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Pengembangan Media Pembelajaran *Smart Board* dengan Pendekatan PMRI pada Materi Bilangan Bulat

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Abstrak

Pembelajaran dapat berjalan dengan baik apabila komponen-komponen yang terdapat didalamnya saling bekerja sama dan mendukung untuk mencapai tujuan pembelajaran. Penelitian ini bertujuan untuk mengembangkan media pembelajaran *Smart board* dengan pendekatan Pendidikan Matematika Realistik Indonesia (PMRI) pada materi bilangan bulat yang valid dan praktis. Penelitian ini menggunakan metode *Research and Development* (R&D). Subjek dari penelitian ini adalah siswa kelas VI MI di Kota Malang. Jenis penelitian ini adalah penelitian pengembangan, dimana instrumen yang digunakan diantaranya lembar wawancara, angket validator ahli materi, ahli media dan angket respon siswa. Melalui instrumen tersebut diperoleh data yang akan dianalisis untuk mengetahui apakah media pembelajaran yang telah dibuat telah layak digunakan pada proses pembelajaran. Model pengembangan yang digunakan adalah model *Analysis, Design, Development, Implementation,* dan *Evaluation* (ADDIE). Hasil validasi ahli materi dan ahli media menunjukkan bahwa media memenuhi kriteria valid dengan rata-rata skor 3,71. Hasil dari angket siswa menunjukkan bahwa media dinyatakan praktis dengan kriteria rata-rata skor hasil angket siswa 3,68. Berdasarkan hasil analisis tersebut, media pembelajaran *Smart board* pada materi bilangan bulat dapat dinyatakan valid dan praktis. Selama proses pembelajaran, siswa dapat lebih mudah memahami materi yang disampaikan sehingga media pembelajaran yang dibuat layak digunakan dalam proses pembelajaran terutama pada materi bilangan bulat.

Kata Kunci: bilangan bulat, media pembelajaran, pendekatan PMRI, *smart board*

Development of Smart Board Learning Media with the PMRI Approach on Integer Material

Abstract

Learning can run well if the components contained in it work together and support each other to achieve learning goals. This study aims to develop Smart board learning media with the Indonesian Realistic Mathematics Education (PMRI) approach on integer material that is valid and practical. This study uses the Research and Development (R&D) method. The subjects of this study were students of class VI MI in Malang City. This type of research is development research, where the instruments used include interview sheets, material expert validator questionnaires, media experts and student response questionnaires. Through these instruments, data is obtained that will be analyzed to find out whether the learning media that have been made are suitable for use in the learning process. The development model used is the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model. The results of the validation of material experts and media experts show that the media meets valid criteria with an average score of 3.71. The results of the student questionnaire show that the media is stated to be practical with the criteria for an average score of the student questionnaire results of 3.68. Based on the results of this analysis, Smart board learning media on integer material can be declared valid and practical. During the learning process, students can more easily understand the material presented because it uses interesting and not boring media. So that the learning media that are made are suitable for use in the learning process, especially on integer material.

Keywords: *integers, learning media, PMRI approach, smart board*

INTRODUCTION

Education is an effort to prepare the younger generation to welcome and face developments in the global era. Mathematics is a field of study that has an important role in the world of education and is the basis of various sciences that play a role in aspects of human life and the development of other sciences. Mathematics is studied at all levels of education, from elementary school to university. (Chotimah, Bernard, & Wulandari, 2018) said that mathematics is a lesson that is closely related to real life, there are many things or problems around us that require mathematics. However, it is still rare to find learning media in which there is an approach that is oriented to the problems of everyday life such as Indonesian Realistic Mathematics Education (PMRI). Realistic Mathematics Education in Indonesia is an approach adapted from Realistic Mathematics Education (RME) which is an approach that is oriented towards the mathematization of everyday experiences (Sembiring, Hadi, & Dolk, 2008).

The importance of the role of mathematics in various fields of life cannot make mathematics subjects at all levels of education easily liked by students. One of the factors that influence this is the way of delivery which is considered less interesting and also boring. Not a few students think that mathematics is a difficult subject because they have to deal with abstract mathematical concepts and symbols. Besides that, there are not a few math teachers who are impatient to teach students who are still confused about mathematical concepts (Rohati, Winarni, & Hidayat, 2018). This problem then has an impact on students' low understanding of the basic concepts of mathematics so that results are not obtained as expected.

The creation of good learning can be done by using the right facilities and infrastructure in order to improve the quality of learning in the classroom. One of them is by using interesting learning media and can help students understand the subject matter presented. Media are all forms of physical tools that can present messages and stimulate students to learn so that learning objectives are achieved (Dari, Muhlis, & Kusmiyati, 2021). The selection and use of media that are appropriate and in accordance with the characteristics of the subject matter will produce good quality education implementation as well. Learning media can be in the form of hardware or software that functions to assist teachers in delivering learning material and helping students understand learning material (Anshar, Ganefri, & Kusumaningrum, 2021). One of the functions of learning media is as an intermediary to make it easier for teachers to convey information to students. Media is an alternative to assist teachers in conveying information properly (Rahmatulloh, Soelistijo, & Wagistina, 2021). Student enthusiasm in the learning process can be realized with the help of the learning media used. According to Widodo & Wahyudin (2018) one of the factors that determine the success of learning mathematics is the learning media used (Budi & Qohar, 2021).

According to Budi & Qohar (2021)in previous research, the use of print media used by teachers to convey material in learning mathematics caused many students to become confused. Therefore, appropriate learning media is needed and supports the implementation of learning in order to improve the expected quality. The learning media used in this research is in the form of mathematical comics (KOMAT) where these media can make students more interested in learning mathematics through a simple arrangement of pictures and words.

Observations made by researchers in one of the schools gave the result that most teachers only used learning media in the form of printed media such as textbooks and worksheets. The use of existing learning media is considered less effective because student learning outcomes are still low. Mathematics learning is considered less interesting and boring because the use of learning media is still not optimal. The right learning media used is interesting and fun learning media. In addition, the use of media is also expected to make students play a more active role during the learning process so that they can develop understanding of a material in an easier and less boring way.

One of the learning media that can be used in learning mathematics is a *Smart Board*. Smartboard media is an interactive whiteboard based on multimedia that is made in as much detail as possible so that it can help children choose what they want when learning is carried out (Ritonga, Syahputra, Arifin, & Sari, 2022). Using this media, objects such as pictures or displayed numbers can be easily installed and replaced at any time according to learning needs. Through the *Smart Board* students can practice

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directly solving problems in learning delivered by the teacher, especially on integer material. The *Smart Board* is equipped with a number line, positive integers, negative integers, number operations as well as attractive pictures and colors. Through the use of concentration media and students' learning interest in understanding a concept in mathematics can develop more optimally. The use of interesting learning media will increase students' motivation and interest in learning so that it will make students successful in understanding the material provided (Setyadi & Qohar, 2017).

Improving the quality of education can be realized through a learning process that focuses on student activities in implementing the teaching and learning process (Cox, 2021). The approach that needs to be applied in learning mathematics is a contextual approach, which links student learning activities with real life in daily activities. PMRI (Indonesian Realistic Mathematics Education) is the right approach to solve this problem. The PMRI approach is an approach that emphasizes student activity and is based on real (contextual) things for students in learning mathematics (Munir & Sholehah, 2020). The PMRI approach is also an approach that utilizes everyday life which places an emphasis on using an imaginable situation by students (Prihartini, Sari, & Hadi, 2020).

Based on the description above, researchers will conduct research with the title "Development of *Smart Board* Learning Media with the PMRI Approach on Integer Material". This research is expected to provide learning that is easy to understand and also meaningful for students, especially grade VI students.

METHOD

This research was conducted from August to September 2022 at MI Hidayatus Sibyan, the target in this study was for class VI students to understand integer material. The method used in this study is the method of research and development. The Research and Development (R&D) method is a research method used to produce a particular product and test the effectiveness of that product (Nisa et al., 2020). The resulting product is a *Smart board* learning media with the PMRI (*Indonesian Realistic Mathematics Education*) approach. *Smart board* learning media can be accessed via HP (*Handphone*) and laptops.

The development model used in this research is the ADDIE development model which consists of Analysis, Design, Development or Production, Implementation or Delivery and Evaluations (Rubianto, 2020). The reason for choosing the ADDIE model in learning media development research is because the ADDIE model is a model that provides opportunities for continuous evaluation and revision in each stage that is passed so that the resulting draft of learning media will become a valid and reliable learning media. Research using the ADDIE model is a very simple model but is still carried out systematically.

Research data analysis techniques using descriptive methods. The descriptive method is a method for examining the status of a group of people, an object, a context, a system of thought, or a class of events in the present (Wijayanti, Hasan, & Loganathan, 2018). Data processing techniques in this study used measurements with a Likert scale. According to Sugiyono (2013), explains that the Likert scale is used to measure attitudes, opinions, and perceptions of a person or group of people about a social phenomenon. The selection of this measurement has the goal of making it easier for respondents to choose answers.

The data collected will be in the form of scores, opinions and suggestions from material experts, media experts related to deficiencies and potential that can be improved from the product being developed. This development research also involved several individuals who in this case were referred to as validators, namely lecturers majoring in mathematics education at the Postgraduate Program at the State University of Malang, mathematics teacher at MI Hidayatus Sibyan and class VI students. Following are the data analysis techniques used in this study.

Validation of Media Experts and Material Experts

The product validity test was obtained from the processing of the questionnaire scores of material experts and media experts. The average validity score obtained is compared with the interval shown in Table 1 to determine the level of product validity. The validity level interval in Table 1 was obtained based on the questionnaire given to the validator. The questionnaire given has four choices for each as shown in Table 1.

Table 1. Validity Table

Average Score Validity (Vr)	Validity Level
$1 \leq Vr < 2$	Invalid
$2 \leq Vr < 3$	Less Valid
$3 \leq Vr < 4$	Valid
$Vr = 4$	Very Valid

(Qohar, Susiswo, Nasution, & Wahyuningsih, 2021).

Student Response Questionnaire

The practicality test is obtained from the processing of field practitioner questionnaire values that have used the product. The practicality test was carried out by conducting trials on 16 grade VI students who were given a response questionnaire. The questionnaire used has four answer choices for each indicator, namely 1) Very inappropriate, 2) Not suitable, 3) Appropriate, 4) Very suitable. The practicality test of learning media is obtained based on the average score of the questionnaire that has been given. The practicality score obtained from the average is compared with the interval in Table 2 to determine the practicality level of *Smart board* learning media.

Table 2. Practicality Level

Practicality Average Score (Pr)	Practicality Level
$1 \leq Pr < 2$	Impractical
$2 \leq Pr < 3$	Less Practical
$3 \leq Pr < 4$	Practical
$Pr = 4$	Very Practical

(Qohar et al., 2021).

RESULTS

The product developed in this study is the *Smart Board* learning media with the PMRI approach on integer material in class VI. The purpose of developing this learning media is to help students understand the material conveyed by the teacher more easily and pleasantly through the activities carried out during the learning process with the help of the *Smart Board* that is made.

Smart board learning media was developed using the ADDIE model, where there are five stages, namely analysis, design, development, implementation, and evaluation. The elaboration of the results of each stage of this development research is as follows.

Analysis

The analysis stage is the stage of analyzing students' character towards learning mathematics. Researchers collect information related to problems that occur in the implementation of learning mathematics and find out the need for developing the media to be used. The process of collecting data to be analyzed is carried out by observing and interviewing. Observations were made at one of the schools, namely MI. Hidayatus Sibyan. Interviews were conducted with class VI students by conducting an analysis in the form of needs analysis and student characteristic analysis.

Design

The design stage is the stage where the researcher has determined the media to be developed and made a design of the media. Researchers also design instruments to be used in research. The instruments in question consist of material validation sheets, media validation sheets, teacher response questionnaire sheets, and student response questionnaire sheets.

Development

The development stage is the stage of realizing the product to be made. At this stage, media development is made in accordance with the plans that have been made before. Several stages were

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carried out in the media development process, namely:

1. Prepare tools and materials to make *Smart board* manipulative media.
2. Assemble and arrange the components on the *Smart board*.
3. Check the completeness of the components that have been prepared.
4. Decorate the appearance of the *Smart board* using attractive colors and objects.

The following is a picture of the finished *Smart board* display

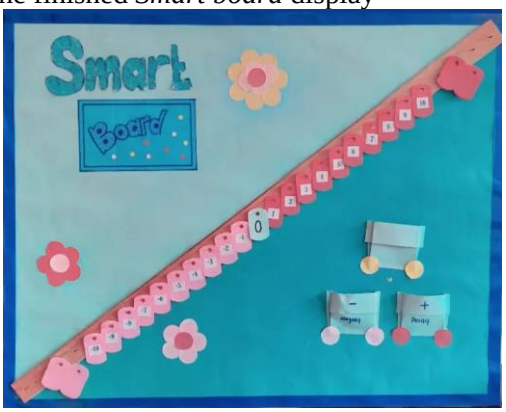

Figure 1. *Smart board* view

Implementation

The fourth stage is the implementation stage. At this stage the researcher tested the media products that had been developed. The following is an explanation regarding the results of the trials conducted.

Media Expert Validation Results

There are two validators who observe and fill out the media expert validation sheet. The validators consist of lecturers and students majoring in mathematics education at the Postgraduate Program, State University of Malang. The results of the validation are presented in the following table.

Table 3. Media Expert Validation Results

Rated aspect	The average score of each aspect
Content of learning media	
- Learning media can help students learn mathematics	3,8
- Learning media can help students build an understanding of mathematical concepts	3,7
- The activities provided allow for positive interaction between students and learning media	3,6
- Activities contained in the use of learning media in accordance with learning objectives	3,5
- Learning media does not cause problems	3,7
The use of learning media	
- Can be used to assist students in achieving learning objectives	3,7
- Can be used as a support for learning mathematics in schools.	3,7
- Can encourage students to be more active	3,8
Form and appearance (manipulative/physical media)	
- Appearance of interesting learning media	3,7
- Form proportional media	3,9
Total average validity score	**3,71**

The validity of the learning media developed in this study is determined by the validation that has been carried out by validators who are experts in their fields. Based on Table 3, the learning media validation results are said to be valid because they have gone through a validity process and obtained a score of 3.71 from the experts. Through several aspects of the assessment, namely the content, use, and form and appearance of learning media, it can be seen that the media made meets good criteria to be applied in the learning process.

Student Response Questionnaire Results

Respondents from filling out the student response questionnaire were MI students. Hidayatus Sibyan class VI as many as sixteen people. The results of the student response questionnaire are presented in the following table.

Table 4. Student Response Questionnaire Results

Rated aspect	The average score of each aspect
Presentation of material	
- Math learning media is easy for me to use	3,8
- Presentation of problems on mathematics learning media helps me understand mathematical concepts	3,6
- I like learning mathematics through this learning media because it is interesting	3,8
- This learning media makes me like mathematics	3,5
- This learning media makes me actively learn mathematics	3,7
- This learning media makes me want to understand mathematics further	3,6
Language and display	
- The instructions and information presented are easy for me to understand	3,7
- Appearance of interesting learning media	3,8
The total average score of the questionnaire	**3,68**

Based on Table 4 which contains the results of the student response questionnaire to the media, the value obtained is 3.68 so that the classification of the value assessment is included in the very practical category.

Evaluation

The evaluation stage is the final stage of the ADDIE development model. At this stage the researcher evaluates the media as a whole. Things that need to be evaluated and revised refer to the results of trials conducted at the Implementation stage along with the results from data obtained from all instruments, both media expert validation sheets and student response questionnaire sheets.

Learning media can help students to bridge abstract mathematical material. Learning media is part of learning technology that must be created, developed, used and managed according to student learning needs in achieving the effectiveness and efficiency of the learning process (Suprianto, Ahmadi, & Suminar, 2019). In addition, the development of learning media must also pay attention to the ease of attraction, use, and use. The development of *Smart board* learning media in this study was carried out in class VI of Madrasah Ibtidaiyah in Malang City. The following is an overview of the activities of class VI students when using the *Smart board* learning media.

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Figure 2. Activities using *Smart board* learning media

Students who are active in the learning process have a greater chance of understanding the material being studied. The use of *Smart Board* learning media helps students to be more active and expressive in participating in learning so that they can determine the steps in solving problems with real actions using the media that has been provided. This shows how important the use of media is in the learning process. In line with this, according to Rahmawati & Leksono (2020) the use of media in learning is very important, because the media is a component of the learning system. The media must also be integrated and in accordance with all the processes that are in it.

DISCUSSION

Based on the results of research that has been obtained previously, the cause of students' lack of understanding of the material presented, especially integers, is the didactical obstacle, namely the obstacle that occurs comes from the method or media used by the teacher in the learning process. This can be seen when the Smart Board learning media is used, they can easily accept and understand what the teacher conveys cheerfully and enthusiastically. Monotonous learning using print media is felt to be boring and there is a lack of interest in the material being studied. Therefore, it is necessary to redevelop the approach or media used in the learning process so that it can attract students' attention or interest in understanding the material presented.

This media was developed to support an easy and fun learning process. The use of learning media is very helpful in understanding the material presented. This *Smart board* learning media contains integer material which is presented with several aspects that support its feasibility.

First, in terms of the material presented very well, it can be learned by students easily and in accordance with the evaluation questions given. This is in accordance with the definition of learning media where media is something that is used to channel messages and can stimulate students' thoughts, feelings, concerns, and willingness so that it can encourage a learning process that is intentional, purposeful, controlled and structured (Hakim & Haryudo, 2014).

Samura (2015) stated that the benefits of media in the learning process are facilitating interactions between teachers and students so that learning will be more effective and efficient. But more specifically, there are some more detailed media benefits, namely the delivery of subject matter can be uniformed, the learning process becomes clearer and more interesting, the learning process becomes more interactive, efficiency in time and effort, improves the quality and results of learning, the media can enable the learning process to be done anywhere and anytime, the media can foster students' positive attitudes towards the material and the learning process, and change the teacher's role to be more productive. In accordance with the results of the media expert's assessment which shows that the material in the *Smart board* learning media is appropriate and included in the valid category. So that this *Smart board* learning media can be used in the learning process properly.

Second, in terms of learning media design which provides stages in learning that are presented in a coherent and structured manner. Students must go through each stage in the learning media in accordance with the existing material arrangement. Integer material is presented in a very interesting way through *Smart board* learning media which has colors and shapes that suit students' preferences. Based on the results of the student response questionnaire, the results showed that the *Smart board*

learning media was very easy to use and could make learning more fun so that students could more easily understand the material in the media. The assessment that has been obtained is included in the practical category and can be implemented in the learning process.

The position of learning media has a considerable influence on the learning process. This is because learning media has the ability to stimulate students' interest in learning, present objects directly or replicas, make abstract things concrete, provide common perceptions, overcome barriers of time, place, number, distance and consistently restate information and provide a learning atmosphere. relaxed, and interesting, so as to achieve learning goals (Elpira & Ghufron, 2015). In accordance with previous research conducted by Arvianto & Widayati (2020) who developed *Smart board* learning media in different forms and materials, namely KPK and FPB in grade V SD. This study obtained an average result of 87.869 which is included in the feasibility category which is very feasible to use during the learning process in the classroom.

The development of *Smart board* learning media with the PMRI approach can help overcome problems in the learning process, especially in integer material. Students also become more active in the learning process because they can directly practice the material conveyed through the media. So that the *Smart board* learning media with the PMRI approach on integer material is feasible to use in the learning process.

CONCLUSION

Based on the series of research stages that have been carried out, the results show that *Smart board* learning media with the PMRI approach to integer material is included in the good media category because it can help students understand the material presented more easily and fun through activities carried out during the learning process with *Smart Board* assistance. This is based on the acquisition of a media expert validation score of 3.71. This score is in the range with very good classification and meets the minimal category of media that is said to be valid. Likewise the results of obtaining a student response questionnaire score of 3.68. This score is also in the range with very good classification and meets the minimum category of media that is said to be practical. Through the use of Smart board learning media, the obstacles experienced by students are reduced. Obstacles experienced by students in this case is the Didactical obstacle, namely the obstacles that occur come from the method or media used by the teacher in the learning process, because it is known that the media used so far is only print media. So that students' interest and interest in learning are felt to be lacking while participating in learning. Therefore, it is necessary to redevelop the use of learning media that is more interesting and innovative with appropriate methods in order to minimize other obstacles that may occur in the learning process.

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