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DEVELOPMENT MODULE BASED ON REALISTIC MATHEMATICS EDUCATION ON STUDENT'S MATHEMATIC CONNECTION SKILLS

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Abstract

This study aims to produce a mathematics learning module based on Realistic Mathematical Education (RME) that meets the aspects of validity and practicality and effectively improves students' mathematical connection skills. This study uses a 4D development model that has been modified into three stages; define, design, and develop. The trial was conducted at SMP Negeri 1 Cilongok with 11 students in class VIII E. The results showed that the developed mathematics learning module was valid by obtaining an average score of 4.3. The teacher's response showed an average score of 4.2 and 3,9 which means that the practical mathematics module is used in the teaching and learning process. The results of the effectiveness are carried out through the results of the pretest and posttest. The test was carried out through the N-Gain trial and obtained an average score of 0.5731, which was interpreted as average.

Keywords: *Module, Mathematical Connection Skills, Realistic Mathematics Education (RME)*

INTRODUCTION

The module has a role as one of the measuring points of ability given by educators who have arranged for students, wherein the formulation that is set in the learning module there is an implementation that can be measured in real through the exercises contained in it so that educators get feedback directly from the learning process and objectives implemented (Daryanto, 2013).

Previous research is related to the development of modules as teaching materials that are valid, practical, and effective. The study of (Istikomah & Purwoko, 2020) resulted that the development of the created module showed a media expert validity score of 3.41 while the RME expert was 3.00, and, the material expert showed a validity score of 69, the practical aspect showed an average score of 83% and the effectiveness aspect was 90 %. Research (Faidah et al., 2019) showed that the created module's development showed a media expert validity score of 80%, material experts showed the validity of 84%, the practical aspect showed an average score of 79%, and the effectiveness aspect was 88%. According to (Putri et al., 2020) it resulted that the development of the created module showed a validity score of 93.00% from media experts and material experts, the practicality aspect was 88.67% in the limited test, and 77.67% in the field test and the effectiveness aspect showed an average score respectively 98.00 and 90.00.

From previous studies related to modules, few researchers have developed modules based on Realistic Mathematics Education (RME) at the Junior High School level. Mathematics education in Indonesia has characteristics: problems that are used contextually, models or bridges that use vertical instruments, student contributions, interactivity, and integration with other learning topics (Zulkardi &

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Ilma, 2010). As a means of support in the learning process in schools, some still use learning facilities such as modules.

Development of modules based on Realistic Mathematical Education (RME) to make it easier for students to understand the connection between mathematics and everyday life. It is hoped that with the Realistic Mathematics Education (RME) approach, students will be more active, creative, and innovative. Submission of material using the Realistic Mathematical Education (RME) approach will be more effectively applied to the 2013 curriculum. Students must be able to connect or connect two different concepts in solving a given problem.

(National Council of Teachers of Mathematics, 2000) suggests that connections are one of five standard processes that are very important in increasing student knowledge. Students need to understand the relationship between mathematical concepts and other concepts (Hendriana et al., 2014). The ability to relate mathematical concepts externally is called mathematical connection ability (Romli, 2016). From these statements, it can be concluded that students' mathematical connection skills are the ability to connect mathematical concepts with concepts in other disciplines that are important in knowledge.

Based on the explanation above, it is necessary to create and develop learning facilities that can be interesting and not boring for learning mathematics, to create a learning atmosphere that can involve students actively thinking and discovering, namely in the form of a Mathematics module ((Depdiknas, 2008). Modules based on Realistic Mathematics Education (RME) can develop students' mathematical connections in the material for presenting data for class VIII Junior High School (SMP). This research aims to produce a mathematics learning module based on Realistic Mathematics Education (RME) that meets the criteria of being valid, practical, and effective in improving students' mathematical connection skills.

METHOD

The type of research used is Research and Development (R&D). A kind of research that produces a particular product and tests the practicality of that product. The development model used is a 4-D development model, consisting of the define, design, development, and disseminate stages (Saputra et al., 2018). The research location that has been carried out for research is SMP Negeri 1 Cilongok. The research subjects involved were class VIII students. The study was carried out in the Odd semester of 2021/2022. The types of data collected include qualitative and quantitative. Quantitative data is obtained from the validator's assessment questionnaire score, educators, and students. The qualitative data are in the form of criticism and suggestions from material experts, media, teacher response questionnaires, and student questionnaires on product development. Data collection techniques include observation, validation sheets, teacher and student response questionnaires, and mathematical connection ability tests. Technical data analysis consists of 3 aspects: validity, practicality, and effectiveness analysis. Table 1 below describes the criteria for the validity score (Widoyoko, 2009).

Table 1. Criteria for Interpretation of Validity

Score	Categories
$4{,}00 < \bar{x} \leq 5{,}00$	Very Valid
$3{,}00 < \bar{x} \leq 4{,}00$	Valid
$2{,}00 < \bar{x} \leq 3{,}00$	Enough Valid
$1{,}00 < \bar{x} \leq 2{,}00$	Invalid
$0 \leq \bar{x} \leq 1{,}00$	Very Invalid

Table 2 further explains the practicality criteria (Widoyoko, 2009).

Table 2. Practical Interpretation Criteria

Penilaian	Kategori
$4{,}00 < \bar{x} \leq 5{,}00$	Sangat Praktis
$3{,}00 < \bar{x} \leq 4{,}00$	Praktis
$2{,}00 < \bar{x} \leq 3{,}00$	Cukup Praktis
$1{,}00 < \bar{x} \leq 2{,}00$	Tidak Praktis
$0 \leq \bar{x} \leq 1{,}00$	Sangat Tidak Praktis

The module is said to be effective for N-Gain analysis if the results show a medium or high category. Table 3 (Hake, 2002) describes these criteria.

Table 3. Classification of N-Gain

Gain Value	Interpretations
$g \geq 0{,}7$	High
$0.3 \leq g \geq 0{,}7$	Moderate
$0 \leq g \geq 0{,}3$	Low

RESULTS AND DISCUSSION

In this section, each stage of 4-D development will be discussed.

Defining Stage

The definition stage consists of front-end analysis, learner analysis, task analysis, concept analysis, and specifying instructional objectives. Learning is carried out online based on the conditions and situations during the Covid-19 pandemic. The results of initial observations of students are less

confident in expressing their opinions, do not understand the material, and students are still challenged to solve math problems related to real life. The questions are also less contextual, so they do not attract students' attention. In line with (Puspita et al., 2016), student learning outcomes can be improved using contextual-based teaching materials. In addition, the learning tools used today are still less attractive for online learning activities, still limited to power points.

Planning Stage

At the design stage, the researchers did several things, namely analyzing the test preparation, media selection, format selection, and initial design. The initial design made by, among others, cover, foreword, motivational words, table of contents, introduction, instructions for using the model, learning objectives, to the author's biodata.

Development Stage

This stage produces a mathematics module based on Realistic Mathematics Education (RME) with data presentation material. Development is the stage of assessing the validity of the module by experts, namely material experts and media experts. The purpose of validation is to get input regarding the modules that have been developed. In addition to getting information, validation also determines the feasibility of a mathematics module based on Realistic Mathematics Education (RME) to be used in learning. The validation results are presented in Table 4 below.

Table 4. Material Expert Validation Results

Validator	Aspect			Average	Categories
	Content Eligibility	RME based Module Compability	Module Systematics		
1	38	41	71	4,3	Very Valid
2	37	40	69	4,1	Very Valid

Table 4 above shows that the module made meets the excellent aspects. After the product design was validated through the assessment of material experts and media experts, the researcher revised the product design developed based on input from these experts. Next, the results of the media expert validation are presented.

Table 5. Media Expert Validation Results

Validator	Aspect			Average	Categories
	Module Size	Module Design	Skin Module Design Content		
1	3	18	44	4,3	Very Valid
2	3	19	45	4,4	Very Valid

Table 5 above shows that the module made meets the very valid aspects. After the product design was validated through the assessment of material experts and media experts, the researcher revised the product design developed based on input from these experts.

Trial Stage

After making revisions from the material and media expert validators, the researcher conducted a trial of the module product on the seventh-grade math teacher related to the practicality test and on students with a limited test to determine the effectiveness of the module. Before being tested on students, the module is given to the mathematics teacher first to assess practicality. With the results of the assessments from the mathematics teachers for grades VII and VIII, the average scores were 4.2 and 3.9, categorized as very practical and practical. The developed mathematics module is already practical to be used in learning activities.

The module developed is declared valid by the validator and then tested on 11 students of SMP Negeri 1 Cilongok class VIIIE online. Before the module is given, students first work on pre-test questions as an initial value in understanding the material in the data presented. After providing the pre-test questions, the module is given to students as a soft file. Students are given three days to study the module. Next, students were given post-test questions to determine the improvement of students mathematical connection skills in data presentation material. There are three questions for pre-test and post-test. The test results were analyzed using the gain normality test (N-Gain). The following are the results of the pre-test, post-test, and N-Gain scores.

Table 6. Values of Pretest, Posttest, and N-Gain

Descriptives

			Statistic	Std. Error
NGain_Score	Mean		.5731	.07643
	95% Confidence Interval for Mean	Lower Bound	.4028	
		Upper Bound	.7434	
	5% Trimmed Mean		.5767	
	Median		.4815	
	Variance		.064	
	Std. Deviation		.25349	
	Minimum		.18	
	Maximum		.90	
	Range		.72	
	Interquartile Range		.49	
	Skewness		.127	.661
	Kurtosis		-1.531	1.279

(Source: output SPSS 16.0)

Based on Table 6, the average N-Gain is 0.5731. This value is included in the “Medium”

category. These results interpret that students' mathematical connection skills using modules based on Realistic Mathematics Education (RME) have increased. After an online trial, the product is said to be valid, practical, and effective, so there is no need to re-test the product. The module can be used as a learning resource for junior high school students and teachers on data presentation material for class VII.

The results of this study state that the Mathematics module is valid for learning mathematics in data presentation material. Mathematics lecturers validated this module at the University of Muhammadiyah Purwokerto, material experts, and media experts. Based on research by material experts, they get a total of 150 out of a total score of 175 or produce an average of 4.3, so it is categorized as very valid, and media experts for a total of 65 out of a score of 75 or get an average of 4.3, so it is classified as very valid. They were referring to (Widoyoko, 2009), where this product is categorized as "very valid" if the overall average results get an average value of "$4.00< x < 5.00$". It can be concluded that the RME-based mathematics module in this data presentation material is categorized as "very valid" for use in the learning process. In line with the thinking (Laurens et al., 2017) that the Realistic Mathematics Education (RME) approach can develop students' mathematical cognitive aspects, including, in this case, the ability of mathematical connections.

The responses of grade VII and VIII mathematics teachers at SMP Negeri 1 Cilongok got a total of 42 out of a total score of 50 or an average of 4.2, so it is categorized as very practical. The results of the second teacher questionnaire get a total of 39 out of a score of 50 or produce an average of 3.9, so it is categorized as practical. Furthermore, it refers to (Widoyoko, 2009), where this product is classified as “Practical” if the overall average results get an average value of “$3.00 < x < 4.00$”. It can be concluded that the RME-based mathematics module in this data presentation material is categorized as "practical" to be used in the learning process. RME in learning helps students understand mathematical concepts in depth to solve problems (Indriani & Julie, 2017).

Based on the results of validity and practicality, the last step is to test the effectiveness. This aims to determine whether the RME-based module can improve students' mathematical connection skills or not. Based on trials conducted on 11 class VIIIE students of SMP Negeri 1 Cilongok on the mathematical connection ability of students in N-Gain calculations of 0.5731 with an interpretation of moderate increase. Furthermore, it refers to (Hake, 2002), where this product is interpreted as "medium" if the results of the N-Gain test get an average of "$0.3\leq g < 0.7$". It can be concluded that the mathematics learning module based on Realistic Mathematics Education (RME) effectively improves students' mathematical connection skills before and after using the module. Thus, the module can be used in learning and as an alternative to enhancing mathematical connection skills.

CONCLUSION

Based on the results of the research and discussion described, it can be concluded that the mathematics learning module based on Realistic Mathematics Education (RME) meets the valid, practical, and effective criteria. The validity aspect shows very valid criteria based on the average results of several validators. The functional element produces an available category that can be used in learning involving teachers and students. The effectiveness aspect of the pretest and posttest questions using N-Gain analysis gives moderate results, meaning it can improve mathematical connection skills. The modules made are limited to statistical material. Further research can be developed on other materials using real-life contexts. This will align with the government's program in developing students' literacy and numeracy skills.

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