



## Improvement of Concept Understanding Through the Development of Interactive Multimedia on Integer Operation Material

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### Abstract

Understanding the concept is the ability expected in every learning process. But not all students can master the understanding of the concept well. Researchers are trying to provide an alternative by creating interactive learning media to help understand mathematical concepts, especially integer material in grade 6 elementary schools. This research aims to develop a number-line interactive multimedia product to increase the understanding of the concept of addition of positive and negative integer operations. The purposes can be specified as follows: (1) to produce valid number-line interactive multimedia; (2) to produce number-line multimedia that is practical and effective; (3) to produce multimedia that can assist educators in the learning and teaching process. This research used the Research and Development (R&D) method with the ADDIE development model. This research was conducted in grade 6 of SD Negeri 1 Matenggeng. The targeted output of this research is to find out how to increase understanding of concepts through the development of interactive multimedia on positive and negative integer operations. The results obtained in this research were based on the validation of material experts, the results obtained were 4.41 very feasible classification. While the media validation shows a score of 4.25 with an interpretation of the very feasible classification. It can be concluded that this interactive learning media is feasible to use.

**Keywords:** Understanding Concepts, Interactive Multimedia, Number Lines, Integer Operations.

## Peningkatan Pemahaman Konsep Melalui Pengembangan Multimedia Interaktif pada Materi Operasi Bilangan Bulat

### Abstract

Pemahaman konsep merupakan kemampuan yang diharapkan dalam setiap proses pembelajaran. Namun tidak semua siswa dapat menguasai pemahaman konsep dengan baik. Peneliti mencoba memberikan alternatif dengan membuat media pembelajaran interaktif untuk membantu pemahaman konsep matematika khususnya materi bilangan bulat di kelas 6 SD. Penelitian ini bertujuan untuk mengembangkan produk multimedia interaktif garis bilangan untuk meningkatkan pemahaman konsep penjumlahan operasi bilangan bulat positif dan bilangan bulat negatif. Tujuan tersebut dapat dirinci sebagai berikut: (1) menghasilkan multimedia interaktif garis bilangan yang valid; (2) menghasilkan multimedia baris angka yang praktis dan efektif; (3) menghasilkan multimedia yang dapat membantu pendidik dalam proses belajar mengajar. Penelitian ini menggunakan metode Research and Development (R&D) dengan model pengembangan ADDIE. Penelitian ini dilakukan di kelas 6 SD Negeri 1 Matenggeng. Luaran yang ditargetkan dari penelitian ini adalah untuk mengetahui bagaimana peningkatan pemahaman konsep melalui pengembangan multimedia interaktif pada operasi bilangan bulat positif dan negatif. Hasil yang diperoleh dalam penelitian ini berdasarkan validasi ahli materi diperoleh hasil 4,41 klasifikasi sangat layak. Sedangkan validasi media menunjukkan skor 4,25 dengan interpretasi klasifikasi sangat layak. Dapat disimpulkan bahwa media pembelajaran interaktif ini layak untuk digunakan.

**Kata Kunci:** Pemahaman Konsep, Multimedia Interaktif, Garis Bilangan, Operasi Bilangan Bulat.

## INTRODUCTION

According to the [Department of National Education](#), conceptual understanding is one of the abilities expected to be achieved in learning. Students can be said to understand a concept if they are able to define, identify and give examples or non-examples of concepts, develop mathematical connection skills between mathematical ideas, understand how mathematical ideas are related to one another so that a thorough understanding is built, and use mathematics in context outside mathematics. Understanding the concept really helps students answer various problems both related to mathematical calculations and problems beyond that. However, understanding the concept has not been seen as important to be achieved in the learning process. So that students can only solve problems that have been taught by the teacher. The failure to understand the concept is also reflected in the inability of students to think about finding various solutions that can be used to solve problems. Based on the results of observations, students' conceptual understanding of the material for adding integers has not been well achieved. Students still have difficulty answering questions with different variations, they are only able to work on the questions taught by their teacher. This shows that students are more oriented towards problem solving procedures than understanding the concept itself.

[Duffin & Simpson \(2000\)](#) defines understanding of concepts as students' ability to: (1) explain concepts, meaning students are able to re-express what has been communicated to them. (2) using the concept in a variety of different situations, (3) developing several consequences of the existence of a concept, it can be interpreted that students understand a concept as a result students have the ability to solve each problem correctly. [Sanjaya \(2009\)](#) also expressed his opinion regarding students' conceptual understanding of mastery of a number of subject matter characterized by being able to rephrase it in other forms that are easy to understand, provide interpretation of data and be able to apply concepts that are in accordance with their cognitive structure.

Numbers are the most frequently used parts of mathematics such as natural numbers, whole numbers, integers and fractions. Integers consist of positive integers, negative integers, and the number 0 ([Muhsetyo et al: 2007](#)). The material for arithmetic operations involving negative numbers is abstract material. Even though elementary students are still in the concrete operational stage, namely at the age of 7-12 years, according to Piaget's statement ([Wahyuningtyas & Iskandar, 2016](#)). [Wahyuningtias \(2015\)](#) found several facts that refer to students' lack of understanding of integer arithmetic operations, and according to him the main reason is because there is no proper media used to help students understand the concept of integer arithmetic operations.

Therefore, learning media is needed as an effort to improve understanding of concepts in the material for arithmetic operations on integers. This is in line with the opinion of [Wildaniati \(2016\)](#) that the use of media in learning mathematics is very meaningful, because mathematics is abstract in nature and elementary school students still tend to think concretely. One alternative that can be used to help increase student understanding is to use interactive multimedia. Interactive Multimedia is media that combines two or more elements consisting of text, graphics, images, photos, audio, video and animation in an integrated manner and creates two-way communication/interaction between users (humans/as users/product users) and computers (*software/application/ product in a specified file format*). The involvement of various senses in the learning process can make it easier for students to gain knowledge. The more senses involved, the more knowledge gained. Koehnert's theory states that "the more senses involved in the learning process, the more effective the learning process will be." Multimedia technology that combines several media is expected to overcome problems in the teaching and learning process, including errors in understanding mathematical concepts.

The interactive multimedia that will be used is in the form of multimedia created using the Canva application. This interactive multimedia can later be used according to what students want to know, so that there is student interaction with interactive multimedia that will be made. In addition, students can also learn material that they still do not understand.

## METHOD

This research is an educational development research (*educational research and development*) which has the aim of developing learning media in the form of interactive multimedia on the material for the addition of positive and negative integer operations for the elementary school level. Educational development research includes several processes, starting from the development process, product

validation, and product trials. The research model chosen by the researchers from this R&D research is the ADDIE development model.

The ADDIE development model developed by [Dick and Carry \(1996\)](#) which has five steps or stages according to the acronym of the name, including (1)*Analysis*, the stages of needs analysis as problem identification and identification of products that are in line with the target. (2)*Design*, the stages of product concept design which will later be developed by researchers. (3)*Development*, the production stage of something that is being developed by the researcher in accordance with the design or concept design that has been made. (4)*Implementation*, this stage is in the form of product trials that have been made by researchers as a concrete step in implementing the product. As well as (5)*Evaluation*, the process of evaluating whether the product is in accordance with expectations, product weaknesses, and improvement plans.

The sample in this study was students of class VI SD N 1 Metenggeng with a total of 19 students. While the instrument used in this study was a questionnaire instrument in the form of questions *pre-test* and *post-test*. Researchers used data collection techniques using instruments with aspects and criteria that were adopted from [Romi Satria Wahono in \(2006\)](#) with further development by researchers adapted to the needs and research objectives.

The data analysis technique used in this study is a quantitative descriptive technique and a quantitative description according to the development procedure. Qualitative analysis in this study was obtained through observations and interviews in the form of descriptions that were changed into descriptions that matched the data obtained. Furthermore, quantitative analysis in this study was obtained through the distribution of validation questionnaires and also the results *pre-test* and *post-test*.

## RESULTS AND DISCUSSION

### Results

The monotonous learning process gives an unattractive impression to students, thus making them more passive in the learning process. The use of multimedia in education is one of the innovative efforts to provide variety in improving the learning process. This is in line with research conducted by [Fitria Hanim, et al \(2016\)](#) which states that the use of multimedia has a significant influence in improving the learning process. This is because the use of multimedia makes students learn through their various senses, from sight, and hearing, to direct interaction in it. This statement is reinforced by [Wahyuni \(2017\)](#) who explains that the use of presentative multimedia can help students and teachers in the process of implementing learning in schools.

Learning mathematics which tends to have abstract characteristics often makes students feel difficult. Students need high concentration and interest in learning to be able to understand mathematics. This is of particular concern, if students are not interested in learning mathematics, how will they understand all the material? Therefore, this interactive multimedia-based learning media was developed.

Study This was carried out on sixth grade students of SD Negeri 1 Metenggeng in the mathematics subject of whole number material in the academic year 2022/2023 with the RnD development model of the ADDIE type. This model has 5 stages according to its name, namely the Analysis stage (*Analysis*), Design (*Design*), Development (*Development*), Implementation (*Implementation*), and Evaluation (*Evaluation*). Thus, the results of research and development of interactive multimedia-based learning media with the ADDIE model are as follows:

#### (1) Analysis (*Analysis*)

At this stage an analysis of potential problems is obtained in the form of teacher needs in procuring innovative learning media in order to increase the active participation of students. This is evidenced by the condition of the students when learning that most of them experience boredom and the low learning outcomes of students seen in the pretest results showing only 11% whose scores are above the completeness standard > 75.

#### (2) Design (*Design*)

The design stage begins with data collection on material related to the operations of addition and subtraction of positive and negative integers with references from the Mathematics Class VI SD/MI teacher and student textbooks which are discussed starting from understanding, implementation, number operations, sample questions, to feedback. Next manufacture flowchart which is a flowchart of interactive

learning media as well storyboard which contains the details or content of each section of flowchart with details starting from the material, script, and details (other components).

### (3) Development (*Development*)

This stage is a follow-up to the design stage which is developed into interactive multimedia-based learning media, including text, images, audio, and animation that has been adapted to the child's developmental stage. The components needed in the development of instructional media were obtained from various sources, such as the text of the manuscript obtained from reference teaching materials for teacher and student textbooks for grade VI mathematics, animations from the work of researchers combined with figures from elements of the Canva application, and audio which is a recording of research members. All of these components are then compiled into interactive multimedia-based learning media with addition and subtraction operations on positive and negative integers using the Canva application.

Visualization of learning media begins with a title page with a design that emphasizes writing, then continues with pages of KI, KD, Indicators, and Learning Objectives combined with link buttons that lead to each content. Furthermore, it leads to the implementation, understanding, and number operations. In addition and subtraction number operations the researcher arranges learning media on the basis of animated figures on the number line with forward, backward and body turning movements according to existing rules. As well as on the last page in the form of student feedback with the selection of emoji that have been provided starting from happy, confused, to sad or difficult expressions.



Figure 1. Media Title Display



Figure 2. Audio-Accompanied Round Number Position Display

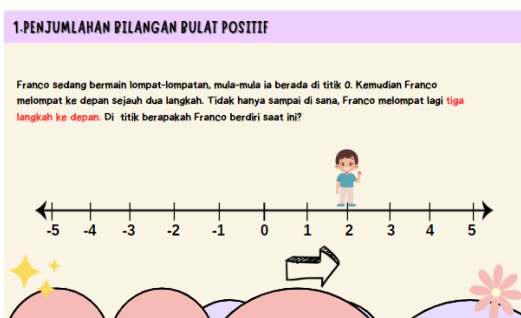


Figure 3. Animated Display of Solving Examples of Number Operations Problems

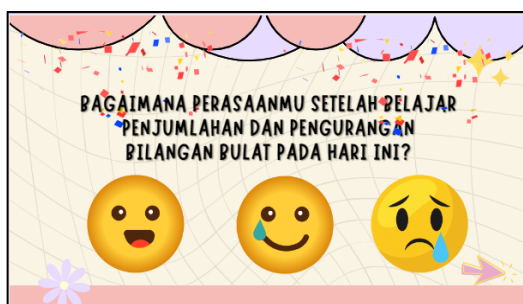


Figure 4. View of the Feedback Page

At the development stage, it was continued with the material expert validation process by Irfan Wahyu Prananto, S.Pd., M.Pd. as a Mathematics Lecturer at Yogyakarta State University, with the following results:

Table 1. Material Expert Validation Results

Assessment Aspects	Shoes Total	Criteria
Material accuracy	25	Worth it
Use of language and writing	14	Very worth it
Illustration quality	10	Very worth it
Quality of information and practice questions	26	Very worth it
<b>Amount</b>	<b>75</b>	
<b>Rate-rate</b>	<b>4,41</b>	<b>Very worth it</b>

The total score is 75 with a result of 4.41 so that the interpretation of the classification is very feasible. This is supported by the conclusions given by material experts that it is feasible to use for research. As for suggestions from material experts, namely the need for synchronization between indicators and learning objectives, because the number of learning objectives must match the number of indicators used.

While the results of the validation sheet from media members by Evy Nur Rochmah, S.Pd., M.Pd. as a Learning Media Lecturer at Yogyakarta State University is as follows:

Table 2. Media Expert Validation Results

Assessment Aspects	Shoes Total	Criteria
Software engineering	18	Very Worth it
Desain learning	14	Very worth it
Visual communication	52	Worth it
<b>Amount</b>	<b>84</b>	
<b>Rate-rate</b>	<b>4,25</b>	<b>Very worth it</b>

The score shows 84, so that the calculation results are 4.25 with an interpretation of the appropriate classification. This is supported by the conclusions given by material experts that it is feasible to use for research. As for suggestions from media experts, that is to pay more attention to the layout of the elements and improvements to the link buttons because there are several parts that are misplaced. Therefore, the development stage is continued with revisions in the form of follow-up from the results of the expert validation sheets based on the suggestions that have been given as considerations in implementing the revision process.

The expert validation stage is carried out in only 1 stage, because the results of the validation of the two experts in stage 1 have reached very feasible criteria.

(4) Implementation (*Implementation*)

The implementation stage of learning media is carried out through interviews with class teachers regarding the learning media that have been created and applied to students. The results of interviews that have been conducted by researchers can be concluded that teachers feel helped by the existence of existing learning media. According to the class VI teacher, class VI students became more active in learning, paid

more attention to learning, and students could understand the concept of positive and negative integer operations more easily.

While the implementation for students, the level of success will be seen through the measurement of the comparison of the percentage of learning outcomes between pretest and posttest which will be given. Question giving posttest given to students after receiving learning using learning media that has been made as a standard for the success of learning media. The following is the learning outcome data posttest:

Table 3. Value Frequency Distribution *Posttest*

Interval Value	Frequency
56-60	0
61-65	0
66-70	2
71-75	1
76-80	8
81-85	0
86-90	5
91-95	0
96-100	2
Amount	19

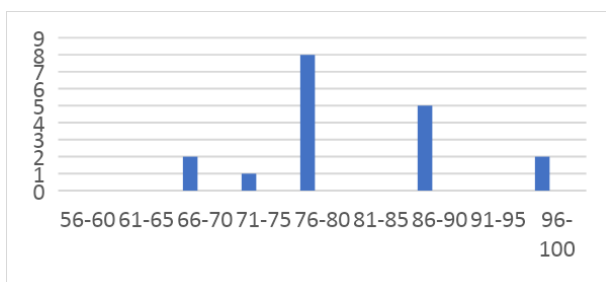


Figure 4. Graph of Value Frequency Distribution Posters

##### (5) Evaluation (*Evaluation*)

The evaluation stage is the stage where the researcher makes improvements to the media that is being developed. The evaluation stage for the ADDIE type RnD method is carried out throughout the process of the four stages above. Therefore, every time the researcher encounters an irregularity or something that needs to be corrected, the researcher can immediately evaluate it at each stage. This was carried out by researchers in several stages, one example at the development stage of the revision section which is the implementation of the evaluation stage with material considerations from the validation results of experts.

## Discussion

Based on the results of the research above, at the problem analysis stage, it was found that in the implementation of learning mathematics, there were problems with teaching materials that were still conventional, student participation was low, and integer material was included in complex material. Teachers feel that they really need innovative digital-based learning media to increase the activity of students in the hope that learning outcomes will increase.

This is the reference for researchers by creating interactive multimedia-based innovative learning media in accordance with the needs of problem analysis. Researchers developed instructional media with a design that contains the concept of positive and negative integer operations combined with various main components such as text visualization, interactive buttons, motion animation, and learning audio.

The design concept was made with the main objective of attracting students' attention to learning, not to mention the media content is still adjusted. The design is then developed or followed up by making media using the Canva application in such a way that a complete learning media is formed.

Learning media that have been made by researchers, then validated by material experts with a scale of 4.41 with a very feasible interpretation. As well as the results of the media expert validation sheet which

shows a result of 4.25 with a very feasible interpretation as well as some additional suggestions as material for revision consideration.

Furthermore, learning media is implemented to class teachers and class VI students. The class VI teacher's response stated that learning media really helped the process of understanding the concept of material for addition and subtraction operations on positive and negative integers, as well as increasing student activity in the learning process.

The indicators of the success of the media implemented to students are through the results of the pretest at the beginning of learning and the posttest at the end of learning with >75 completeness criteria. This also showed positive results, namely initially the average grade of 55 with only 11% mastery increased to an average grade of 82 with 83% completeness. Or it can be said that the increase in learning outcomes reaches 87% for student completeness and 49% for improving learning outcomes for all students in class VI.

However, researchers also encountered obstacles in the implementation of learning, including (1) limited school projector facilities, (2) limited availability of school computers or laptops, so that students could not try learning media independently using school facilities, and (3) Internet networks that cannot be facilitated by schools. However, the researcher tries to overcome these obstacles by asking students who have smartphones to try this learning media on their respective devices, so that active student involvement in learning can still be achieved.

Media in learning is an important component, this was revealed by [Ardiati, et al \(2012\)](#). According to [Dewi \(2021\)](#), interactive learning media is media that can help improve students' understanding of concepts related to this material. The use of interactive multimedia is expected to stimulate students to be able to understand the material better and foster students' interest in learning, so that learning becomes more alive with the active participation of students.

## CLOSING

The results and discussion analyzed by the researcher found that there was an increase in students' understanding of the integer operations material. This can be seen based on the results of the pre-test and post-test that have been carried out, based on the scores obtained in the pre-test, only 11% completed, then there was a significant increase in the results of the post-test, namely 83% of students completed.

The use of this interactive multimedia can be said to be influential and effectively applied to integer operations material, because this interactive multimedia can attract students' interest and make learning meaningful. Apart from that, it also helps students understand material on integer operations easily and practically.

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