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SOCIOMATHEMATICS DIGITAL TEACHING MATERIAL DESIGN FOR ELEMENTARY SCHOOLS

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ABSTRACT

In the modern world, the approach to learning mathematics is considered a social activity because it involves interaction between teachers and students, building collaboration, and using technology to solve mathematical problems. The design of digital sociomathematics teaching materials aims to create a learning environment that is more accessible, flexible, interactive, collaborative, innovative, and efficient. This research aims to develop a socio-mathematical digital teaching material for elementary schools. The research uses development research methods, using the ADDIE development model, which consists of analysis, design, development, application, and evaluation stages. However, the current research focus is analysis, design, and development. The study data was obtained through the questionnaire. The material validation results showed 61% of the category is high and 39% is excellent. This study concludes that the instructional materials developed are employed in classroom teaching. This study suggests that future research could be directed towards evaluating the implementation of socio-mathematical digital teaching materials in primary school classrooms.

DESAIN BAHAN AJAR DIGITAL SOSIOMATEMATIKA UNTUK SEKOLAH DASAR

Kata Kunci:

Desain
Sekolah dasar
Sosiomatematika
Bahan Ajar

ABSTRAK

Dalam dunia modern, pendekatan pembelajaran matematika dianggap sebagai kegiatan sosial karena melibatkan interaksi antara guru dan murid serta membangun kolaborasi dan penggunaan teknologi untuk memecahkan masalah matematika. Seperti halnya desain bahan ajar digital sosiomatematika bertujuan untuk membangun suasana belajar menjadi lebih mudah diakses, fleksibel, interaktif, kolaboratif, inovatif, dan efisien. Penelitian ini bertujuan mengembangkan bahan ajar digital sosiomatematika untuk sekolah dasar. Penelitian ini menggunakan metode penelitian dan pengembangan, menggunakan model pengembangan ADDIE, yang terdiri dari analisis, desain, pengembangan, aplikasi, dan tahap evaluasi. Namun, fokus penelitian saat ini adalah analisis, desain, dan pengembangan. Data penelitian ini diperoleh melalui *lifting sheet*. Hasil validasi materi menunjukkan 61% dari kategori baik dan 39% sangat baik. Penelitian ini menyimpulkan bahwa bahan ajar yang

dikembangkan digunakan dalam pembelajaran di kelas. Saran untuk penelitian selanjutnya dapat difokuskan pada evaluasi implementasi bahan ajar digital sosiomatematika di kelas sekolah dasar.

1. INTRODUCTION

Learning mathematics focuses on understanding mathematics concepts, principles, and applications. Mathematical studies include discussions, experimentation, problem-solving, and others designed to enhance students' ability to think logically, analytically, critically, and solve problems. It becomes the basis that special mathematics can be taught to students in everyday life through problems and practical exercises, which allows them to correct mistakes and improve their skills [1]. It is clear that participation and positive activity are required to improve students' mathematical knowledge [2], [3]. To distinguish this, various means of communication, including written, visual, digital, verbal, and nonverbal, are used [4], [5]. Such interactions specifically refer to the type of interaction in which two or more objects influence or influence each other.

The interaction of digital learning is in line with the development of this modern era, where learning mathematics is accepted as a social activity [6], [7]. However, in reality, there are still some perspectives of people who believe that learning math is just an individual process and that social interaction does not play an important role [8], [9]. Some people believe that individualism affects learning mathematics. It becomes problematic if individual interests and principles are more important than groups or societies. Although individualism has advantages, such as encouraging individual freedom and creativity, it also has disadvantages. To mitigate its negative effects, the values of individualism must be balanced with common interests. This can lead to problems such as isolation, inequality, social solidarity, low social responsibility, disagreement in group decision-making, excessive consumer mentality, lack of attention to shared well-being, empathy, and social involvement. Individuals must be aware of the importance of social responsibility and positively contributing to society.

Social behavior can positively influence learning mathematics unconsciously [10]. It can be understood that social behavior can influence individual students towards other individuals [11], [12]. Interaction is the interaction between the student and the student or the student with the teacher [13]. Social behavior can also be influenced by social values learned and internalized by individuals through learning and interaction with others. Seeing the importance of mathematical position in social interaction, Gorgorió & Planas formulated the four objectives of mathematical education, namely, practical objectives, civil objectives, professional objectives, and cultural objectives. These goals relate to the individual's problem-solving ability and social interaction skills [14].

The relationship between mathematical learning and its identical social interaction is called sociomathematic learning. In the study, the theory obtained stated that sociomathematics was presented by Tine Wedege at the Adults Learning Maths (ALM) conference in 2003. Sociomathematics is the subject of mathematical education research on the relationship between society and mathematics in social life. Based on his research, he concluded that sociomathematics is an analytical concept that encompasses the study of computation, ethnomathematics, and workplace mathematics in a single term: a field of problems concerning the relationship between individuals, maths, and society, and a major field that combines math, individuals, and societies such as those found in etnomatometry, individual math, adult counting, and maths of competence. Tine Wedege also stated that as a field of problem, sociomathematics is defined by a sociocultural

perspective on mathematical education. As a subject field, sociomathematics was defined through a sociomathematics approach to subjects of people, mathematics, and society, see Figure 1.

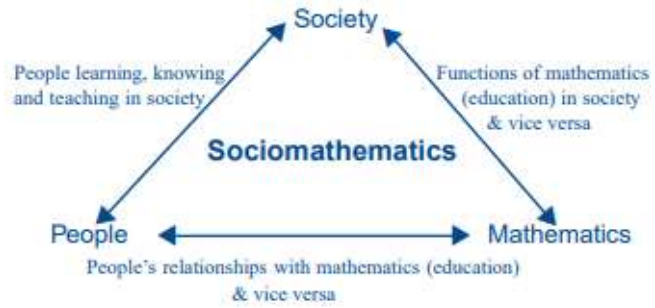

Figure 1. Sociomathematics as a Subject

Sociomathematics problems relate to three aspects: (1) people's relationship with mathematics (education) in society and vice versa. Relations of people can be seen as cognitive, affective, or social according to the given perspective of a particular study. These relationships are key issues, but to investigate these problems, you have to study two other problems: (2) the function of mathematics (education) in society and vice versa, and (3) people learn, know, and teach in society. These three things are the focus of the sociomathematics study, which looks at the relationships between individuals, mathematics, and society that are then brought to the mathematical classroom when math is taught. So, sociomathematics is a field in mathematical education research that studies the relationships between individuals, mathematics, and society in math classrooms.

This sociomathematics study is a broad concept, so research is being done to simplify it into elementary education. In elementary school, students usually have textbooks ordered by the publisher. The number of textbooks published and worked usually varies as curriculum changes apply. Indonesia has a free curriculum. Regulation No. 262/M/2022, amending the Regulation of the Minister of Education, Culture, Research, and Technology No. 56/M/2022 on guidelines for applying curricula within the framework of learning recovery, requires teachers to make the product of the material as accompanying students. Fill in the independent curriculum structure, rules of learning and assessment, projects to improve student profile, and teacher responsibilities.

The teaching material is defined as a set of materials containing the objectives, steps, and learning media, as well as the assessment required in one unit/subject based on the course of learning objectives [15]-[17]. The teacher has the power to create, select, and modify the teaching modules available according to the context, characteristics, and needs of the student [18]. The teaching module is similar to a learning implementation plan or lesson plan containing a classroom learning plan. However, the learning module has a more complete component than the learning implementation plan, the learning execution plan plus [19], [20]. The instruction module can help educators in (1) providing guidance to the educator in learning; (2) facilitating, simplifying, and improving the quality of learning; (3) serving as a reference for teachers in learning activities; (4) being a framework that describes learning procedures and organization according to learning access; and (5) supporting the achievement of competence in Learning Achievement and Student Profile of Pancasila at each learning stage [21]-[23].

The preparation of the teaching material is closely linked to the development of the times [24]. Nowadays, it has entered the digital age. Digital learning is critical to facilitating students' learning regarding accessibility, flexibility, interaction, collaboration, innovation, and efficiency. Digital learning has great potential to improve the quality of education and prepare students to face the challenges of the digital world. This is marked by the dramatic number of publications on digital learning in the five years from 2019 to 2023, with 294 articles quoted from the publish or perish application.

Research related to the development of digital teaching materials has been carried out, including the development of mathematics comics [8], and the development of learning tools for learning independent curriculum [15], [17], [21]. However, no researcher has yet studied the sociomathematics learning. Therefore, this research is expected to inspire other researchers.

This research aims to develop a digital teaching material design for sociomathematics in elementary schools. This research focuses on sociomathematics learning, where no development has been done for designing digital teaching materials for sociomathematics in previous studies. For this reason, this research was conducted to fill the research gap.

2. METHOD

The study uses the ADDIE model, which consists of five phases [25], [26]. First phase analysis, second phase design, third phase development, fourth phase implementation, and fifth phase evaluation. Each stage has a unique feature. For example, the first phase involves assessing the student's learning needs; the second phase is design, which means creating a product; and the third stage is development, in which language, material, and media are validated through expert assessment of three validators [27].

Phase one needs analysis involves examining student performance, learning objectives, and facts, concepts, principles, and procedures of learning material [28]-[31]. This need analysis aims to determine whether this educational material matches the needs of the state primary schools in the five Metro cities. In the second phase of the design, the activities are carried out as a follow-up to the determination of the ideas and analysis of the targets undertaken during the first stage of the needs analysis. Furthermore, the production and evaluation of media is part of the process [32].

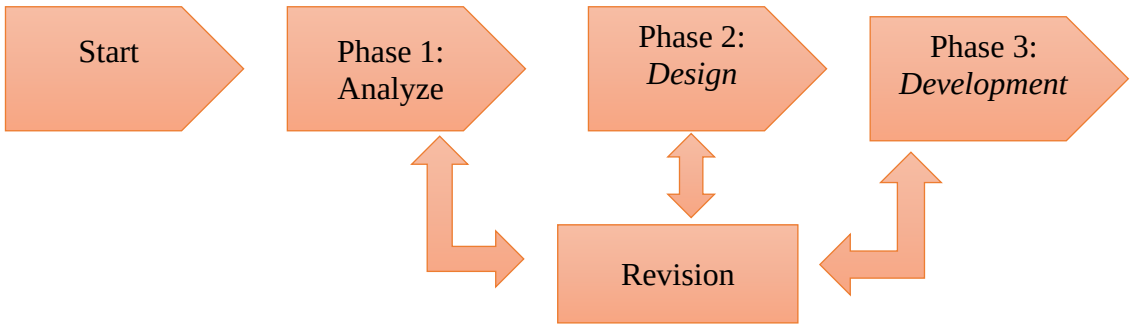

Figure 2. Research Procedure

Table 1. Guidelines for Converting Quantitative Data to Qualitative Data

No	Average	Criteria
1	$X > 4{,}21$	Highly necessary
2	$3{,}40 < X \leq 4{,}21$	Necessary
3	$2{,}60 < X \leq 3{,}40$	Moderately necessary

4	$1{,}79 < X \leq 2{,}60$	Unnecessary
5	$X \leq 1{,}79$	Highly unnecessary

3. RESULTS AND DISCUSSION

The results of the research at the State Primary School 5 of Weste Metro are as follows.

3.1 Analyze

The analysis was done in the fourth grade of the State Elementary School 5 of Western Metro. The results show that students are more interested in social and mathematical learning integrated into digital material. Class teachers teach materials with e-books that students still find it difficult to understand mathematics because they do not associate teachers with students' social lives. Based on this need analysis, class teachers need to use an interesting learning resource that connects the social life experienced by students with math. Next, the researchers spread elevators of student needs to respondents of as many as 30 students.

Table 2. Analysis of Student Needs

Student Needs	Access Indicator	Average	Category	Percentage
Learning Methods	The student's need for variable learning methods	3,32	Necessary	22%
Learning Media	Student needs to learn the media	3,77	Necessary	24%
Learning Resources	The need to learn using technology	4,25	Highly necessary	52%

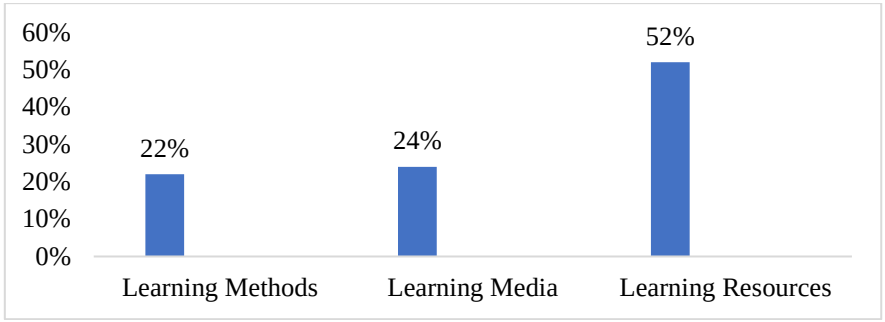

Figure 3. Histogram Analysis of Students' Needs of State Elementary School 5 of West Metro

Based on the analysis of the student needs of the above data, it can be understood that the level of student needs for sociomathematics teaching materials belongs to the category "needs". This can be demonstrated by an average obtained: (1) Learning Methods gets a percentage of 3.32. (2) Learning Media gets a percentage of 3.77. This early analysis becomes the basis for continuing research to the next stage. The use of needs analysis also has several benefits in early research, such as setting goals, gathering data, analyzing data, identifying needs, prioritizing needs, designing solutions, and conducting evaluations.

3.2 Design

After obtaining data on the above analysis activities, the next is to design the product. Design is the process of planning, visualizing, and creating effective and aesthetic solutions to existing problems. The design stage involves a series of steps that must be followed to achieve the desired results. Here is an explanation of the stages in the design process before determining the product of the socio-mathematics teaching

material: identification of problems, research, and analysis, collection of concepts, sketches and design, prototyping, evaluation and revision, implementation, assessment and maintenance. Here are the design stages used.

Table 3. The Design of the Early Stage of Sociomathematics Teaching Materials

No	Aspect	Indicator	Number of Items
1	Cover Design	Images reflect the content of the text	6
		Line and color match	
		Character match to the story	
		Background match to character/picture	
		Font match, color, space, and font size	
		Accurate placement of objects, text, and images	
2	Text Design	Types, colors, spaces, and corresponding font sizes	5
		Precision of sentences used	
		Compatibility of background colors with text	
		The balance between text and images	
3	Visual Design	Compatibility of the picture with the material	3
		Conformity of the image with the characteristics of the student	
		The quality of the images presented in the teaching material	
		Total	14

After the design is made, the next draft of the initial product that has been compiled is carried out. The next stage is a validation test to assess the validity of digital sociomathematics teaching material before being given to students as a learning medium in the classroom. In this validation test, the researcher performs a validation test of material, media, and signage with each validation using three validators. The validation tests carried out with the experts are as follows.

Table 4. Learning Media Expert Instruments

No	Observation Aspects	Validator		
		1	2	3
1	Material			
	The digital teaching materials used can support the materials that will be taught	5	4	4
	Digital teaching material used for learning purposes	5	4	4
	The use of digital learning materials in conformity with the Basic Competence	4	4	4
2	Illustration			
	The digital teaching media used can make it easier for students to understand the historical material in the classroom	4	4	4
	The digital teaching media used can present video and images of the battle by the original to support the learning of History	5	4	5
3	Media Quality and Display			
	The display of digital material media can attract the attention of students and encourage student learning activities	4	4	4
	Digital material media display color, visual, and visual appearance	5	4	4
4	Traction			
	The use of digital teaching media can enhance the student's learning spirit in class	5	5	4
	The use of digital learning media can help teachers communicate historical learning effectively to students in class	4	5	5

The assessment aspects of the digital sociomathematics teaching materials' validation sheet cover four aspects: material, illustration, quality of appearance, and attractiveness. The method of media validation is selected using a Likert scale. The next step is the evaluation and the suggestion of the validator after filling in the validation of

the media. The outcome will be corrected and measured by converting quantitative data into qualitative.

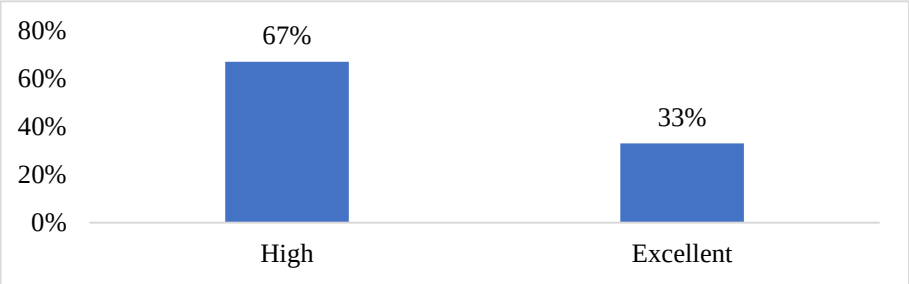

Figure 4. Histogram Frequency Distribution by Validators 1, 2, and 3

Based on the above data, it is clear that the product of the sociomathematics teaching material can be used for advanced validation tests.

Table 5. Learning Materials Expert Instruments

No	Aspects Assessed	Validator		
		1	2	3
1	Form			
	Clear distribution of material	5	4	5
	S. Clear distortion system	5	4	4
	The setting of spaces/arrangements	5	4	4
	Type and size of letters accordingly	4	4	4
2	Language			
	Good language structure	4	4	5
	Simple sentence structure	5	4	4
	Compatibility of sentences with student thinking	5	5	4
	Communicative and easy to understand	4	4	4
	Instructions and instructions clear	4	4	4
3	Illustrations			
	Illustration support to clarify concepts	4	4	4
	Give a visual stimulus	4	4	5
	Have a clear view	5	5	4
	Use a local context	4	4	4
4	Content of the material			
	Truth/fullness of the material	4	4	5
	Grouped into logical parts	4	5	4
	Compatibility of learning with the submitted material	5	4	5
	Compliance of the task with the material	4	4	5
	Encourage students to understand the attitude of historical empathy	4	5	4
	Qualification as a learning tool	5	4	5

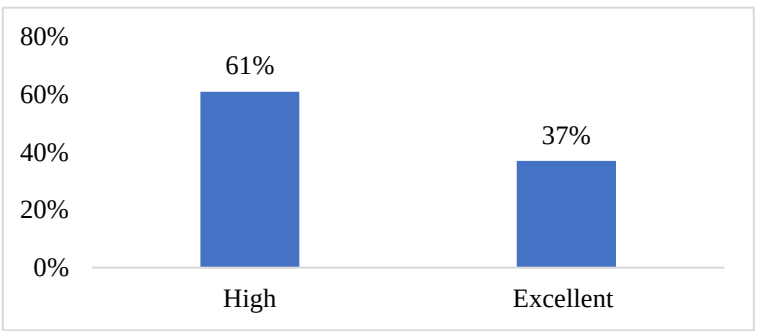

Figure 5. Histogram Frequency Distribution by Validators 1, 2, and 3

Based on the above information, it is clear that sociomathematics education results can be used for advanced validation tests.

3.3 Development

This phase is the implementation of the product, which was first validated by media and material experts. The product has been improved according to the criticisms and suggestions of the validators. This phase is followed by a product test to determine the validity of the product. The ability of the students to be subject in the implementation of the experimental product of digital sociomathematics teaching materials is homogeneous so that the data obtained can complement each other in improving the quality of digital sociomathematics teaching materials.

3.4 Product Testing

Digital teaching materials for class IV sociomathematics must be tested to ensure they are effective and valid. Twelve experts conducted this developmental study. First, content experts, learning designers, and learning media experts are evaluated. Once expert validation is complete, the product is tested. Product testing will be carried out in two phases: small-group testing and large-group testing. Two data collection techniques were used in this developmental research: questionnaire and testing. Tables 8 and 9 show a list of instruments.

Table 6. Small-scale Trial in Class IV A

Scale Assessment	Respondent	Amount	Number of Distribution X Scale Evaluator	Score	Average	Description
1		5	5			
2		15	30			
3	30	80	240	1168	38,93	High
4		107	428			
5		93	465			

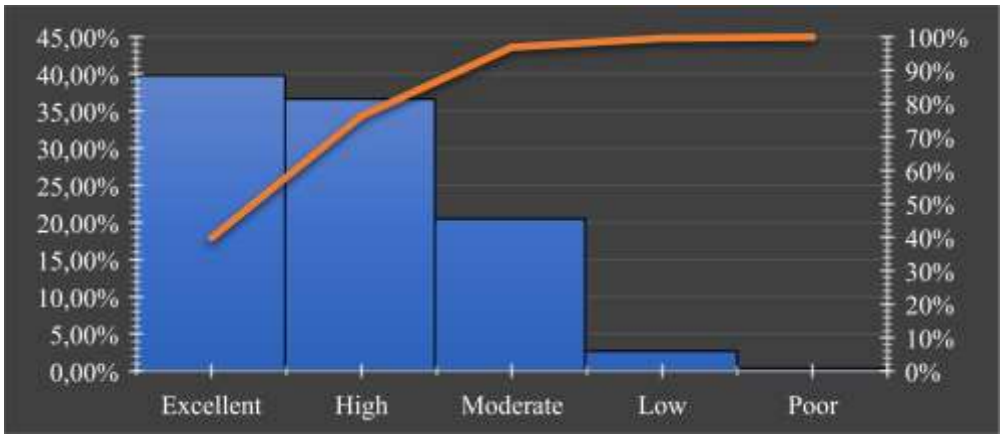

Figure 6. Histogram Percentage of Class IV A

Based on the above data, limited test results in class IV A with 30 respondents obtained a score of 1168 with an average of 38,93, which is included in the high category.

Table 8. Large-scale Trial in Class IV B and C

Scale Assessment	Respondent	Amount	Number of Distribution X Scale Evaluator	Score	Average	Description
1		36	36			
2		32	64			
3	75	172	516	2899	38,65	Good
4		267	1068			
5		243	1215			

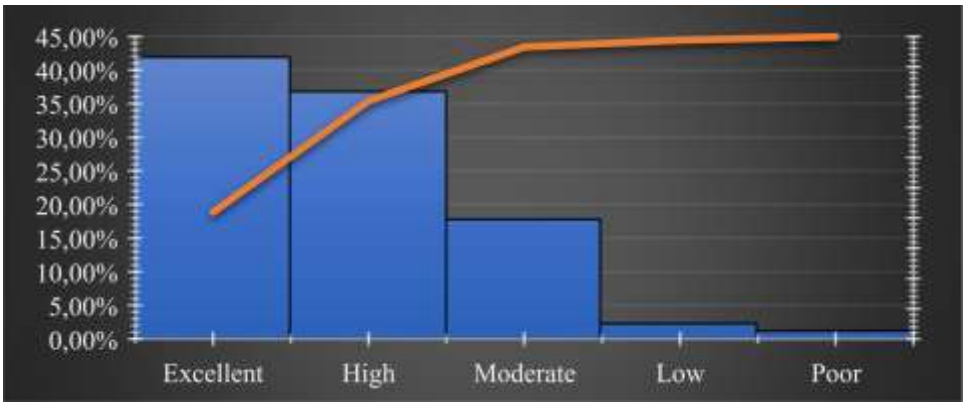

Figure 7. Percentage Histogram of Class IV B and C

Based on the above data, only 75 students took the test. A score of 2899 and an average of 38.65 were obtained, indicating they were in the high category.

4. CONCLUSION

The results of this research are valid teaching materials, with the material, design, and media aspects obtaining a score of 61% (high category) and 39% (excellent category). A small-scale trial in class IV A obtained an average score of 38.93 with a high category. Furthermore, a large-scale trial was conducted in Class IV B and IV C, obtaining an average score of 38.65 with a high category. The sociomathematics of the fourth-grade elementary school are easily understood by State Elementary School 5 of West Metro students based on the questionnaire they filled out. The students can easily understand the teaching materials used. This study suggests that future research could be directed towards evaluating the implementation of socio-mathematical digital teaching materials in primary school classrooms.

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