of a story in Europe, an area that students have never been seen

Perhatikan berita berikut!

Sepanjang bulan Januari 2014, suhu di Eropa berubah secara drastis. Saat siang hari bisa mencapai 10°C (baca 10 derajat Celsius) di atas titik beku (0°C), sedangkan pada malam hari turun hingga 15°C di bawah titik beku.

Figure 1

Examples of non-contextual integers

Some of the outermost areas in Maluku are underdeveloped areas so this example is an example that is far from the thinking of students. In addition, this area is a hot area and a sub-zero explanation would be elusive. The term "freezing point" will be a problem for students to understand negative numbers will also have problems.

Explanation of the addition and subtraction of two integers

The addition and subtraction operations for integers are described using a number line and arrows. The weakness of this method is the difficulty of students completing the subtraction operation by subtracting negative integers.

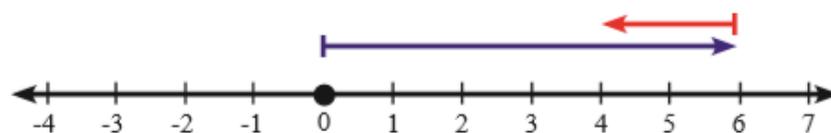


Figure 2

The Weakness of student's book

Researchers found that the subtraction operation described in this way confuses students when they want to subtract a negative number from a number. The student book does not

explain the meaning of each arrow which makes it difficult for students to determine the addition or subtraction result for other numbers.

The analysis of Maluku local wisdom, specifically Southwest Maluku, is the diversity of marine life specifically 'kulibia'. Kulibia is often found on the coast during low tide. Students are familiar or well acquainted with the various types of crustaceans and it becomes interesting if they are used in learning integers.



Figure 3
The 'kulibia' or cochlea

In addition, one way to catch fish is by using arrows. The divers will go down to the bottom of the sea where there are many corals where the fish are hiding, and then they will shoot the fish and go back to land.

Based on the preliminary analysis, the research designs learning tools, namely:

1. The Learning Plan serves as a teacher's guide in learning integers using Maluku local wisdom
2. Teaching materials are combined with worksheets because the teaching materials only contain limited information, then students will construct their concepts comparing two integers and fraction operations. The construction that students are expected to do is related to the material: (a) the concept of negative integers uses the fish archer approach, (b) comparison of two integers based on the position of the fish archer from sea level, and (c) The Integer Operation uses the activity of divers and the medium of the culture.

INGAT!

Jika kita menjumlahkan 2 bilangan, maka kita **menggabungkan** beberapa kulibia yang mewakili bilangan itu, kemudian **pasangkan warna hitam dan putih yang berarti nol**, hasil penjumlahan adalah kulibia yang tidak memiliki pasangan

Ayo Cari Tahu

Selesaikan penjumlahan bilangan bulat berikut dengan menggambarkan kulibia yang mewakili setiap bilangan kemudian tentukan hasilnya.

$3 + (-5)$

Kulibia yang tidak punya pasangan sebanyak 2 dan berwarna hitam, yang mewakili bilangan negatif
Jadi
 $3 + (-5) = -2$

Figure 4
Examples of Teaching Materials

The tools that have been developed were given to three experts to be validated. The results of the validation are described in Table 3.

Table 3
Results of the validation of Lesson Plan

No	Aspect	Average	Classification
1	Identity	5	Highly Valid
2	Time Allocation Accuracy	4,6	Highly Valid
3	Formulation of Learning Objectives	4	Valid
4	Material Selection	4,6	Highly Valid
5	Selection of Learning Approach	4,6	Highly Valid
6	Explanation of learning activities	4	Valid
7	Selection of learning resources	4	Valid
8	Assessment of Learning Outcomes	4,3	Valid
Average		4,39	Highly Valid

The results of the three validators' assessment of the eight aspects of the lesson plan show that the learning tools designed are very valid. However, some validator inputs are used to improve the steps in the lesson plan. The results of the validation of teaching materials and student worksheets are also described in Table 4.

Validation is a process to produce valid tools, both lesson plans and teaching materials and student worksheets (Laurens & Laamena, 2020).

Tabel 4
Results of the Validation of Teaching materias

No	Aspect	Average	Classification
1	Sentences are very clear and not confusing	5	Highly Valid
2	Provide opportunities for students to construct their own knowledge	4,6	Highly Valid
3	According to RME syntax	4	Valid
4	The media used is right	4,6	Highly Valid
5	Worksheets guide students well	4,6	Highly Valid
Average		4,56	

From the five aspects of teaching materials and worksheets, the average assessment of the three validators is very valid. There are several sentences in teaching materials and worksheets that must be corrected so that students can more easily construct their knowledge. The devices that have been validated and repaired are then tested on students. Table 5 describes the results of the analysis of the implementation of the device in learning.

Table 5
Analysis of Learning Devices Implementation

Activity	Meeting	Result	Category
Teacher	First Meeting	95%	Very Practical
	Second Meeting	90%	Very Practical
	Third Meeting	92%	Very Practical

Students	First Meeting	83%	Practical
	Second Meeting	83%	Practical
	Third Meeting	86%	Practical

Teacher activities related to the implementation of the tools developed show a number of more than equal to 90%, which means that the tools developed are very practical for teacher use. Student activity also shows a high enough number, which is above 80%, which means that students can learn well using the learning tools that have been developed. After that, students and teachers are asked to respond to the tools that have been developed. Teacher and student responses are described in Table 6.

Table 6
Analysis of Teacher and Student responses to Learning Devices

	Percentage	Category
Teacher Response	99,16	Very good
Students response	98,24	Very good

The percentage of teacher and student responses of more than 95 shows that the tools that have been developed are very interesting and useful for students and teachers. Very good positive responses given by teachers and students show that students and teachers are happy and interested in learning using local Maluku wisdom.

To find out the effectiveness of the learning devices that have been used, researcher give test for the students . The following table (Table 7) describes the student test results for 58 students.

Table 7
Analysis of Students' Abilities Before and After Learning

No	Criteria	Score	Number of Students		Percentage (%)	
			Pretest	Posttest	Pretest	Posttest
1.	Very High	$x \geq 85$	2	2	3,45	3,45
2.	High	$70 \leq x < 85$	2	16	3,45	27,58
3.	Moderate	$55 \leq x < 70$	10	21	17,24	36,21
4.	Low	$40 \leq x < 55$	28	9	48,28	15,52
5.	Very Low	$x < 40$	16	10	25,58	17,24

The data in Table 7 can be illustrated with a bar chart in Figure 3. Table 7 shows that almost 70% of students are in the medium to very high category in the posttest. There are still students in the low and very low category, but with a smaller percentage than the pre-test.

The introduction of the concept of negative numbers using context fish archers has a big impact on improving students' ability to the concept of negative integers. Muslimin, Putri, and Somakim (2012) call context a starting point in learning mathematics. This is in accordance with the results of previous research which states that the use of traditional games as a context in mathematics learning can have a positive effect on learning that is more meaningful, fun and supports understanding of the concepts being studied (Charitas, 2012; Jaelani, 2012).

Other than that learning with the context of local wisdom helps students understand abstract concepts (Laurens, Laamena, Matitaputty (2019). Local wisdom which is used as a medium is used by students to rediscover the principle of the operation of the two make numbers. When students find it themselves, the concept will be stored for a long time in the students' memory.

Student interest and learning outcomes increase and develop optimally as a result of the learning process which provides opportunities for students to develop their thinking skills based on the knowledge and experience gained (Jamdin, Ratumanan & Laamena, 2019)

In terms of argumentation, when students learn there is an argument between students and students and students and teachers and students are able to construct the concept of addition operations, even though at first it is not perfect. The argumentation process completes the students' initial answers and the teacher provides scaffolding to perfect the students' concepts

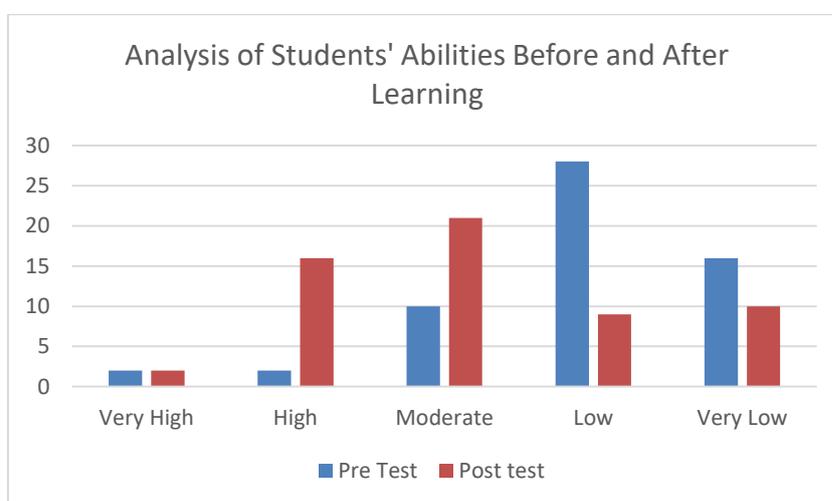


Figure 5
Pretest and posttest scores

CONCLUSION AND IMPLICATION

Based on the results of the research and discussion above, it can be concluded that learning using local wisdom can improve student learning outcomes on integer material. The resulting learning device is valid and gets a positive response from both teachers and students.

The process of generating the correct concept about addition operations was rediscovered by students with the help of the teacher based on the local wisdom used. This experience is used by students when performing addition operations so that learning outcomes are better

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