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Developing Flipped Classroom Learning Materials to Improve Mathematical Literacy and Learning Independence

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Abstrak

Penelitian ini bertujuan untuk membuat perangkat pembelajaran berbasis Flipped Classroom Model yang berkualitas tinggi untuk meningkatkan literasi matematika dan kemandirian belajar siswa SMP kelas VII materi ukuran pemusatan data. Metode penelitian ini merupakan penelitian pengembangan metode Analysis, Design, Development, Implementation, Evaluation (ADDIE). Hasil penelitian ini adalah perangkat pembelajaran berbasis Flipped Classroom Model valid dan praktis; kemampuan literasi matematika siswa meningkat sebesar 0,65 yang tergolong sedang; kemampuan belajar mandiri siswa meningkat sebesar 0,23 yang tergolong sedang. Flipped Classroom Model efektif untuk pembelajaran Pengukuran Sentralisasi Data. Flipped Classroom Model berfungsi baik untuk pembelajaran ukuran pemusatan data. Lebih dari 75% tujuan pembelajaran tercapai, lebih dari 85% siswa memperoleh nilai minimal 75, lebih dari 85% siswa memberikan respon positif terhadap perangkat pembelajaran berbasis model flipped classroom, dan penggunaan waktu pada perangkat pembelajaran tidak melebihi jam pembelajaran reguler.

Kata Kunci: *Kemandirian Belajar, Literasi Matematika, Model Flipped Classroom*

Abstract

This study aims to create a high-quality Flipped Classroom Model-based learning device to improve mathematical literacy and learning independence of seventh grade junior high school students on data centralization measurement material. This research method is a development research of the Analysis, Design, Development, Implementation, Evaluation (ADDIE) method. The results of this study are that the Flipped Classroom Model-based learning device is valid and practical; students' mathematical literacy skills increased by 0.65 which is classified as moderate; students' independent learning abilities increased by 0.23 which is classified as moderate. The Flipped Classroom Model is effective for learning Data Centralization Measurement. The Flipped Classroom Model functions well for learning data centralization measurements. More than 75% of learning objectives were achieved, more than 85% of students scored at least 75, more than 85% of students responded positively to the flipped classroom model-based learning device, and the use of time on the learning device did not exceed regular learning hours.

Keywords: *Learning Independence, Mathematical Literacy, Flipped Classroom Model*

A. Introduction

Mathematical literacy is one skill. (Zahroh, H., Hafidah, 2020) defined mathematical literacy as the capacity to understand, communicate, and solve issues. Therefore, every student needs this capacity to increase their talents. (Kosasih, 2019) defined mathematical literacy as the ability to identify and understand concepts that are used to solve problems. Other scholars define mathematical literacy as the capacity to accept and comprehend information (Handayani, N. F., & Mahrita, 2021). According to (Asrizal, 2018) noted that mathematical literacy requires a methodical attitude, logical thinking, and effective communication to solve common issues and compete in life. Mathematical literacy is the knowledge and skills needed to complete personal and social mathematical records and satisfy the social demands of informed, reflective, and participating citizens (Bakhruddin, 2021). In his study, (Riwulang, 2024) mentioned that mathematical literacy skills are the capacity to apply mathematics in the actual world, the major objective of mathematics education worldwide.

In the process of learning mathematics, mathematical literacy skills are an aspect that needs to be taken seriously. (Sabilli Firman Syah, 2024) stated that mathematical literacy skills possessed by students can help them solve problems faced in life, interpret data, graphics, numerical reasons and geometric situations, and communicate using mathematics. Furthermore, (Ariani, 2017) stated that in line with the increasing development of communication technology and science, mathematics has become the basis for solving problems, processing information and communicating which are requirements in work. Therefore, mathematical literacy is needed by someone not only in everyday life but also in the world of work. In addition, the results of research by (Siswanto & Ratiningsih, 2020) increasing the mathematical literacy of junior high school students is very important because the results of PISA 2022 showed a significant decline in the mathematical literacy achievements of Indonesian students, with an average score decreasing compared to the results of (Anggraena., 2021). This decline is the impact of the Covid-19 pandemic, but is also caused by structural problems in the education system that existed before the pandemic(Schleicher, 2019).

According to (Riwulang, 2024), students' mathematical literacy skills are low, namely only 30% of students meet the KKM. Meanwhile, 70% of other students do not achieve the specified KKM. (Atikah, H. F., Sarifah, I., & Yudha, 20024) regarding junior high school mathematics textbook questions, it is known that in the competency test questions in mathematics textbooks, there are questions that are included in high-level thinking questions, namely around 0.39% - 11.63% of the total questions and most of the questions are included in application questions (applying) namely 66% - 92% of the total questions. This shows that the test instruments used in mathematics learning in schools still do not facilitate students' mathematical literacy skills because learning is only oriented towards procedural knowledge and the use of routine questions in evaluating student learning outcomes is still very dominant. To obtain information on the condition of mathematics learning in schools, on August 18, 2024, researchers conducted

a mathematical literacy test on class VII-1 of SMP Negeri 2 Rahuning, totaling 32 students. To measure the category of students' level of mastery of students' mathematical literacy skills, it will be adjusted to the category of mastery levels based on (Kemendikbud, 2013). Based on the information obtained, 3 students managed to get a score of 70 and 27 students got a score below 70. This achievement shows that the average level of students' mastery of students' mathematical literacy skills is 43.7%. This figure shows that the level of students' mastery of mathematical literacy skills is still in the low category. This finding is in line with the results of research by (Sintawati, M, 2019) which showed that students' mathematical literacy skills were relatively low with an average score of 44.44%.

In addition, students' learning independence also needs to be improved because based on direct observation in the classroom, students are still less enthusiastic about the material presented (Aulia , L. N., Susilo, S., & Subali, 2017). So the teacher has to explain repeatedly. Some students only pay attention to the teacher as a source of learning, and there are some students who look unfocused by occasionally looking away (Wulandari, 2022). Then when working on the questions given by the teacher, several students were found discussing and asking for answers from other friends to solve the questions. This is thought to be because the teacher has not used an innovative learning model, causing students to be less enthusiastic about learning. The low mathematical literacy and independence of students, especially at SMP Negeri 2 Rahuning, is partly due to the rarity of teachers in learning to link mathematics with real elements in everyday life. In addition, the questions used have never been experienced by students or have never been heard by students. So that students are less enthusiastic and less responsive to these questions. Then the affective aspect that also determines the success of students according to (Turmuzi, 2022) in learning mathematics is learning independence.

This is in line with the regulation of the Minister of Education and Culture of the Republic of Indonesia Number 65 of 2013 concerning the standards of elementary and secondary education processes, namely the learning process in elementary and secondary education units, namely the learning process in educational units is held interactively, inspiringly, fun, challenging, motivating students to participate actively, and independently according to the interests, talents and physical and psychological development of students. Learning activities that are thought to be able to be applied to improve mathematical literacy skills and student independence are the Flipped Classroom learning model on the subject of data centralization measures (Meilisa, 2020).

Flipped Classroom (Sukma, L. H., Ramadoni, R., & Suryani, 2022) is one of the blended learning models. Flipped classroom is an implementation of a learning model where teachers can divide the time for learning activities outside the classroom, at school and sending online assignments after school (Nurhayati, S., 2013). According to (Septriani, Nicke, Irwan, 2019)

flipped classroom is a learning process that reduces the capacity of learning activities in the classroom. Flipped classroom is a learning model where the provision of material and assignments are reversed (Meilisa, 2020).

The material that is usually delivered in class turns into homework that must be studied. While at school, students do assignments or confirm the knowledge learned at home with their friends and teachers. In flipped classroom learning, the media used is the Google Classroom application which can be accessed on a laptop or mobile. Google Classroom is quite easy to learn and is a fairly light application to reach students even though the internet network is limited at home (Marzano, R. J. dan Heflebower, 2012). Flipped classroom learning makes students more active and more involved when class learning begins (Surjono, 2017).

According to (Sukma, L. H., Ramadoni, R., & Suryani, 2022), flipped classroom can improve students' ability to understand the material and their learning outcomes. So the success of the flipped classroom will be largely determined by the attitudes and learning methods of students outside the classroom (Nana Laode Sukmadinata, 2018). The Flipped Classroom Learning Model can improve students' mathematical literacy skills and learning independence with an extension of the traditional method of learning. Students study the material at home through videos or online sources provided by teachers or others, then apply that knowledge in class through discussions and problem solving (Maulia, 2017). This learning model encourages students to take responsibility for their own learning, increases interaction with teachers, and develops important thinking skills needed in mathematical literacy. Thus, this learning model creates a more active and independent learning environment. Based on the explanation above, a study can be conducted with the title "Development of Learning Tools based on the Flipped Classroom Model to improve mathematical literacy and learning independence of class VII students".

B. Research Method

This type of research is development research. This development research uses Analysis-Design-Develop-Implement-Evaluate (ADDIE) development. According to (Sugiyono, 2018) there is one learning design model that is more generic in nature, namely the ADDIE development model (Analysis-Design-Develop-implement-Evaluate). The selection of this model is based on the consideration that this model is developed systematically and is based on the theoretical foundation of learning design. This research was conducted at SMP Negeri 2 Rahuning in the even semester. The subjects in this study were all students of class VII of SMP Negeri 2 Rahuning. The selection of junior high school students of class VII as research objects was based on considerations of the cognitive level of students. As, junior high school students/MTs are included in the concrete operational stage to formal operational. Sampling in this study was selected randomly consisting of 2 existing classes. The development of ADDIE consists of five steps, namely: (1) analysis, (2) design, (3) development, (4) implementation, and (5) evaluation. The following are systematic stages as follows;

Analysis

At this stage, the activity is to analyze the need for the development of new learning methods and analyze the feasibility and requirements for the development of new learning methods.

Design

At this stage is to plan teaching and learning activities. This activity is a systematic process that starts from setting learning objectives, designing scenarios or teaching and learning activities, designing learning devices (such as teaching modules, teacher books, student books, LKPD and Tests). The design of this learning method is still conceptual and will underlie the next development process.

Development

Based on the development procedure, the implementation at this development stage is the start of product creation so that it produces a product in the form of a good final device, then validation will be carried out by experts. Furthermore, it will be revised based on input from experts and data obtained from field implementation.

Implementation

Implementation is carried out to obtain input from the developed learning devices to see their effectiveness, increasing mathematical literacy skills based on the flippedclassroom model and student responses.

Evaluation

Evaluation is a process to see whether the learning devices that have been prepared have been successful or in accordance with initial expectations or not. Evaluation can be carried out formatively or summatively

C. Result and Discussion

Data analysis and research results obtained at each stage of development are presented as follows:

Analysis

Observations at SMP Negeri 2 Rahuning show that it uses the Independent Curriculum. At this step, the researcher examined grade VII SMP Semester 2 Mathematics, particularly data centralization procedures. Centralization measurements include mean, median, and mode. According to the Minister of Education and Culture's autonomous curriculum regulation, Phase D's Learning Outcomes indicators are examined for learning tool development. This research uses a concept map to identify, describe, and arrange students' data centralization assessment topics. This concept map is customized for the Flipped Classroom Model to promote students' mathematical literacy and learning freedom. The student's book contains the idea map. A research idea map is below.

Figure 1. Concept Map View

Design

The purpose of this stage is to design learning devices so that a prototype (initial design of learning media) is obtained for the data centralization measurement material. Activities at this stage are test preparation, media selection, format selection, and initial design of learning devices.

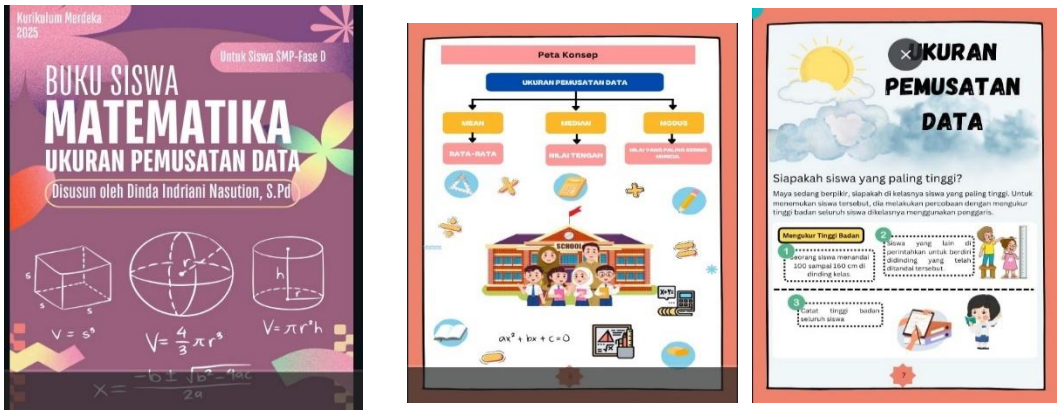

Figure 2. Student Book Layout

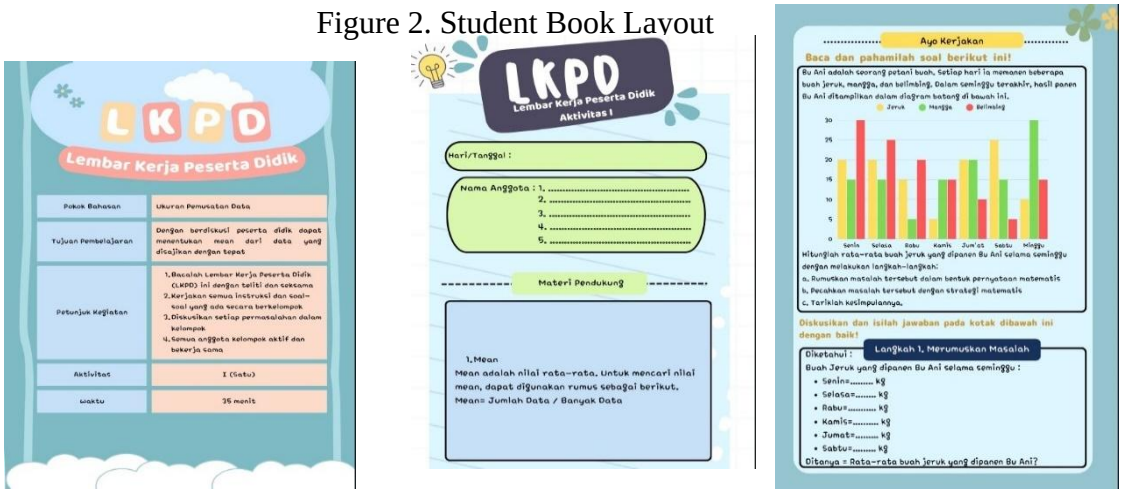

Figure 3. Student Activity Sheet Display

Development

An basic learning device design is created during the Analysis and Design Stages. Field trials follow expert validation at the development stage. Expert validation examines the learning device's format, content, images, and language. Expert validation yields validation values, adjustments, comments, and ideas for enhancing the learning device. Revisiond learning device satisfies relevant requirements. The validation results in the learning process can be seen in the following table.

Table 1. Validation Results

No	Aspect	Average	Category
1	Teaching Module	4,6	Valid
2	Teacher's Book	4,5	Valid
2	Student Worksheets	4,5	Valid
3	Mathematical Literacy Ability Test	4,5	Valid
4	Learning Independence	4,5	Valid

Table 1 shows that the RPP, Student Worksheets have a total "valid" average of 4.5. The data in this study were analyzed using descriptive statistical analysis. According to Sheskin (2004), descriptive statistics as an analysis tool for the purpose of describing data without drawing conclusions and making predictions. Common procedures used in descriptive statistics are in the form of tables, graphs, diagrams and calculations on the size of the central and dispersion of data.

Implementation

Results of Mathematical Literacy Ability Test Analysis

In this research, students' mathematical thinking abilities are tested to determine their competence. Pretest and posttest were given to 32 pupils in class VII-1 to measure mathematical literacy. Table 4.18 describes mathematical critical thinking abilities test results:

Table 2. Description of Mathematical Literacy Ability Results

Description	*Pretest*	*Posttest*
Highest Value	83,00	98,00
Lowest Value	33,00	69,00
Average	67,86	88,96

According to table 2, the average pretest mathematical literacy ability was 67.86, with the greatest value of 83.00 and the lowest value of 33.00, and the average posttest score was 88.96, with the highest value of 98.00 and the lowest value of 69.00. Table 4.19 shows the implementation outcomes' mathematical literacy levels.

Table 3 Level of Mastery of Mathematical Literacy Skills

No	Value Interval	*Pretest*	*Posttest*	Category

		Number of Students	Percentage	Number of Students	Percentage	
1	90 ≤ KKLM ≤ 100	0	0%	14	43,75%	Very High
2	80 ≤ KKLM < 90	2	6,25%	17	53,12%	High
3	70 ≤ KKLM < 80	15	46,87%	0	0%	Fair
4	60 ≤ KKLM < 70	10	31,25%	0	0%	Low
5	0 ≤ KKLM < 60	5	15,62%	1	3,12%	Very Low

Table 3 shows that in the pretest of 32 students, no students had mathematical literacy skills in the very high category (0%), 2 students (6.25%) had high mastery, 15 students (46.87%) had sufficient mastery, 10 students (31.25%) had low mastery, and 5 students (15.62%) had very low mastery. In the posttest after learning using flipped classroom devices, 14 students (43.75%) had very high mastery, 17 students (53.12%) had high mastery, 1 student (0%) had very low mastery, and no students (0%) had sufficient or low mastery.

Analysis of Student Learning Independence Results

The student learning independence questionnaire evaluated how well students take responsibility for themselves, show initiative, control their actions, and stay stable while understanding media and learning tools used in a flipped classroom model. 15 good and 15 negative comments were on the student learning independence questionnaire. According to the analysis of student questionnaire answers, the average proportion of favourable student learning independence questionnaire replies is shown in Table 4.

Table 4.Results of Student Learning Independence Questionnaire

Interval	Category	Pretest		Posttest	
		Number of Students	Percentage	Number of Students	Percentage
76-100	Very Good	4	12,50%	14	43,76%
51-75	Good	17	53,12%	17	53,12%
26-50	Quite Good	11	34,38%	1	3,12%
0-25	Not Good	0	0%	0	0%
Total		32	100%	32	100%

Based on table 4.22, it shows that before being given treatment, students who obtained the very good category were 4 students (12.50%), students who obtained the good category were 17 students (53.12%), for the fairly good category were 11 students (34.38%) and for the less good category were 0 students (0%). While after being given treatment, students who obtained the very good category were 14 students (43.76%), students who obtained the good category were 17 students (53.12%), for the fairly good category were 1 student (3.12%) and the less good category were 0 students (0%).

Overall, these results support that the developed learning devices are effective in facilitating increased literacy and learning independence, although they have not achieved maximum

results for all students. It can be concluded that the learning products are very much enjoyed by students and can improve students' literacy and learning independence..

Evaluation

This assessment step evaluates learning device quality. Researchers assess learning progress and suggest device and learning enhancements at this stage. All stages of analysis, design, development, and implementation are evaluated. Five validators—three lecturers and two teachers—complete and validate the learning gadget. The five validators changed the media and mathematical literacy ability tests' image and table descriptions, the LKPD's instructions for filling in answers, and the learning independence questionnaire's language. Thus, the product is considered legitimate after incorporating minor changes suggested by the five validators. The created learning gadget was also tested in SMP Negeri 2 Rahuning class VII-1. Based on five essay questions on mathematical literacy ability and 30 assertions about learning independence, it was valid, reliable, and could be utilized for research.

Discussion

Experts validated flipped class model-based learning devices, finding that teaching modules, teacher books, student books, and LKPD met validity indicators of 4.6, 4.58, and 4.56, respectively. The flipped class model's learning gadgets may assess students' critical thinking and learning independence. The learning devices in this study are more valid than those in (Septriani, Nicke, Irwan, 2019) on the development of flipped class learning devices to improve science learning independence in elementary schools with the ADDIE model for students in grade V of SD Kanisius Noyoyudan Yogyakarta, with RPP validation of 3.33 and learning module validation of 3.38 and a very feasible category, respectively. Dea (Mirnasulistyawati, Armelia, 2019) developed flipped class learning devices based on Schoology and guided discovery learning on grade VIII students' conceptual understanding with the ADDIE model, which had an LKS validity value of 139 with very good criteria, an LMS validity value of 79.5 with good criteria, and a concept understanding test validity value of 52 with very good criteria. According to (Lestari, 2018), flipped class learning gadgets on harmonic vibration material have an average product score of 43.60 with a highly valid certification. According to Andi (Ramadhani, R., Wardani, H., Nurdalilah, N., & Nasution, 2023), flipped class learning gadgets have a media expert validity rating of 3.96 and a material expert validity value of 3.68. Research by Arini (Setyaningsih, R., & Rahman, 2022)on a flipped learning design model for daring learning with 3.36 learning device validity was quite valid. Then, from student response analysis, a realistic success criterion. According to student answers, the learning gadgets produced satisfied practicality requirements with an average score of 87.31% in the very favourable category. Since more than 85% of students liked the learning gadget based on the flipped class concept, it satisfied the practicality indication. This study's observation score for

learning implementation is higher than (Dawa, 2021) relevant research on the development of LKPD oriented to the flipped class learning model on social arithmetic material with the ADDIE model's 83.2% practicality score with a very practical category. It is lower than Andri Sriatu Nurdiyanti (Setyaningsih, R., & Rahman, 2022)'s study on ratuchemweb media in the flipped class learning paradigm, which had a teacher response of 98.92% and a student response of 84.04%.According to posttest findings after utilizing the created learning gadget, 31 of 32 pupils (96.88%) were deemed complete or had traditionally successful grades in mathematical literacy.

D. Conclusion

Based on the results of the research and discussion in this study, the following conclusions can be put forward: learning devices based on the flipped classroom model in improving students' mathematical literacy skills and learning independence are included in the valid category. The learning device is a teaching module with a validity level of 4.6 or in the valid, practical and effective category. The results of the analysis of improving students' mathematical literacy skills and learning independence after learning using learning devices based on the flipped classroom model have increased.

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