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Design of Mathematics Teaching Materials Based on Local Wisdom for Strengthening Mathematical Literacy on Social Arithmetic Material

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Abstrak

Penelitian ini bertujuan untuk mengidentifikasi profil awal kemampuan literasi matematis siswa, merancang dan mengembangkan bahan ajar matematika berbasis kearifan lokal untuk meningkatkan literasi matematis, dan mendeskripsikan hasil belajar siswa setelah menggunakan bahan ajar tersebut. Penelitian ini menggunakan pendekatan Research and Development (R&D) dengan menggunakan model ADDIE, yang meliputi lima tahap yaitu analisis, desain, pengembangan, implementasi, dan evaluasi. Pada tahap analisis, tingkat literasi matematika siswa kelas 9 di empat sekolah menengah pertama (SMPN 1 & 2 Sukahening, SMPN 6 & 14 Tasikmalaya) ditemukan pada level 2-3, berdasarkan kerangka kerja PISA. Pada tahap desain, dibuatlah rencana pembelajaran yang mengintegrasikan unsur-unsur kearifan lokal Tasikmalaya. Pada tahap pengembangan, handout interaktif dibuat dengan menggunakan Canva, dengan menggabungkan pilihan font, warna, dan grafik tematik. Soal pre-test/post-test dan kuesioner persepsi siswa juga dikembangkan dan divalidasi oleh ahli materi dan ahli media, yang menghasilkan nilai kelayakan sebesar 92% (sangat layak). Siswa menyelesaikan pre-test sebelum menggunakan handout dan post-test setelahnya, diikuti dengan kuesioner tentang kepraktisan dan persepsi. Analisis data menunjukkan peningkatan rata-rata penguasaan pembelajaran dari 50,84% (pre-test) menjadi 71,18% (post-test). Siswa memberikan tanggapan yang sangat positif mengenai isi, desain, dan relevansi budaya dari materi.
Kata kunci: Bahan ajar; matematika; kearifan lokal; literasi matematika; aritmatika sosial

Abstract

This study aims to identify students' initial profiles of mathematical literacy skills, design and develop mathematics teaching materials based on local wisdom to enhance mathematical literacy, and describe students' learning outcomes after using these materials. The research employs a Research and Development (R&D) approach using the ADDIE model, which includes five phases: analysis, design, development, implementation, and evaluation. In the analysis phase, the mathematical literacy level of 9th-grade students at four junior high schools (SMPN 1 & 2 Sukahening, SMPN 6 & 14 Tasikmalaya) was found to be at levels 2–3, based on the PISA framework. During the design phase, lesson plans were created that integrated elements of Tasikmalaya's local wisdom. In the development phase, interactive handouts were created using Canva, incorporating thoughtful choices of fonts, colors, and thematic graphics. Pre-test/post-test questions and student perception questionnaires were also developed and validated by a content expert and a media expert, resulting in a feasibility score of 92% (highly feasible).The implementation took place over four class sessions across the selected schools. Students completed a pre-test before using the handouts and a post-test afterward, followed by a questionnaire on practicality and perception. Data analysis showed an increase in average learning mastery from 50.84% (pre-test) to 71.18% (post-test). Students gave highly positive responses regarding the content, design, and cultural relevance of the materials.
Keywords: Teaching materials; mathematics; local wisdom; mathematical literacy; social arithmetic.

I. INTRODUCTION

One of the international institutions that has become a benchmark in assessing the quality of the education system is the Organization for Economic Co-operation and Development (OECD). Through the Program for International Student Assessment (PISA) program, the OECD routinely evaluates the competence of 15-year-old students in three main domains: mathematics, science, and reading literacy. The 2022 PISA results showed that Indonesian students' math scores significantly decreased by 21 points compared to the previous results (OECD, 2023). These findings reflect serious challenges in achieving numeracy and mathematical literacy competencies among students.

International research also confirms that the integration of context-based learning - including realistic and local culture-based approaches - has a positive impact on student motivation and understanding (Boaler, 1998; Gravemeijer & Doorman, 1999). In addition, students who are accustomed to working on contextual problems tend to have better problem-solving skills and are able to perform mathematical reasoning more flexibly (Stillman & Brown, 2011).

Therefore, it is necessary to develop teaching materials that are not only oriented towards procedural mastery, but also touch on applicative and reflective aspects through contexts that are relevant and close to students' lives. This effort is in line with the direction of the modern curriculum that emphasizes the importance of 21st century skills, including critical thinking, problem solving, and numeracy literacy.

According to Astrini et al. (2013), mathematical literacy reflects a person's ability to identify, apply, and understand mathematical concepts in real-life situations. This literacy does not only focus on mastering the material, but also includes the use of logical reasoning, concepts, and mathematical procedures to solve everyday problems, including in explaining and predicting various events through a mathematical approach.

The learning process involves many important components, one of which is teaching materials. Teaching materials are the main means for students to understand the material. Teachers play a major role in determining relevant and appropriate teaching materials, so it is important for teachers to analyze and adjust before using them in learning (Clements & Sarama, 2004).

The success of the learning process is strongly influenced by various components designed by the teacher, such as the formulation of learning objectives, material selection, delivery strategies, and evaluation methods. One of the efforts that teachers can make to improve the effectiveness of learning is by preparing teaching materials that can arouse student learning motivation (Dimyati & Mudjiono, 2009). Teaching materials act as external factors that can strengthen students' intrinsic motivation. Therefore, it is important for teachers to develop teaching materials that are not only aligned with the curriculum, but also in accordance with the characteristics of students. This includes consideration of the social, cultural,

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geographical aspects, as well as the stage of cognitive development of students. In addition, teaching materials should be strategically designed to help students overcome any learning barriers they may experience.

Developing teaching materials that are relevant to learners' backgrounds and local cultures is becoming increasingly important in the current era. Unfortunately, character values that should be integrated in the education process often do not receive the attention they deserve. Learning will be more meaningful if it is associated with objects, events and problems from real life. This approach is known as local wisdom-based learning (Fajarini, 2014). Local wisdom in learning can be in the form of values or other forms of culture (Hilaliyah et al., 2018).

In accordance with Permendikbud Number 22 of 2016, local potential must be conveyed in introductory activities. Knowledge of students' home regions can be raised in examples of problems or issues. The use of real examples in the learning process has proven effective in improving students' higher-order thinking skills (Hosnan, 2016). Unfortunately, most of the teaching materials available today still do not include elements of local wisdom (Hilaliyah et al., 2018). In fact, material that is related to the surrounding environment of students tends to be easier to understand because it is in line with their experiences. In addition, teachers can more freely use language and contexts that are familiar to students, so that the delivery of material becomes more effective.

Local wisdom is a form of knowledge, perspective, and life strategies that develop from community activities in meeting daily needs (Kaunang et al., 2018). Local culture cannot be separated from people's lives, especially in Indonesia, which is rich in cultural diversity. Unfortunately, the utilization of local wisdom is declining (Kharis, 2017). Therefore, it is important to revive these values through the learning process in schools (Mansur, 2018).

II. METHOD

This research uses the ADDIE instructional development model, which consists of five main steps: analysis, design, development, implementation, and evaluation (Andhriyani et al., 2022). Each stage is carried out systematically to produce teaching materials that are in accordance with the needs of students and the learning context at hand. In the initial stage, namely analysis, various activities were carried out such as field observations, literature studies, review of the curriculum, and evaluation of learning resources used by students. This stage also includes the process of identifying the needs and characteristics of the learners who are the focus of the research.

The second stage is design, which includes the preparation of local wisdom-based lesson plans, validation of lesson plans by experts, and revision based on input from validators.

In the development stage, various learning tools were developed, including handouts, instruments used for this research. All of these tools then went

through a validation process by lecturers and teachers. The preparation of handouts involved several steps, such as making the cover design, determining learning objectives by formulating achievement standards, selecting relevant Core Competencies (KI) and Basic Competencies (KD), and designing the flow of material in the form of a concept map. Next, appropriate elements of local culture are selected to be integrated into the learning content. This process was followed by the preparation of practice questions, the development of evaluation tools to measure student understanding, as well as the preparation of questionnaires to assess student responses to teaching materials and the completeness of other devices.

The fourth stage, the implementation stage, was carried out by applying handouts, pre-test and post-test questions, and questionnaires that had previously passed the validation process and were declared suitable for use. This process was carried out in a number of schools that had been designated as trial locations. The activity began with organizing a pre-test before the use of handouts in learning, followed by a post-test after the learning activities were completed. This step aims to evaluate how effective the designed teaching materials are in improving students' abilities. In addition, students were also asked to fill out a questionnaire to reveal their perceptions of the practicality of handouts based on local wisdom values.

Meanwhile, the fifth stage or evaluation stage involves the process of analyzing the validity, effectiveness, and practicality of teaching materials based on the findings during the research implementation.

III. Result and Discussion

This research was conducted in four junior high schools located in two administrative areas, namely Tasikmalaya Regency and City. The schools included SMP Negeri 1 and SMP Negeri 2 Sukahening in Tasikmalaya Regency, and SMP Negeri 6 and SMP Negeri 14 in Tasikmalaya City. The teaching materials developed have gone through a quality review process by one material expert and one media expert. The development process followed the ADDIE systematic approach, which consists of five main steps: analysis, design, manufacture, implementation and review.

A. Analysis

At this stage, researchers conducted a study of the needs of students through observation of teaching materials currently used in grade IX in the four schools that became the subject of the study. In general, the textbooks used are appropriate for the teaching materials, but they do not include elements of local wisdom that are relevant to the students' surrounding environment. As a result, students are not familiar with the local context that could help them understand the material in a more relevant and meaningful way.

In addition, the researcher also examined the curriculum implemented at the school, namely Curriculum 2013, based on interviews with mathematics teachers.

It is known that students' mathematical literacy skills are at levels 2 and 3. The

existing teaching materials are also considered less interesting and have not connected learning with students' real lives. Based on these findings, the researcher developed an initial design to develop mathematics teaching materials based on local wisdom, with the main objective of improving mathematical literacy, especially on the topic of Social Arithmetic at the junior high school level.

B. Design

In the design stage, researchers began to develop the needs of teaching devices, starting with designing lesson plans that integrate elements of local wisdom in the Tasikmalaya region. The lesson plans were then validated by experts, and revisions were made based on input from the validation process. The validation results showed that the lesson plans were suitable to be used as the basis for further development of teaching materials.

C. Development

Tahap ini merupakan kelanjutan dari tahap desain, di mana peneliti menyusun dan mengembangkan berbagai perangkat pendukung pembelajaran, antara lain handout sebagai bahan ajar utama, soal pre-test dan post-test untuk mengukur hasil belajar, serta angket untuk menilai tanggapan siswa terhadap bahan ajar. Seluruh perangkat tersebut kemudian divalidasi oleh ahli, termasuk dosen dan guru, dan dilakukan perbaikan berdasarkan hasil validasi tersebut.

The main activities in this stage include: making the visual design of handouts, determining basic competencies and learning objectives, selecting and integrating relevant local wisdom materials, preparing contextualized question exercises, and preparing assessment instruments and student response questionnaires. All these components are prepared to support the implementation of teaching materials that are more contextual, interesting, and in accordance with the characteristics of students.

1) Handout Development Process
   The initial stage in the development of handouts began with the collection of materials from various reference sources, such as mathematics textbooks, modules related to social arithmetic, journals on local wisdom in the City and Regency of Tasikmalaya, and information sources from the internet. Furthermore, the visual design of the handout was carried out using the Canva application, with the selection of fonts, colors, and graphic elements that were adjusted to the theme of local wisdom carried. All illustrations used are sourced from elements in the application or from the internet that are relevant to the context of the teaching material. After the handout design was completed, it was validated by material experts and media experts to assess the feasibility of its content and visual appearance.
2) Preparation of Pre-test and Post-test Instruments
   The preparation of pre-test and post-test questions aims to assess the effectiveness of local wisdom-based social arithmetic teaching materials in

improving students' mathematical literacy. The questions were designed by considering students' ability to understand, apply, and analyze mathematical concepts in the context of everyday life that are closely related to their local environment.

3) Preparation of Student Response Questionnaire

The questionnaire instrument was prepared as a means to collect students' opinions regarding the use of teaching materials that have been prepared. This questionnaire utilizes a Likert scale with five response levels, ranging from “strongly disagree” to “strongly agree”. The main purpose is to measure the level of interest, acceptance, and students' perceptions of the effectiveness of handouts that raise local wisdom values in learning social arithmetic.The purpose of distributing this questionnaire is to obtain information on whether the teaching materials get a positive response from students.

4) Expert Validation Process

The teaching materials developed then went through a validation process by two experts, each in the field of content and learning media. In its development, researchers used mathematics textbooks as the main reference to ensure alignment with curriculum standards, including Core Competencies (KI), Basic Competencies (KD), and indicators set. Each section in the handout was designed by linking contextual local values, in order to strengthen students' understanding and mathematical literacy skills through an approach that is closer to their environment.Validation was carried out by paying attention to several important aspects, namely the feasibility of content, language use, presentation of material, graphic aspects, and the extent to which teaching materials support the development of students' mathematical literacy.Assessment Results from Material Validators

Table 1.
Recapitulation of Assessment by Material Experts

No	Aspect	Score	Category
1	Content eligibility	100%	Very Feasible
2	Presentation feasibility	96%	Very Feasible
3	Appropriateness of language	86,67%	Very Feasible
	Total	92%	Very Feasible

Table 2.
Material Expert Comments and Suggestions

Comment	Sugestion
-	It is better to add supporting images to the examples and practice questions so that they are more interesting and students know the local wisdom in the questions.

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Figure 1. Before Improvement - Feasibility Assessment by Media Validators

Figure 2. After Improvement - Feasibility Assessment by Media Validators

Table 3.
Recapitulation of Evaluation Results from Media Experts

No	Aspect	Score	Category
1	Display	90%	Very Feasible
2	Ease and Benefits Using Teaching Materials	90%	Very Feasible
3	Graphics	96%	Very Feasible
	Total	92%	Very Feasible

Based on the results of the calculation of the feasibility questionnaire for material expert validators and media experts, the teaching materials are suitable for use and proceed to the next stage.

D. Implementation

The next stage was to conduct trials at SMPN 1 Sukahening Tasikmalaya Regency, SMPN 2 Sukahening Tasikmalaya Regency, SMPN 6 Tasikmalaya City and SMPN 14 Tasikmalaya City. Before the learning activities students were given a pre-test first. After completing the pre-test, the results showed that students' mathematical literacy skills were at level 2 and level 3. In learning activities, researchers used social arithmetic modules for 4 meetings. After the KBM, students were given test questions again, the aim was to see whether the teaching materials used during learning could improve mathematical literacy skills or not. Then students continue to fill out a questionnaire at the end of learning, the aim is to find out the response to the teaching materials developed positively or negatively.

E. Evaluation

In this phase, an analysis of the evaluation results covering aspects of

validity, effectiveness, and practicality of the handouts that have been designed and implemented in SMPN 1 Sukahening Tasikmalaya Regency, SMP N 2 Sukahening Tasikmalaya Regency, SMPN 6 Tasikmalaya City and SMPN 14 Tasikmalaya City. Based on the analysis of validation results from material experts and media experts, the teaching materials are categorized as very feasible.

The results of student responses using local wisdom-based teaching materials are in the very positive category. The following Table 4 shows the results of students' responses:

Table 4.
Results Response from learners

No	Aspect	Score	Category
1	Content Feasibility	93%	Very Positive
2	Ease and Benefits c Using Teaching Materials	93%	Very Positive
3	Local Wisdom Content	90%	Very Positive
	Total	92%	Very Positive

The pre-test results of mathematical literacy skills of students in SMPN 1 Sukahening Tasikmalaya Regency (A), SMPN 2 Sukahening Tasikmalaya Regency (B), SMPN 6 Tasikmalaya City (C) and SMPN 14 Tasikmalaya City (D) are as follows:

Table 5.
Pre-test Result

Level	A	B	C	D	Description
1	4	3	5	4	Not Complete
2	11	9	10	12	Not Complete
3	15	16	15	13	Complete
4	-	-	1	-	Complete
5	-	-	-	-	-
6	-	-	-	-	-
∑	30	28	31	29	-
%	50	57,14	51,61	44,82	

The data shows that students are mostly at levels 2 and 3 and the percentage of completeness of 118 students reached 50.84% in the sufficient category.

As for the post-test results after learning to use teaching materials integrated with local wisdom, the following data were obtained:

Table 6.
Post-test Result

Level	A	B	C	D	Description
1	2	1	3	2	Not Complete
2	5	6	8	7	Not Complete
3	14	13	16	17	Complete
4	6	4	2	2	Complete
5	2	4	1	1	Complete
6	1	-	1	-	Complete

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Level	A	B	C	D	Description
∑	30	28	31	29	
%	76,67	75	64,51	68,96	

From the results of the post-test of mathematical literacy skills of students from SMPN 1 Sukahening Tasikmalaya Regency, SMPN 2 Sukahening Tasikmalaya Regency, SMPN 6 Tasikmalaya City and SMPN 14 Tasikmalaya City, data were obtained from 118 students with a percentage of completeness reaching 71.18% in the good category. Where the best improvement in mathematical literacy skills is in schools SMPN 1 Sukahening Tasikmalaya Regency and SMPN 2 Sukahening Tasikmalaya Regency. However, overall, from the data it can be seen that there is an increase in students' mathematical literacy skills after conducting KBM using teaching materials integrated with local wisdom.

IV. CONCLUSION

Students' initial mathematical literacy skills are generally at levels 2 and 3. The teaching materials used previously were considered less interesting and less relevant to the context of students' real lives. The process of designing and developing mathematics teaching materials is carried out by integrating elements of local wisdom from the City and Regency of Tasikmalaya. This integration is expected to strengthen students' mathematical literacy skills.

After participating in learning using the local wisdom-based teaching materials, learning outcomes showed an increase, with students' mathematical literacy skills reaching levels 3, 4, and 5. Suggestions for future research in local wisdom-based learning activities, activities that allow students to experience and apply local wisdom directly, such as community-based projects or field trips.

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