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Handout Design of Scientific-Based Mathematics and Inquiry Strategies

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ABSTRACT

Purpose of the study: This study aimed to produce scientifically based mathematics handout products and inquiry strategies on opportunity material in class seven which is valid according to experts, and to determine the effectiveness of the learning process.

Methodology: This type of research is design and development research using the ADDIE development model (Analysis, Design, Development, Implementation, Evaluation). The instruments used in this study were: (1) validation sheets for material experts; (2) validation sheets for handout design experts, both of which are used to assess the feasibility of teaching materials; (3) teacher response sheet; (4) student response sheets, these sheets are used to assess the validity of teaching materials; (5) student observation sheets about student activity, used to see student activity; and (6) post-test question sheets, used to see the effectiveness of the learning process.

Main Findings: From the analysis carried out on the final test of opportunity material, the average post-test score was 93.3 with a percentage of student completeness of 82.5%, and the results of observations of student activity in learning were 73.32% in the "good" category. The study results show that the learning process using scientific-based mathematics handouts and inquiry strategies runs effectively.

Novelty/Originality of this study: The latest update in this research is to develop a scientifically based mathematics handout and an inquiry strategy on probability material. There has been no research on developing scientifically based mathematics handouts and inquiry strategies on opportunities. Therefore, this study complements previous research.

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1. INTRODUCTION

Learning is a process that is deliberately designed to create learning activities within the individual [1]–[3]. In other words, learning is something that is external and deliberately designed to support the internal learning process within the individual. Of the many fields of study in education, one of the sciences that needs to be developed is mathematics. Mathematics is one of the subjects at every level of formal education that plays an important role [4]. Mathematics subjects are taught at every level of education in Indonesia, starting from elementary school, junior high school to senior high school. This is because mathematics is an important science as an introduction and basis of other sciences [5]. To increase students' understanding of mathematics, many efforts have been made, including improving the curriculum, developing methods for learning mathematics and developing teaching materials.

Suggestions for developing teaching materials are listed in Peraturan Pemerintah dan Permendiknas, yakni dalam PP nomor 19 tahun 2005 pasal 20, implied that teachers are expected to develop learning materials,

which are then emphasized through Peraturan Menteri Pendidikan Nasional (Permendiknas) nomor 41 tahun 2007 regarding process standards, which among other things regulate the planning of the learning process which requires educators in educational units to develop Learning Implementation Plans (RPP). One of the elements in lesson plans is learning resources. Thus, teachers are expected to develop teaching materials as a source of learning.

One type of teaching material commonly used in the learning process is printed teaching materials. One example of printed teaching materials commonly used is handouts. Handouts are teaching materials that originate from several literatures that are relevant to the basic competencies and subject matter taught to students [6], [7]. This teaching material is given to students to make it easier for them to follow the learning process. Handouts can contain explanations of a material, explain links between topics, ask questions and activities to readers, and can also provide feedback and follow-up steps [8].

In the learning process to achieve learning objectives cannot be separated from approaches, strategies and learning methods. The 2013 curriculum emphasizes modern pedagogic dimensions in learning, namely using a scientific approach [9], [10]. The scientific approach (scientific approach) in learning as intended includes observing, asking, trying, processing, presenting, and concluding [11], [12]. In the world of education, strategy is defined as a plan that contains a series of activities designed to achieve certain educational goals. It can be concluded that learning strategies are very important in the learning process. Therefore the author tries to implement an inquiry learning strategy as outlined in a mathematics handout. Inquiry strategy is a strategy that requires students to find something and know how to solve problems in a scientific research. The main objective is to develop students' attitudes and skills that enable them to become independent problem solvers [13], [14].

As with the subject matter of mathematics, namely opportunity. Opportunity material is studied in class VII even semester junior high school in accordance with the 2013 curriculum. It is not uncommon for students to be confused in determining the concept of opportunity that they should use in solving everyday problems. This is because students do not understand the material or the concept of opportunity.

2. RESEARCH METHOD

This research is a development research with the ADDIE development model. The stages of the ADDIE development model are analysis, design, development, implementation, and evaluation. At the analysis stage, curriculum analysis and student characteristics were analyzed. The curriculum analysis stage is useful for knowing the curriculum used in schools, knowing competency standards and basic competencies, and knowing what materials exist in mathematics lessons that can be used as material for making mathematics learning tools in the form of scientific-based handouts and inquiry strategies. While the analysis of student characteristics aims to find out how the characteristics of students and know the initial knowledge of students. Because the product to be made is for seventh grade students so it analyzes the characteristics of students in seventh grade. This can be done by asking class teachers who are experienced in teaching these students, for example by asking the students' character and asking about students' math scores.

After the next analysis is done is the design stage. At this stage, the design of teaching materials in the form of handouts will be carried out. The design of scientific-based mathematics handouts and inquiry strategies in mathematics includes several aspects, namely handout design, validation by a team of experts, and design revisions.

At the development stage, individual trials, small group trials, large group trials, and product revisions were carried out. Individual trials were carried out to obtain initial input about learning media. The individual test subject is one teacher who is experienced and competent in his field. In individual trials a questionnaire was used to obtain initial input on the media, where the data obtained was qualitative data [15]–[18]. After being revised based on one-to-one evaluation input, the next step in research and development is to conduct small group trials. The purpose of this pilot is to see the effectiveness of the handout. Suggestions from small group test subjects were used to improve the handout before being tested on large groups. This trial involved the subject of one class of students. The questionnaire used was a closed questionnaire and a post-test was also carried out. The questionnaire given was in the form of a closed questionnaire but students were asked to comment freely about the teaching material in the form of this handout. This aims to make it easier for researchers to revise the handout.

Product revision needs to be done for several reasons, namely: a) the trials carried out are still limited, so they do not reflect the actual situation and conditions, b) in the trials found weaknesses and deficiencies in the products being developed, and c) data to revise the product can be captured through product users or those who are targeted for product use. So in this case, product revisions are carried out if during product trials weaknesses are found in the handouts with opportunity materials. Furthermore, these weaknesses are reduced by improving the handout design.

At the implementation stage, the product developed will be implemented in real situations. Products in the form of scientific-based mathematics handouts and inquiry strategies are implemented in real class. In this

test, researchers conducted field trials in one class in seventh grade junior high 11 Jambi City. Meanwhile, the evaluation stage is carried out at the end of each research and development stage starting from the cover design, content design, product creation, design validation, revision, so that at the evaluation stage a final product will be produced. The final product is in the form of scientifically based mathematics handouts and inquiry strategies.

The primary data in this study were content validation data and handout designs from experts, observation data and student post-test results. Secondary data in this study was in the form of data obtained from the school regarding the number of students as research subjects and student grades. The research instruments used in this study were questionnaires and post-test questions. The data analysis technique used in this research is a development technique according to the ADDIE development steps with descriptive statistics to know the presentation of student grades. Descriptive statistics are methods related to the collection and presentation of a set of data so as to provide useful information [19]–[21].

3. RESULTS AND DISCUSSION

The results of this study are a scientific-based mathematics handout and inquiry strategy on opportunity material in seventh grade junior high school 11 Jambi City. The results of this study are as follows.

Material Validation and Handout Design

In validating this material, the researcher chose two experts. The material validation component is divided into seven parts, namely content accuracy, content coverage accuracy, handout digestibility, language use, facial expressions, handout illustrations, component completeness. As for the assessment category to see the feasibility of material validation in terms of design validation, it can be seen from the following table:

Table 1. Rating Category

Interval	Category
$1.00 \leq N \leq 1.79$	Very Bad
$1.80 \leq N \leq 2.59$	Bad
$2.60 \leq N \leq 3.39$	Netral
$4.20 \leq N \leq 5.00$	Good
$4.20 \leq N \leq 5.00$	Very Good

With the information that N = total minimum score. From the classification above, the results of the assessment are obtained based on the average validation score, which is 3.33. So the results of the assessment of the handout material as a whole are valid and included in the category $2.69 \leq N \leq 3.39$: with "moderate" quality.

And for product design validation based on a scientific approach and inquiry strategy, obtaining a total rating score from the validator is 35 with the highest number being 50, it can be obtained that the percentage score for the validator's assessment of the media handout design is 3.6. So, the results of the assessment fall into the category of $3.40 \leq N \leq 4.19$: "good".

Product Trials

Based on the mathematics teacher's responses, it was found that the number of answers from the two validators who chose the appropriate answer was 19, so the percentage of answers (PJ) was 100%. So, the results of the assessment fall into the category $80 < PJ \leq 100$: "Very Good". So it can be concluded that the mathematics teacher's responses regarding scientific-based handouts and inquiry strategies can be said to be good and interesting. There were comments and suggestions from the teacher, namely that before starting the opportunity material it should be given statistical prerequisite material. Based on small group trials it was found that the number of answers from the five students who chose the appropriate answer was 45, then the percentage of answers (PJ) was 100%. So, the results of the assessment fall into the 51-100% category: "Very suitable".

So it can be concluded that student responses regarding the scientific-based handout and inquiry strategy can be said to be good and interesting. Based on the large group tryout, it was found that the number of answers from sevent grade students who chose the appropriate answer was 294, so the percentage of answers (PJ) was 96%. So, the results of the assessment fall into the 51-100% category: "Very appropriate." It can be concluded that the students' responses to the scientific-based mathematics handout and inquiry strategies can be said to be good and interesting. There are no comments on this handout, only suggestions given about the handout.

Student Learning Outcomes Test (Post-test)

Students who complete, that is, have scores above the Minimum Completeness Criteria, are 33 students complete, and 7 students have not yet completed. Judging from the percentage of class students who complete reached 82.5%. From this percentage it can be said that the handout is very good.

After going through the development process, the stages of which included: first, the researcher designed a scientific and inquiry-based handout in mathematics, especially the opportunity material. The design of this handout refers to the components of scientific learning, namely (1) observing, (2) asking, (3) reasoning, (4) trying, (5) concluding. In discussing the overall opportunity material in the handout students can understand more easily because the way students think has been directed to the description of the material that is done using the components of a scientific approach, the tasks and work steps are presented in the form of an inquiry. This handout is equipped with basic competencies and competency achievement indicators that have been mentioned in the introduction to the handout. Then at the end of the handout questions have also been prepared covering the entire material discussed.

After finishing designing the handouts, then the handouts are validated by material experts and learning media design experts. The average results of material validation are included in the category of $2.69 \leq N \leq 3.39$ "moderate" with an average score of 3.33 and validation of learning media design in the category of $3.40 \leq N \leq 4.19$ "good" with an average score 3,5.

After the design and material for the handouts were revised, the researchers conducted a product trial in a small group consisting of 1 math teacher and 5 students. Trials can be carried out in limited groups. After testing the handout product on the teacher, the results of the assessment were included in the category $80 < PJ \leq 100$: "Very good" with a percentage of the teacher's answers being 100%. For trials on students, an assessment is in the 51-100% category: "Very suitable" with the percentage of answers to product trials in small groups being 100%. After the design and material for the handouts were revised, the researchers conducted a large group trial in seventh grade B, junior high school 11 Jambi City with a total of 34 students. The teaching and learning activities were carried out in four meetings. After completion, students are given a post-test to see student learning outcomes. The average student learning outcomes in the large group trials reached 79.4% with 7 students who had not completed and 27 students who had completed. The KKM used was 70 and obtained an assessment of student responses in product trials in large groups in the 51-100% category "Very appropriate" with the percentage of answers to product trial responses in large groups being 96%.

A teaching material media is said to be effective if the handout meets the indicators of student learning outcomes that have achieved completeness and there is a positive student response as shown from the questionnaire given during the trial use.

The handout that was declared valid was then tried out in the implementation class, namely seventh grade B of junior high school 11 Jambi City with a total of 40 students. The trial was conducted in four meetings according to the time allocation available in the 2013 curriculum syllabus. During the learning process, the writer was assisted by the teacher in the field of mathematics in observing student activities. The mathematics subject teacher gives an assessment of student activity with an average rating of 73.32%, thus student activity is categorized as "good or active". After the teaching and learning process is complete, a post-test is given to see student learning outcomes. The post-test was attended by all students who were the subject of implementation. Based on the results of the post-test, students who passed with a percentage of 82.5% achieved the class completeness requirement, namely 75% of students achieved the minimum score. The test results show that handouts have a good impact on students' ability to understand concepts.

Based on the research shows that the development of scientific-based mathematics handouts and inquiry strategies is very necessary. So this research is also a scientific-based mathematics handout and inquiry strategy by presenting the updates offered. The latest update in this research is to develop scientific-based mathematics handouts and inquiry strategies on opportunities in seventh grade junior high school 11 Jambi City. There has been no research on the development of scientifically based mathematics handouts and inquiry strategies on opportunities. Therefore, this study complements previous research.

This research is expected to be used as a mathematics learning tool that can assist teachers in a lesson. Not only used in opportunity material, the researcher provides recommendations for further research in order to be able to use or even develop scientific-based mathematics handouts and inquiry strategies that can be used in other materials or even in other subjects.

4. CONCLUSION

This research has produced a product in the form of scientific-based mathematics handouts and inquiry strategies on opportunity material in seventh grade junior high schools. The learning outcomes of students in seventh grade junior high school 11 Jambi City who participated in teaching and learning activities using scientific-based mathematics handouts and inquiry strategies on opportunity material obtained an average score of 78.7 with the highest score of 93.3 and the lowest score of 53.3. The percentage of students who complete according to the minimum score is 82.5%. The level of student learning activity is 73.32% in the "good or active" category. The results of student responses to the handouts included in the $80 \leq PJ \leq 100$ interval with the "very good" category. Based on the above data, the scientific-based mathematics handout and inquiry strategy on

opportunity material in seventh grade junior high schools are effective for use. So, this handout can help students understand concepts and solve problems related to opportunity material.

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