Validity of Digital Learning Devices through Realistic Mathematics Education for Teaching Integer Number at Junior High School

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Abstract. Technology has an important role in learning mathematics to build and develop student competencies needed in the 21st-century students. However, digital learning tools especially related to problem solving on integers are still limited. The aim of this research is to develop digital learning tools with a realistic mathematical approach to teach integers in junior high schools that meet valid criteria. This research is a development research that follows the Plomp phases, which is limited to the preliminary research and assessment phases. The instruments used in this research were validation sheets and digital device readability sheets, which consisted of videos, live worksheets and post-tests. The digital device was validated by an expert and tested on 30 grade 7th students at a junior high school in Banda Aceh. The results of the study show that digital learning tools through RME for teaching integer number for junior high school students meet the valid criteria. Devices that meet these valid criteria then need to be tested for practicality and effectiveness.

Keywords: Digital Technology, Learning tools, Realistic Mathematic Education (RME).

1 Introduction

Improving the quality of learning can be improved through the support of learning tools that are in accordance with the demands of the 21st century [1]. Learning tools developed with the help of technology are expected to improve the quality learning. The development of digital technology has changed learning tools to be all digital and become easier to access anytime and anywhere, so that learning becomes quality [2]. The use of technology in the education sector has become an important part of the learning process for students inside and outside the classroom [3].

Efforts to improve the quality of learning are by utilizing advances in science and technology [4]. Technology has an important role in learning mathematics to build and develop the competencies needed by 21st-century students. The development of learning tools is something that must be considered [5], especially in learning mathematics, one of which is integer material. [6] Integer material is the initial material in grade Vll junior high school students. Learning tools can be a determining factor for

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success in order to achieve learning objectives and improve the quality of student learning in learning integer material [7].

The use of learning tools in the learning process is one alternative for teachers to help and facilitate students to understand and learn the material taught [8]. However, students still have difficulty understanding whole numbers. The most difficult challenge for students is solving problems involving large numbers, especially negative numbers [9]. Negative numbers cannot be seen in reality by students so they are difficult to understand, while positive numbers can be realized in thoughts and real objects [10].

Students must have problem solving skills in finding problems and finding solutions to problems [11]; [12]; [13]. Problem solving is the process of overcoming problems by involving critical and creative thinking, as well as the search for alternative ideas along with concrete steps to overcome obstacles or weaknesses in thinking [14].

Problem solving helps students gain basic skills to solve everyday life problems and develop higher level skills [15]. The ability of teachers who can present problems in the context of daily life is needed in the classroom [16]. This is due to the challenges in the 21st century which require that mathematics taught in schools has a correlation with the real world [17]. One of the learning approaches that can improve students' learning ability in searching and finding their own answers to a questionable problem is the Realistic Mathematics Education (RME) [18]. With RME, students are able to understand mathematics by solving problems, imagining and illustrating mathematics related to everyday life. [19]. RME was formed based on Freudenthal's two main principles for teaching and learning mathematics [20]. First, it postulates the idea that mathematics is a human activity. This means that students must be given the opportunity to learn through experience [21]. Second, mathematics learning is the result of human work and social activities [22].

So far, there have been many learning tools RME Approach to help students learn. However, the availability of digital-based learning tools RME is still very limited. Therefore, it is necessary to develop digital learning tools in the form of learning videos, Liveworksheets, and Quizizz, especially on whole number material combined with the Realistic Mathematics Education (RME).

The purpose of this research is to obtain digital-based learning tools through RME for junior high school students that meet valid criteria. This research is limited to digital learning tools in the form of learning videos, Liveworksheet, and Quizizz on integer material using RME. The development of the method used in this research is the Plomp method which focuses on the prototyping and assessment phases. Based on the description above, the researchers are interested in developing digital learning tools in the form of learning videos, liveworksheets, and through RME.

2 Methode

This research uses the Research & Development (R&D) method with the Plomp [23] which consists of 3 stages, namely preliminary research, development or prototyping phase and assessment phase. In the preliminary research phase, needs analysis, learner analysis, curriculum analysis, concept analysis, and analysis of existing teaching materials were conducted. At the development or design stage, the development of digital learning tools through the Realistic Mathematics Education (RME) approach, namely learning videos, Liveworksheet, Quizizz, and validation by experts to determine the validity of products in the form of learning videos, Liveworksheet, and

Quizizz developed. At the final assessment or evaluation stage, the developed math digital learning tools will be tested.

This study was carried out only preliminary research development or protortyping phas. The digital learning device was tested to 30 grade 7th students from one of junior high school in Banda Aceh, Indonesia. The instrument is a validation sheet given to validators (lecturers and teachers). Validator consists of 3 experts, namely 2 lecturers from the mathematics education study program at University Syiah Kuala 1 mathematics teacher from Banda Aceh Junior High School. Each validator got validation sheet which aims to measure whether the learning material developed is valid or not. Suggestions and input from the validators will be used to revise digital learning material through RME. The criteria as presented at Table 1.

Table 1. Table captions should be placed above the tables.

Criteria	Average
Very Valid	$4 \leq$ KV[a] < 5
Valid	$3 \leq$ KV < 4
Less valid	$2 \leq$ KV < 3
Not valid	$1 \leq$ KV < 2
Very Valid	$4 \leq$ KV[a] < 5

[a] Average validation result from expert on learning tools

Based on Table 1, if the validation results show that the data obtained are valid or very valid, then the digital learning device design is feasible to be tested. However, if the validation results are less valid or invalid, the digital learning device design must be revised.

3 Results and Discussion

The development and prototyping stage is carried out by the process of design and validation by several experts. The results of the design of digital learning devices through RME validated by media and material experts are presented in Table 2.

Table 2. Result of validation of digital learning devices

Component	Aspects Assessed	V1	V2	V 3	Average	Average Validation	Criteria
Media	Display Screen Design	3.6	5	4	4.2	4.3	Very Valid
	Ease of Use	4.8	4.7	4.2	4.6		
	Consistency	4	4.7	3.3	4		
	Usability	4.2	4.4	5.2	4.6		

	Graphics	4.2	4.7	3.5	4.1		
	Video Content	4.7	4.7	3.5	4.3		
	Video Display	4.3	4.6	3.7	4.2		
	Construct	3.7	4.5	4	4		
	Content	4.2	4.7	3.5	4.1		
	Language	3.7	4.7	3.5	3.9		
	Presentation	4.2	4.9	4	4.4		
	Design	4	4.6	4.3	4.3		
	Ease	5	5	4.3	4.8		
	Material	5	4.3	4	4.4		
Material	Content feasibility	3.7	4.6	3.7	4	3.4	Valid
	Language	3.2	4.7	3.5	3		
	Presentation	3.6	4.4	3.8	3.1		

In Table.2, the average value of validation results from V1 and V2 (mathematics education lecturers) and V3 (junior high school mathematics teachers) for the media of digital learning devices from all aspects of the media is appropriate and can be said to be valid by obtaining a validity value of 4.3 with a very valid category. And for the results of the validity test on the digital learning device material from all aspects it can be said to be valid by obtaining a validity value of 3.4 in the valid category. Thus the design of digital learning devices with a through RME can be tested with minor revisions.

Based on the results of validation by three validators in providing assessments, there are several suggestions for improving digital learning tools through RME in the form of learning videos, Liveworksheet, and Quizizz. Validators suggested that the use of command words be applied and the use of language that can be more easily understood by junior high school students. The preparation of learning objectives must contain audience elements, behaviors, conditions, and degrees according to the demands of the curriculum teachings, and attach teaching materials. In addition, the activities presented in digital learning tools are still general, so researchers need to make the activities in learning more detailed and structured again. The following are all the validators' comments and suggestions on the digital learning tools and the revised results.

3.1 **Learning Video**

The comments given by V1, V2, and V3 were the suitability of the content in the learning objectives with the learning outcomes that need to be reconsidered. In addition, all validators suggested to researchers to add problems that can spark students in learning. In addition to these comments and suggestions, there are still several other comments and suggestions as shown in the Table 3.

Table 3. Result of comment and suggestions from media experts on learning videos

Before Revision	Validator Comments	After Revision

Learning video meeting 2 slide 4 which has not yet  listed problems that can spark students Learning video meeting3 slide 4 which has no other animations listed yet 	Validator 1: The color design used, both text and background, is appropriate. Text and images are clear and can be adapted to junior high school students. Find references that match real-life problems to trigger students in the learning video Validator 2: Add more interesting animations to learning videos that still look empty Add sound that can attract students' attention to the learning video Validator 3: Add background music to make the video more interesting for students to learn	Additional problems that are real and can trigger students in the learning video meeting 2 slide5.  Additional animation in the learning video at meeting 3 slide4.  Additional background music in the learning video to attract students' interest in watching the video

Table 4. Result of comment and suggestions from material experts on learning videos

Before Revision	Validator Comments	After Revision
 Learning video of meeting 1 slide 4	Validator 1: Additional material on meeting situation 4 Validator 2 Lack of further explanation on the video of meeting 2 & 3 Add questions that can trigger students to answer the activities in the liveworksheet Validator 3: In the video of meeting 4, slide 5 is lacking in explanation to trigger students	Changing command words into words that are more easily understood by junior high school students Correct language adjustment 

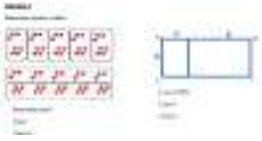
Learning video of meeting video 4 slide 5

More detailed explanation on the meeting 4 learning video so that students can understand more easily.

3.2 **Liveworksheet**

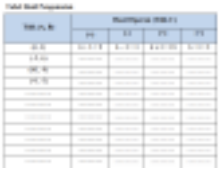
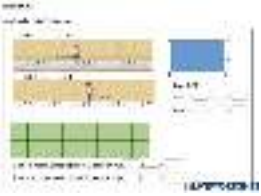
The comments given by V1, V2, and V3 were that the suitability of the content in the learning objectives with the learning outcomes needs to be reconsidered. In addition, all validators suggested to researchers to add activities that train students' thinking skills in the Liveworksheet. This is because the learning tools developed are expected to improve students' thinking skills. In addition to these comments and suggestions, there are still several other comments and suggestions as shown in the following table.

Table 5. Result of comment and suggestions from media experts on Liveworksheet

Before Revision	Validator Comments	After Revision
Liveworksheet 2 &3 activity 4 student answer column is not visible 	Validator 1: The design used is in accordance with the LKS and is suitable for junior high school students. Add instructions for student activities	Improvement of student answer column on Liveworksheet 2 &3 
Liveworksheet meeting 4 activity 1 	Validator 2 Additional answer column on liveworksheet 2 & 4 Include detailed images to direct the material Associative addition liveworksheet 4, include a picture of the completion of the beam nets	Improve the design so that the writing looks clearer 
	Validator 3: The design used is more colorful on the learning trajectory.	

		Add animation to the Liveworksheet 

Table 6. Result of comment and suggestions from material experts on Liveworksheet

Before Revision	Validator Comments	After Revision
Situation ice berg meeting 1  Liveworksheet 1 Observation table  Liveworksheet meeting 2 activity 1 	Validator 1: Use standardized terms Replace command words with language that is easier for junior high school students to understand Validator 2: In Liveworksheet 1, the previous explanation is to trigger students to the closed nature, that the closed nature of the result is also closed. Liveworksheet 1, in the observation table, there should not be too many tables. Make only a few but can be understood by students Validator 3: Liveworksheet 1 still does not contain the learning objectives, you should follow the ice berg.	Situation ice berg meeting 1, added problems in accordance with the model for  Additional problem solving on liveworksheet 1 in the observation table  Additional material on liveworksheet 2 

3.3 **Quizizz**

The comments given by V1, V2, and V3 were the suitability of the content in the learning objectives with the learning outcomes. In addition, all validators suggested to researchers to adjust the completion questions with the liveworksheet questions. This is because the learning tools developed are expected to improve students' ability to complete the evaluation of learning whole numbers. In addition to these comments and suggestions, there are still some other comments and suggestions as shown in the following table.

Table 7. Result of comment and suggestions from media experts on Quizizz

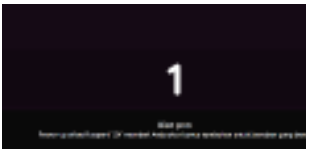
Before Revision	Validator Comments	After Revision
Plain bacground design view  	Validator 1: Easy to use application by students and teachers Practical to use as an evaluation tool The application can operate properly Validator 2: Buttons can be used well Can attract students' interest with the colors and designs chosen The appearance of Quizizz is not monotonous because it uses many types of problem solving Validator 3: Provide direct direction or explanation on the quiz display for parts that are difficult for students to understand, such as the command to draw on the graph.	Explanation on the problems that students will work on Added an interesting background design to make the quiz more enjoyable for students.  Additional types of quiz completion by drawing graphs 

Table 8. Result of comment and suggestions from material experts on Quizizz

Before Revision	Validator Comments	After Revision
The quiz questions that have not been revised do not match the content of the material	Validator 1: Additional questions that match those presented in the Liveworksheet Validator 2:	Improvements to the questions on the quizizzes are still in the context of the Student Worksheets on the liveworksheet

	The answer key provided is not correct with the correct answer Adjust the questions in the quizizzes with the Student Worksheet Validator 3: The material presented is easy for students to understand Additional use of questions that are more challenging and allow students to think critically	Improvements to the correct answer key  The revised questions are in accordance with the distributive property: 

Comments and suggestions given by validators on Learning Videos, Liveworksheet, and Quizizz have been followed up and revised to produce digital learning tools with RME that have met the criteria of very valid and valid. Revisions were made to the presentation aspect of learning tools to meet the demands of the through RME applied in junior high schools. The right choice of words is very important so that grade 7th students from one of junior high school students can solve the problems in the digital learning tools given properly. Provide examples by linking real-life contexts with given problems related to the context of the Realistic Mathematics Education (RME). Digital learning devices can be displayed easily so that teachers can also gain a basic understanding of the material to be taught.

The digital learning tools that have been validated will then be tested for readability to students grade 7th students from one of junior high school in Banda Aceh h by forming small groups. After analyzing students' responses when using digital learning devices, students provided suggestions for improving the digital devices developed, namely there are some uses of words and sentences that are difficult to understand, the details of the work of the developed devices still need to be clarified and the mismatch of the answer column. Based on the suggestions given by the students of grade 7th, the researcher concluded that the digital devices that have been developed can be understood well and then the researcher will re-improve the digital devices according to the suggestions and comments given by the students.

Likewise, when testing the readability of students' answers after working on test questions using Liveworksheet, the researcher then observed the students' comments and suggestions in writing including the following:

Table 9. Students' readability test results on digital learning devices

No.	Student	Comments/Suggestions
1.	Group 1	Students who are still difficult in solving multiplication and division

		are increasingly difficult to apply learning with learning tools. It is better if the learning video also discusses previous material to provoke students in solving problems.
2.	Group 2	Text boxes or columns for student answers that are not available directly under the question.
3.	Group 3	The difficulty of students in registering an account is because students are still 13 years old, so creating an account will be more difficult because it must be connected to the parent's device.
4.	Group 4	Students' difficulty in working on activity 1 on the Liveworksheet meeting 4 is due to the questions that are too complicated.
5.	Group 5	Students' difficulties in filling in the answer column in meetings 2 and 3
6.	Group 6	The difficulty of students answering the quiz with the time provided, students need more time.

Based on the validation results of three validators and the results of the readability test on students, digital learning devices with the Realistic Mathematics Education (RME) approach, the researcher draws the conclusion that the digital learning devices developed can be used properly, it's just that there are some improvements to the evaluation quiz that are not in accordance with the material being taught, so that students are less in understanding the evaluation questions in the context of RME. the incongruity of the questions can make learning evaluations more complicated [24]. Therefore, all digital learning tools with the Realistic Mathematics Education (RME) approach that have been developed can be used with minor revisions. Then after revising the questions from the evaluation quiz by adding many RME contexts, the digital learning tools with RME can be said to be valid.

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5 Conclusion

Based on the results of the research and discussion that has been described, it can be concluded that the results of the validation of digital learning tools developed with the Realistic Mathematics Education (RME) consisting of Learning Videos, Liveworksheet, and Quizizz have met the criteria of validity and are suitable for use with minor revisions. However, digital learning tools with a realistic mathematics

Education (RME) still need to be tested further to determine their practicality and effectiveness.

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