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Digital Flipbook-Based Mathematics Teaching Materials using RME Approach to Improve Mathematical Problem-Solving Ability

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Abstract: Digital Flipbook-Based Mathematics Teaching Materials using RME Approach to Improve Mathematical Problem-Solving Ability. This research aims to determine the validity, practicality, and effectiveness of flipbook-based statistics teaching materials using realistic mathematics education (RME) approach in improving the mathematical problem-solving abilities of class XI AKL students at SMK N 1 Karanganyar. This research and development uses a 4D model. The assessment of the development of teaching materials is based on the validity and practicality aspects, while the assessment of mathematical problem-solving abilities is based on the effectiveness aspect. Data were collected through material expert and media expert validation sheets for validity aspects, teacher and student response questionnaires for practical elements, and experimental class and control class student answer sheets for effectiveness aspects. Material and media experts assessed the validity aspect, and experimental class students and teachers evaluated the practicality aspect. The effectiveness aspect was by looking at the average post-test score for the experimental and control classes via the t-test. The assessment results show that the teaching materials developed are valid, practical, and effective.

Keywords: teaching materials, realistic mathematics education, research and development

Abstrak: Bahan Ajar Matematika Berbasis Flipbook Digital Menggunakan Pendekatan RME untuk Meningkatkan Kemampuan Pemecahan Masalah Matematika. *Tujuan penelitian ini untuk mengetahui kevalidan, kepraktisan, dan keefektifan bahan ajar statistika berbasis flipbook menggunakan pendekatan realistic mathematics education (RME) untuk meningkatkan kemampuan pemecahan masalah matematis siswa kelas XI AKL SMK N 1 Karanganyar. Penelitian dan pengembangan ini menggunakan model 4D. Penilaian pengembangan bahan ajar berdasarkan aspek kevalidan dan aspek kepraktisan, sedangkan penilaian kemampuan pemecahan masalah matematis dengan aspek keefektifan. Pengambilan data melalui lembar validasi ahli materi dan ahli media untuk aspek kevalidan, angket respon guru dan siswa untuk aspek kepraktisan, sedangkan lembar jawab siswa kelas eksperimen dan kelas kontrol untuk aspek keefektifan. Aspek kevalidan dinilai oleh ahli materi dan ahli media, aspek kepraktisan dinilai siswa kelas eksperimen dan guru, lalu aspek keefektifan dengan melihat rerata nilai posttest kelas eksperimen dan kelas kontrol melalui uji t. Hasil penilaian menunjukkan bahan ajar yang dikembangkan valid, praktis, dan efektif.*

Kata kunci: *bahan ajar, pendidikan matematika realistik, penelitian dan pengembangan.*

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INTRODUCTION

The learning crisis is one of the effects of the Covid-19 pandemic on the educational system. To prevent this, the Ministry of Education and Culture is switching from the revised Curriculum 2013 to the Merdeka Curriculum. Teachers are free to select instructional resources in the Merdeka Curriculum that best match the requirements of their pupils. Aside from that, students have the most freedom to experiment, express their creativity, and advance their skills. However, several people have criticized this curricular revision. The change in curriculum was undertaken without adequate planning, which is the reason. Some educators still need clarification regarding the appropriate procedures, media, and evaluations.

Teachers must find references for the new material in the Merdeka Curriculum to share with their pupils. Creating instructional materials is one action that can be taken. Teaching resources help students develop their knowledge and ideas through real-world applications (Putri, 2019). In addition, according to Widodo and Jasmadi, teaching materials are a set of learning tools containing learning materials, methods, and evaluations arranged systematically and interestingly to achieve certain competencies (Lilis et al., 2019). Thus, teaching materials are non-printed materials that contain subject matter to support learning planning based on learning objectives.

Much consideration must go into the choice of instructional resources to support autonomous learning and enhance student performance. For this to happen, teaching materials must first grab students' attention. Flipbook-based instructional resources make learning engaging and dynamic for students, which boosts their motivation to study (Andini et al., 2018). A flipbook is a digital book that includes text, photos, audio, and video. Accordingly, books have recently changed from print to digital, making them more valuable and effective in operation (Azizah et al., 2020). UNESCO suggested in 2002 that technology be used in teaching and learning. Due to the abstract nature of mathematics, which makes it difficult for pupils to understand, technology-assisted learning materials are required (Nurwijayanti et al., 2019). An application called Flip PDF Corporate transforms PDF files into HTML or EPUB files that resemble flipbooks or digital books. The dancing appearance of teaching materials made with Flip PDF Corporate increases students' interest in what they are learning (Susanti et al., 2021).

One of the most essential and mandatory aspects of learning mathematics is the ability to solve mathematical problems (Anggraini & Fauzan, 2020). According to Soejadi, mathematical problem-solving ability is a skill that allows students to use mathematical activities to solve problems in mathematics, in other sciences, and everyday life (Masri & Layali, 2020). Indonesia's performance on the 2018 Program for International Student Assessment (PISA) test indicates that the country still has low mathematical problem-solving skills. The OECD estimates that 71% of Indonesian students fall short of minimal proficiency in mathematics, indicating that many students still struggle to solve problems using mathematical techniques. The National Council of Teachers of Mathematics (2000) highlights the importance of problem-solving, saying that it is part of mathematics; mathematics has applications; there is motivation in mathematics problems; problem-solving problems can be enjoyable; and teach students to develop problem-solving techniques (Annizar et al., 2020). According to Polya in Astutiani, Isnarto, & Hidayah (2019), there are additional steps in problem-solving that include comprehending the problem, planning for problem-solving, executing the plan for problem-

solving, and (4) verifying the outcomes of problem-solving. Sugeng, Anzainil, and Nuryanto (2020) stated that the RME method helps students think about mathematics in a more relatable way rather than an abstract one. Utilizing reality or everything in the student's surroundings is called RME learning (Rahman, 2017). The Realistic Mathematics Education (RME) approach, according to Anggraini and Fauzan (2020), is used to overcome weak problem-solving skills in mathematics. This is because issues with RME are conceivable and realistic issues that may exist. This agrees with Zakaria and Syamaun (2017), who claimed that applying the RME approach during learning improved student learning outcomes. The five traits of RME were formulated as follows by Treffers in Putri (2019): use of contextual or realistic problems in mathematics learning, students are directed to use models, schemes, and symbolization as a bridge from concrete to formal-level mathematical knowledge, the results of student contributions, namely, to direct them from informal to formal, are needed in rme learning, the importance of interaction between teachers and students to obtain formal forms of mathematics, and students use relevant formulas or theories to solve contextual problems

In actuality, though, this is at variance with what the researchers at SMK N 1 Karanganyar observed and learned from their observations and interviews. Researchers discovered that SMK N 1 Karanganyar's instruction was still teacher-centered and that students' responses were less positive based on their observations. Aside from that, pupils are less excited about learning when there are insufficient teaching resources and teachers utilizing technology. Researchers discovered that teachers struggled to locate references for developing lesson plans on new material based on the findings of their interviews. Instructors are limited to creating formula summaries, model questions and discussions, and standalone exercises in PDF format. The created independent exercises keep little distinction from the sample questions. As a result, students tend to commit standard formulas and techniques to memory. Students acknowledge having trouble answering the questions when altered from the sample questions in their independent practice. In addition, pupils find the instructional materials less engaging and boring. Learners prefer instructional resources, such as images, audio, or video, that can be accessed anytime and anywhere.

This study differs from earlier studies in that new content from the Merdeka Curriculum, not included in the 2013 Curriculum's revised edition, was used to create the instructional materials. Statistics is the new subject, with sub-chapters on scatter diagrams and basic linear regression. This instructional resource presents real-world problems using the RME. The difference between the flipbook developed by researchers and other flipbooks lies in the aspect of student abilities that will be improved and the content of the learning materials using RME. Flipbook, which the researchers developed, focuses on enhancing mathematical problem-solving abilities. Therefore, based on the background that has been described previously. This research was conducted to determine the Flipbook's validity, practicality, and effectiveness based on Realistic Mathematic Education (RME) to improve vocational students' mathematical problem-solving ability. Aside from that, Polya's method for solving mathematical puzzles is followed in the solution steps of this instructional material. It is believed that doing this will help students become more adept at solving mathematical puzzles. Mathematical problem-solving aspects used in this research are understanding the problem, devising a plan, carrying out the plan, and looking back.

METHODS

The type of research that researchers use in this research is development research. The method used is research and development (R & D). This research will apply the analysis to develop a learning design using the 4D approach. The population in this study were all eleven-grade students at SMKN 1 Karanganyar (vocational school). The research sample was taken based on the cluster random sampling technique; therefore, the validity, practicality, and randomly selected class were class XI AKN 1 as the experimental class and class XI 2 AKN 2 as the control class. This research procedure refers to the 4D development model as follows. Define: defining user needs such as materials, learning objectives, and need for teaching materials, Design: designing an initial product (prototype) to improve existing products based on defined findings, Development: Product development includes expert assessment and development testing. Material experts and media experts carry out expert assessments to assess product validity. Development tests to determine the practicality and effectiveness of the product. Practicality can be seen from the responses of teachers and students after using the product. In contrast, effectiveness can be seen from experimental and control class students' final ability test scores, Disseminate: disseminating products after being declared valid, practical, and effective.

The technique for analyzing the validity and practicality of teaching materials uses assessment score guidelines in a Likert scale with four scales shown in Table 1.

The assessment results are then converted into qualitative values using the score calculation guidelines according to Widoyoko in Afifi (2021) as Table 2. Teaching materials are considered valid or practical if they meet the minimum criteria of "Good."

Table 1. Guidelines for score assessment of the validity of teaching materials

Criteria	Score
Excellent	4
Good	3
Enough	2
Bad	1

Table 2. Four scale score conversion

Interval Score	Criteria
$3.25 < M \leq 4.00$	Excellent
$2.50 < M \leq 3.25$	Good
$1.75 < M \leq 2.50$	Enough
$0.00 < M \leq 1.75$	Bad

Note : M is Average score on the aspect assessed

RESULTS AND DISCUSSION

Define

Researchers now know the industry's issues and requirements related to learning media. The observations and interviews at SMK N 1 Karanganyar revealed that teachers were having trouble locating resources for students to learn from because the content was new, so they were limited to using government textbooks for their education. Most textbooks include conclusions that are thought to be less relevant to the characteristics of students. Consequently, the

instructor produced instructional materials in PDF format that included formulas, sample questions, and solo tasks. Due to students' lack of positive responses, learning still occurs through direct methods. This is believed to result from students learning online during the pandemic, including absenteeism from parents or teachers, signal issues, the environment they are studying, motivation, etc.

According to student interviews, students felt less engaged and bored with teaching materials that included much writing. Pupils prefer educational resources that can be accessed at any time and from any location, such as those that incorporate images, audio, or video. Aside from that, students continue to commit to memorizing the approach provided by their teacher while working on questions. If the solution for the problem differs slightly from the solution for the problem in the example, students still struggle.

Since SMK N 1 Karanganyar uses the Merdeka Curriculum for class XI, it is required to include a profile to strengthen Pancasila in each lesson, according to the curriculum analysis. The instructional materials for material analysis cover statistical topics and include sub-chapters on scatter plots and basic linear regression. The steps involved in solving a mathematical problem are as follows: comprehending the issue, creating a plan for solving it, carrying it out, and double-checking the solution.

Design

Researchers are currently designing instructional materials that will be created as upgrades to currently available instructional materials. Before that, scientists need to create test tools to evaluate the efficacy of instructional resources. There are three description questions on each of the pretest and posttest questions on the test sheet. To obtain improvements, the test instrument must be validated by a validator. The test instrument must first be tested to ascertain the variation in power, degree of difficulty, and dependability after revision. Question items have good discriminating power if the discriminating power index is r_{xy} e" 0,30. The result indicated that items have good differentiating power with index 0.76-0.81 for pretest and 0.71-0.84 for posttest. Moreover, Items have a good difficulty level if the index is 0,30 d" P d" 0,70. Question items have good level of difficulty with index 0.55-0.59 for pretest and 0.56-0.63 for posttest. Items are reliable if they have a reliability coefficient e" 0.70. the pretest and posttest are fairly reliable with Cronbach alpha coefficient 0.75 for pretest and 0,72 for posttest.

The Flip PDF Corporate application created the instructional materials, and the results were links. Students can use AppGeyser online to turn it into an application they can download and install offline on their Android smartphone or access it online. The Ministry of National Education (2008) discusses the methodical preparation of instructional materials, which are divided into three sections: an introduction, a content section, and a conclusion. The following is a display of the teaching materials developed as shown in Figure 1, Figure 2, and Figure 3.

Development

After creating an initial design, the instructional materials undergo expert evaluation and development testing. Expert evaluation occurs when media and content experts evaluate the reliability of instructional materials. The validity assessment comprises a qualitative evaluation of expert suggestions and comments and a quantitative evaluation of a validation sheet score. Up until reliable teaching materials are acquired for use in the field, improvements to the materials are made. Two lecturers from Sebelas Maret University's Faculty of Teacher Training and

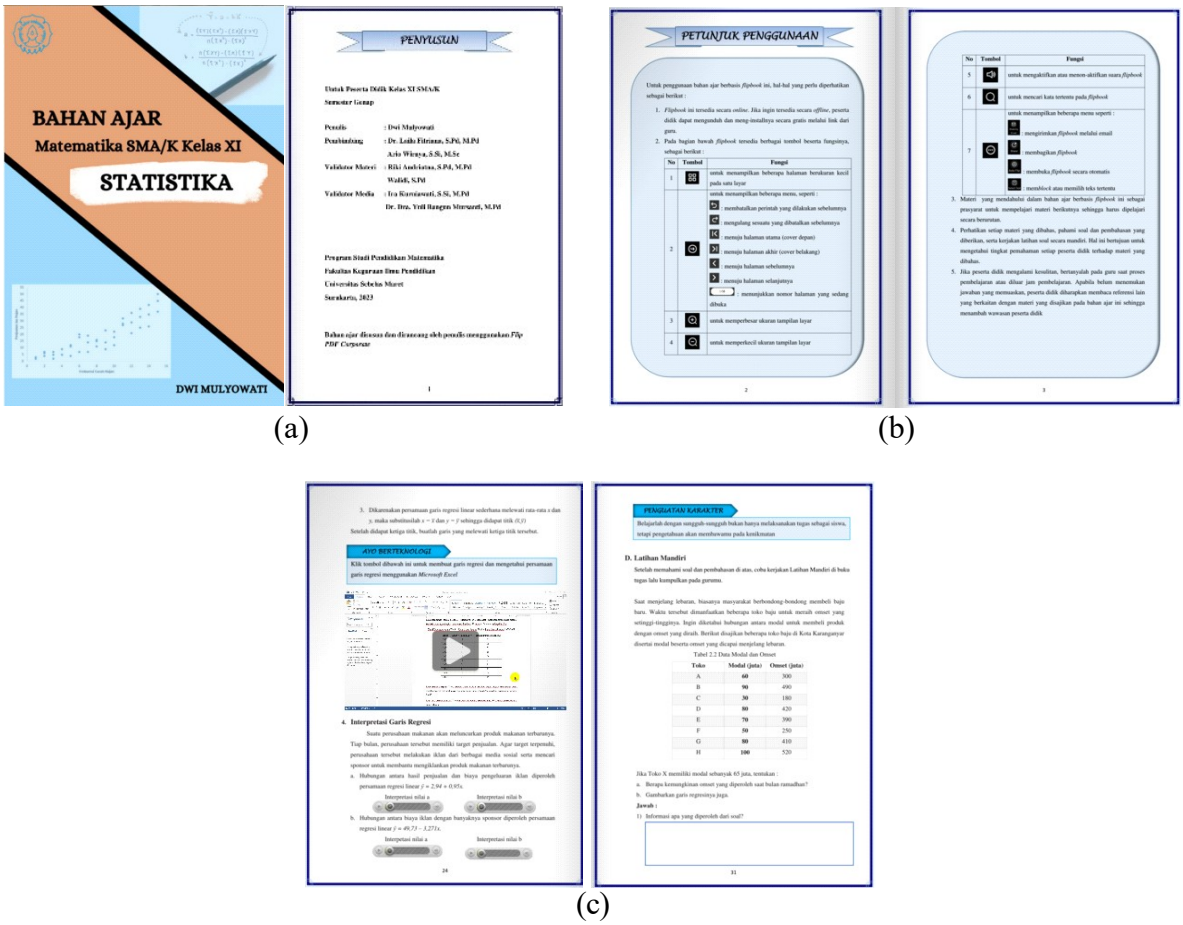

Figure 1. (a) front cover and organizer, (b) instructions for use, (c) videos, character strengthening, and independent practice

Education's Bachelor of Mathematics Education Study Program served as the research's media experts. One lecturer from Sebelas Maret University's Faculty of Teacher Training and Education's Bachelor of Mathematics Education Study Program and one mathematics teacher from class XI AKL SMK N 1 Karanganyar are the research material experts. The evaluation results of media experts are 3.25 for graphic display, 3.25 for use and 3.2 for presentation which are in good criteria. Moreover, the evaluation results of content experts are 3.43 for relevance, 3.5 for accuracy, 3.25 for didactics, and 3.5 for quality. The results indicated that the teaching materials are valid in terms of media and material.

The practicality assessment was conducted by distributing practicality questionnaires to users, namely class XI AKL mathematics teachers and experimental class students. The practicality assessment consists of a quantitative assessment in the form of a practicality questionnaire score and a qualitative assessment of user suggestions and comments. The quantitative assessment results of teachers' practicality are 3.86 for learning, 3.3 for media quality, 3.75 for media display, and 4 for media functions which are in excellent criteria. Moreover, assessment results of students' practicality are 3.86 for learning, 3.79 for media quality, 3.75 for media display, and 3.8 for media functions. Furthermore, it indicated that

practicality of teaching materials is excellent for use in mathematics learning.

Testing product effectiveness refers to the posttest scores of the experimental and control groups. The experimental class is a class that uses developed teaching materials, while the control class uses textbooks from the government during learning. Before the effectiveness test, a mean balance test was carried out to determine the initial conditions of the two classes with pretest scores through the t-test. Before the two tests are carried out, prerequisite tests are needed, namely normality and homogeneity tests with a significance level of 5%. After calculations, the pretest and posttest values were obtained from a normally distributed population. The pretest scores for the experimental class and control class, as well as the posttest scores for the experimental class and control class, were also homogeneous. Therefore, it can be concluded that the conditions for conducting the paired t-test or effectiveness test used SPSS to ensure the accuracy of calculating the effectiveness test. Descriptive analysis informed that the average pre-test value in the experimental class before using the Flipbook was 60.64, with a standard deviation of 14.29. Meanwhile, the average post-test score for the experimental class or after students learn using the Flipbook is 69.35, with a standard deviation of 13.40. Paired sample t-test showed fairly significant mean difference between two groups ($p < 0.05$). mean score of posttest for the experimental group is better than control class. Thus, the teaching materials developed can effectively improve students' mathematical problem-solving abilities.

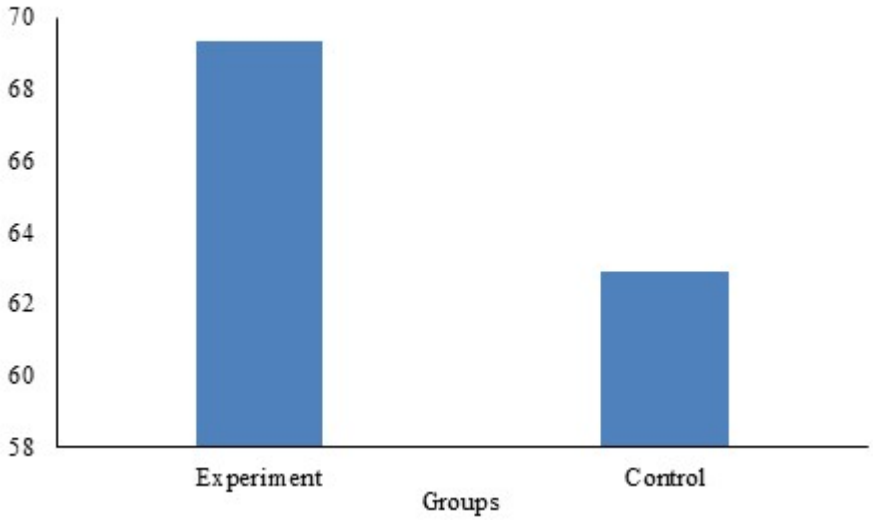

Figure 4. Post-test scores of experiment class and control class

Disseminate

After the teaching materials have been tested and revised, they are disseminated and promoted so that many users can accept and use them. In this research, product dissemination was carried out among mathematics teachers and class XI students at SMK N 1 Karanganyar.

■ CONCLUSIONS

Based on the research results, it can be concluded that flipbook-based RME statistics teaching materials are valid, practical, and effective. The assessment of the validity of the material and media aspects meets the very valid criteria. Practicality assessments from teachers

and students also meet the excellent criteria. Based on this, flipbook-based RME statistics teaching materials can be used in mathematics learning. Researchers provide suggestions for teachers to be able to create separate flipbook-based teaching materials with other materials. The creation process is not complicated, even though it is made through an application. This research tests students' mathematical problem-solving abilities so that other researchers can test other abilities. It is hoped that the products resulting from this research and development can be used and disseminated more widely and that the material used will not be limited to statistical material.

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