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Implementation STEAM and Thematic Learning Models Assisted by STEMATIK Learning Media in Elementary School

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a b s t r a c t

The aim of this research was to explain the component analysis of integrating STEAM and thematic learning using STEMATIK learning media, to describe the importance of using learning media in enhancing students' independence and motivation to learn, and to present the results of using STEMATIK learning media as a tool for learning mathematics. The research method employed was a quasi-experiment. This study tested causal results to determine the influence of one variable on another. The product development process was based on the ADDIE model, which is a systematic approach that includes five different stages: analysis, design, development, implementation, and evaluation. The method used in this research was the descriptive, qualitative and quantitative method. The research results showed an increase in students' independence and learning outcomes. The use of learning media can increase student activity in the classroom, thereby creating a conducive classroom condition.

K e y w o r d s :
learning media,steam, thematic, elementary school.

INTRODUCTION

Background of the Study

Learning media is a tool to connect materials and clarify the delivery of messages, information, and enhance student motivation (Wulandari et al., 2023). The presence of learning media can also provide students with the same experience about their environmental events, and allow direct interaction with teachers, society, and the environment (Justicia et al., 2023; Leavy et al., 2023). Visual-based or image-based media plays a crucial role in the learning process (Wulandari & Anugraheni, 2021). One way to improve the quality of education, according to Istiqamah & Zirmansyah (2024), is by implementing STEAM (Science, Technology, Engineering, Art, and Mathematics). Learning with a STEM approach is said to be capable of preparing students to face a real world full of problems and to be ready for global competition. As revealed by Widya et al. (2019), advanced countries like the United States have been using STEAM to address problems and challenges that arise in the 21st century (Priyantini et al., 2021; Wardani et al., 2021). This certainly does not rule out the possibility for developing countries like Indonesia to use STEAM, so that they can compete in various aspects in this modern era (Shonkoff et al., 2020). The STEAM approach can be implemented by creating learning media to produce optimal learning.

Challenges in mathematics and reading during childhood can have long-lasting impacts into adulthood, negatively affecting educational attainment, income, wealth, and health (Shonkoff et al., 2020). One of the goals of mathematics education is to equip students with the ability to think logically, analytically, systematically, critically, creatively, and to work cooperatively (Nurcahyono & Putra, 2023). Mathematical literacy acts as a channel that connects mathematical concepts with real-world applications. Integral aspects of mathematical literacy involve the utilization, implementation, and recognition of mathematics in various situations (Papadakis et al., 2021; Sulistyaningrum et al., 2021). Although literacy is generally associated with basic skills such as reading and writing, mathematical literacy is crucial for problem-solving in new situations and interpreting mathematics in various contexts (Evianah, 2023; Verschaffel et al., 2020).

Previous studies have discussed the development of STEAM learning models in elementary schools to support the optimization of the learning process. First, the research conducted by Twiningsih & Elisanti (2021) found that STEAM-based learning media can enhance critical thinking skills and science literacy. Second, according to Lu et al. (2022), augmented reality-based STEAM learning media can improve the quality of natural science in elementary schools. Third, the research conducted by Septinaningrum et al. (2022) resulted in the validation of STEAM-based learning media and 2C based on local wisdom. Fourth, according to Adiputra et al. (2021), STEAM-based learning videos can enhance students' trigonometry skills. Fifth, as noted by Mulder et al. (2023), web-based science learning media with a STEAM approach can enhance students' creative thinking abilities. Sixth, Suryaningsih and Ainun Nisa (2021) explained that STEAM can contribute to project-based learning in measuring students' science process skills and creative thinking. Seventh, as mentioned by Purwanti & Zulkarnaen (2023), loose part learning media based on STEAM can build students' learning independence.

Learning media that integrates the STEAM model will be more attractive to students, by optimizing creativity in creating good learning media. Integration with the thematic learning model will foster student growth in various subjects. Therefore, it is important for teachers to develop learning media by integrating STEAM and thematic learning models in designing a learning. This research aimed to explain the component analysis of integrating STEAM and thematic learning using STEMATIK learning media, to describe the importance of using learning media in enhancing students' independence and motivation to learn, and to present the results of using STEMATIK learning media as a tool for learning mathematics.

METHODS

Type and Design

The research method employed was a quasi-experiment. This study tested causal results to determine the influence of one variable on another. The product development process was based on the ADDIE model, which is a systematic approach that includes five different stages: analysis, design, development, implementation, and evaluation.

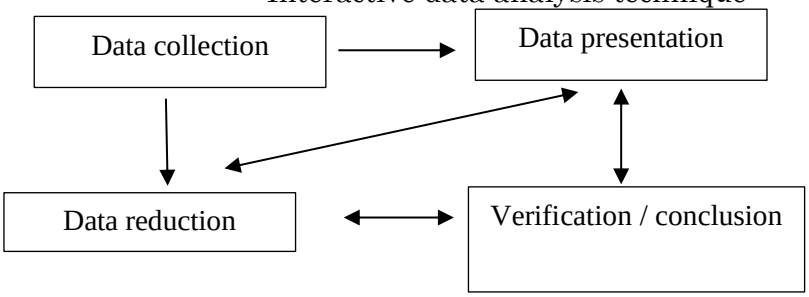
Data and Data Sources

The method used in this research was the descriptive, qualitative and quantitative method. The subjects of this study were 31 elementary school students from the first grade. Data were collected from Muhammadiyah Elementary Islamic School (MI) of Paseban Bayat, Klaten. Anggito and Setiawan (2018) state that in qualitative research, data sources or samples are purposively (intentionally) determined, and informants (research subjects) need not represent the population. The interviewee for this research was a first-grade teacher named Mrs. Dewi Minani, who has experience in creating learning media for elementary schools.

Data Collection Technique

The data collection techniques included interviews, observations, questionnaires, field notes, and documentation. This descriptive research aimed to obtain an overview and descriptions of the learning media, student characteristics, methods, strategies, and mathematics materials studied. This study utilized data analysis techniques that refer to the Miles and Huberman model. Miles and Huberman propose that activities in qualitative data analysis are carried out interactively and continuously until completion, so that the data are saturated (Palazzolo, 2023). Table 1 explains the interactive data analysis technique used in this study.

Table 1
Interactive data analysis technique



Data Analysis

The stages of data analysis conducted in this study, which refer to the Miles and Huberman model, were: (1) data reduction (data collection). Reducing data means summarizing, selecting the main things, focusing on important things, and looking for themes and patterns; (2) data presentation (data display). Miles and Huberman state that the most commonly used method to present data in qualitative research is through narrative text. Data presentation was conducted to facilitate a more comprehensive understanding of the obtained data; (3) verification/conclusion. Conclusions in qualitative research are new findings that have not previously existed. A finding can be a description or depiction of an object that was previously unclear or dark, but after being researched becomes clear, it can be a causal or interactive relationship, hypothesis, or theory (Palazzolo, 2023).

RESULTS AND DISCUSSION

STEAM Analysis in STEMATIK Learning Media

Based on the results of interviews with the teacher, the creation of learning media can use recycled materials, such as paper, ice cream sticks, cardboard, and printed images. The

teacher modifies these recycled items into attractive learning media in accordance with the material being taught. The creation of learning media is believed to enhance student learning outcomes. In addition, the creation of learning media can also increase creativity and cooperation among the students in the class.


Figure 1.
STEMATIK Learning Media

Figure 1 shows the result of creating STEMATIK learning media for the first grade. STEMATIK learning media is a learning media that integrates the STEAM and thematic learning models. According to Mumpuni et al. (2022), the use of recycled materials can be used in learning media because they are easily obtained and not harmful to students, can train creativity, reuse unused goods, and can become art and counting learning media. The analysis of the STEAM model and thematic content using STEMATIK learning media is explained in the following Table 2:

Table 2
STEAM learning media analysis

No	STEAM Component	Meaning	Description
1.	Science	Knowledge	The knowledge in this learning media includes the study of art and the insulating properties of plastic.
2.	Technology	Tools to assist human work	With the help of this learning media, students will be assisted in performing tens to hundreds of additions and subtractions.
3.	Engineering	A systematic way of teaching something	The learning media is designed using plastic material. If marked with non-permanent black ink, the markings can be erased, allowing for the repeated use of the media.
4.	Art	Skill in creating works	The creation of learning media is integrated with students' creativity skills in sticking, drawing, and providing complements to the learning media to make it look attractive.
5.	Mathematics	Mathematics	The mathematical contents in the creation of media are measuring the length of cardboard and the squares of the media, as well as determining the precision of the learning media.

STEMATIK learning media integrates many learning contents, making it thematic. The learning contents included in the created learning media encompasses Civic Education (PPKn) learning content in the form of attitude assessment, Art and Culture (SBdP) in the form of student creativity assessment, and Indonesian language in the form of reading comprehension assessment. Thematic learning is a learning method that supports specific themes to teach several curricular concepts (Setiawan, 2019). In addition, the creation process also incorporates students' multiple intelligences, accommodating a variety of student abilities.

This statement aligns with the research conducted by Yavich and Rotnitsky (2020), which states that multiple intelligences encompass students' problem-solving abilities. In preparation for its creation, the students prepare materials and tools at home according to the teacher's instructions, and then independently develop the STEMATIK learning media. The thematic learning contents are explained in the following Table 3:

Table 3
Analysis of learning media thematic content

No	Learning Content	Description
1.	Mathematics	Students learn various additions and subtractions through learning media.
2.	Civic Education	Students learn independence, discipline, and cooperation in the creation of learning media.
3.	Indonesian Language	Teachers can vary questions with reading questions that are included in the HOTS (High Order Thinking Skills) problem analysis.
4.	Art and Culture	The creation of this learning media requires skills in cutting and shaping to make it look neat and good.

Development of STEMATIK Learning Media

Figure 2
Use of STEMATIK in learning

The use of STEMATIK learning media in the classroom supports the students' understanding of addition and subtraction material. The presence of learning media that they created themselves from observation results showed that students were more interested and motivated to learn. The students were more curious about whether the answers they got were correct or wrong. This opinion aligns with the research conducted by Antoneta et al. (2023) that using learning media can improve students' cognitive and psychomotor outcomes. According to observation results, the first-grade students were more interested in learning integrated with the conventional learning media. The students' learning motivation could be seen from their engagement in answering the questions that the teacher provided on the blackboard. The engagement of the students can be seen in Figure 3.

Figure 3
STEMATIK learning evaluation

The learning evaluation was conducted by answering the given questions, providing an opportunity for the students to write their answers on the blackboard. Selected students would come forward to write their answers. The students collaborate to confirm the answers written on the blackboard. The assessment system included several aspects, including oral, practical, and discussion-based assessments. This aligns with the research by Marzuki (2023), in which the assessment system can consist of administering tests, contextual mathematical exams, and assessments in the form of student character surveys that are in line with the practice of Pancasila. The oral assessment involved the students answering directly. The practical assessment consisted of giving problems to the students, who then solved them using the provided materials. The final assessment was conducted through discussions, which involved learning evaluation activities by collaboratively correcting answers. The students' learning outcomes can be seen in Figure 4.

Figure 4
Students' answers

The students were given problems with tens numbers, in line with the material they were taught. According to the teacher, the basic mathematics material that first-grade students must master was counting. Based on the interview with the teacher, in the first trimester, the students could count from 1 to 20, and in the second trimester, the students could count from 20 to 100. Subsequently, after being able to count, the students learned how to write and memorize the numbers. Afterwards, the students learned about addition, subtraction, comparing numbers, sorting numbers, up to the last material which was a number pattern consisting of two images. In this assessment, two samples of mathematical assessments were taken before utilizing learning media and three meetings using STEMATIK learning media to measure the success of the learning process with the media employed (Rukayah et al., 2021; Silva-Hormazábal & Alsina, 2023).

Table 4
Students' cognitive scores before and after the use of learning media

Phase Prior to the Use of Learning Media	Average Score
Phase 1	70,65
Phase 2	72,58

Phase Following the Use of Learning Media	Average Score
Phase 1	73,55
Phase 2	84,00
Phase 3	93,00

Based on Table 4, there is a change in the students' knowledge scores. In the phase before using the learning media, the average score in the first phase was 70,65, taken from a total of 31 first-grade students, while in the second phase, the average score was 72,58. The score in the third meeting, or the first meeting of creating learning media, resulted in an average of 73,55. For subsequent mathematics learning, the students worked on addition and subtraction tasks using the aid of learning media. On the following day, the students were given tasks again for the next data collection. The second meeting using the learning media yielded good results, with the average score rising to 84,00. To test the validity of the increase in knowledge scores, the researchers tested again by giving an assessment and produced a good average score of 93,00.

The knowledge assessment that had been conducted resulted in satisfactory score attainment. Subsequently, the researchers added an assessment of student learning independence after using the learning media. The indicators that examined the scores, according to the research conducted by Tresnaningsih et al. (2019), are as follows:

Table 5
Independence assessment indicators

Variable	**Indicator**	**Observed Aspect**
Learning Independence	1. Self-confidence	1.1 Displaying courage in public
		1.2 Confident in their abilities
		1.3 Actively asking questions
		1.4 Not afraid to express opinions
		1.5 Speaking loudly in public
		1.6 Active during discussions
		1.7 Calm in problem-solving
		1.8 Trying to work on tasks independently
	2. Able to work independently	2.1 Having the initiative to work independently
		2.2 Completing tasks without assistance
		2.3 Feeling satisfied with their own abilities
	3. Able to make decisions	3.1 Calm in making decisions
		3.2 Able to solve problems on their own
	4. Responsible	4.1 Having the courage to express the truth
		4.2 Having the courage to take risks
		4.3 Failure is not despair
	5. Desire to advance competitively	5.1 High learning motivation
		5.2 Feeling challenged to improve themselves
		5.3 High creativity
	6. Discipline	6.1 Obedient and orderly at school
		6.2 Preparing themselves well
		6.3 Not violating school rules
	7. Active in	7.1 Exchanging opinions

learning	7.2 Trying to find problem solutions 7.3 Adjusting to a good learning atmosphere 7.4 Having the courage to express opinions

Based on the indicators that have been presented, the researchers then categorized them into several criteria. The category of scores in the scale of student independence improvement is presented in Table 6 below:

Table 6
Score category

Score	Scale / Criteria
81-100	Excellent
61-80	Good
41-60	Average
21-40	Below Average
0-20	Poor

Observations with direct actions were carried out by the researchers to determine the calculation of the level of student independence. The formula used to determine the level of student independence is as follows:

$$P = \frac{f}{n} \times 100\% \quad (1)$$

Where:
P = percentage
f = frequency of each response
n = number of data/samples
The assessment of independence attitude was based on the predetermined indicators. After knowing the formula in determining the assessment of learning independence, the assessment of students' learning independence is explained in Table 7 below (Tresnaningsih et al., 2019):

Table 7
Results of the learning independence questionnaire

No	Indicator	Calculation	Score	Criteria
1.	Self-confidence	$P = \frac{26}{31} \times 100\%$	P = 84	Excellent
2.	Able to work independently	$P = \frac{22}{31} \times 100\%$	P = 71	Good
3.	Able to make decisions	$P = \frac{17}{31} \times 100$	P = 55	Average
4.	Responsible	$P = \frac{24}{31} \times 100$	P = 77	Good
5.	Desire to advance competitively	$P = \frac{24}{31} \times 100$	P = 77	Good
6.	Discipline	$P = \frac{9}{31} \times 100$	P = 29	Below Average
7.	Active in learning	$P = \frac{26}{31} \times 100$	P = 84	Excellent
Mean		**68, 14**		**Good**

Source: Processed data

Based on Table 7 above, it demonstrates that the level of student learning independence is good, achieving a score of 68,14, which according to the category is considered good. Not only that, the researchers also collected data on student learning motivation after using the

learning media. The achievement indicators of student motivation research are explained by Arifin and Abduh (2021), which include student activity in carrying out learning tasks, student involvement in problem-solving, courage to ask questions, and being active in seeking learning resources. The assessment of the student learning motivation indicator sheet was calculated using the following formula:

$$\text{Score of motivation for each indicator} = \frac{frequency\ of\ students\ fulfilling\ indicator}{total\ number\ of\ students} \text{ x } 100\% \quad (2)$$

After determining the formula to be used in calculating the level of student independence, the researcher employed indicator criteria to determine the level of student independence. The researcher utilized the established indicators as shown in Table 8 below:

Table 8
Student motivation percentage category

	Criteria
75% - 100%	High
51% - 74%	Medium
25% - 50%	Low
0% - 24%	Very Low

After categorizing the remaining motivation scale, the researchers calculated the level of student learning motivation after utilizing the learning media. The student data were observed by the researchers, and the calculation of the student learning motivation scale after using the learning media is as follows:

Table 9
Learning motivation indicators

Indicator	**Frequency**	**Calculation**	**Criteria**
When teaching and learning activities take place, students participate in carrying out their learning tasks.	31	$M = \frac{31}{31}$ x 100% = 100%	High
Students want to be involved in problem-solving in learning activities.	24	$M = \frac{24}{31}$ x 100% = 77%	High
Students want to ask friends or teachers if they do not understand the material or encounter difficulties.	26	$M = \frac{26}{31}$ x 100% = 84%	High
Students want to try to find information that can be used for solving the problems they are facing.	22	$M = \frac{22}{31}$ x 100% = 71%	High
Mean		**83%**	**High**

Source: Processed data

Based on the student motivation indicators, this research is considered successful, because out of 31 students, the percentage for the student learning motivation category falls into the high criterion. The result of these indicators shows a score of 83, which is categorized as high. Therefore, the use of learning media can enhance the aspect of student learning motivation.

CONCLUSION

Novelty and Contribution

STEMATIK learning media are learning tools that integrate STEM and thematic learning

models. STEMATIK learning media integrates many learning contents, thus encompassing multiple intelligences of students. The learning contents of the learning media created by the teacher includes PPKn learning content in the form of attitude assessment, SBdP in the form of student creativity assessment, and Indonesian Language in the form of reading comprehension assessment.

Limitation and Future Study

This study has several limitations, one of which is that the data collection on student independence cannot be generalized to every student. Not all students applied honesty (avoiding peer cheating) when completing cognitive tasks.

Implication and Suggestions

The research results prove that a learning system adopting learning media can enhance knowledge, independence, and motivation of elementary school students. The integration of STEM and thematic learning is a good integration to implement because it covers various aspects of learning content. The easy-to-use STEM model influenced the students' interest in using the media, while its thematic content aimed to integrate several learning contents in accordance with the 2013 curriculum model that is based on thematic content.

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AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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