

The Development of Teaching Material on Integers with Problem-Based Learning Model

Bagus Ardi Saputro^{✉1}, Siti Nur Fadlilah² & Mira Azizah³

^{1,2,3} Faculty of Education, Universitas PGRI Semarang, Semarang, Indonesia

✉ bagusardi@upgris.ac.id

Abstract. A variety of observations and findings revealed that the current teaching materials for mathematics learning, particularly in the area of integer operations at the elementary school level, are inadequate to meet the learning needs of students. To address this issue, this study was conducted with the goal of developing effective and engaging learning materials for integer operations designed around a Problem-Based Learning (PBL) model. The research involved 17 students and 2 teachers from the 6th grade at SDN 2 Ringin. Data collection was carried out through a combination of observation, interviews, and questionnaires, ensuring a thorough understanding of the teaching and learning environment. The PBL approach was integrated into classroom activities, while the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) guided the systematic development of the materials. Results showed that both students and teachers responded favorably, with experts evaluating the materials as practical and valid. These materials offer a promising alternative for improving mathematics learning in elementary schools.

Keywords: ADDIE Model; Development; Integer; Mathematical; Operations; Problem-Based Learning; Teaching Material.

1. Introduction

In everyday life, it is not possible to separate humans and mathematics, both in the smallest details and in the most complex technological advances. Therefore, starting from elementary school, all students must be exposed to mathematics to equip them with the ability to think logically, analytically, systematically, critically, innovatively, creatively, and collaboratively. It was shown that learning is not applied and implemented as intended in schools. The learning process only focuses on completing the subject matter rather than developing students' understanding and sense of significance. Another problem is that students and teachers only use teaching materials provided by the government, such as student books and teacher books (Lewis et al., 2020).

Students' difficulties in mathematics learning are caused by some factors, namely teachers that are still using conventional methods (lectures) in teaching, without using media, only referring to information in student books, and not linking information to students' knowledge and experience. The use of monotonous teaching materials, the absence of learning media, and a focus on student learning outcomes without considering the learning process all contribute to monotony and lack of creativity in mathematics learning (McCormick, 2022; Russo et al., 28M.; Tanujaya et al., 2017). The teaching materials and learning models used are one of the important aspects of the sustainability of mathematics learning. According to Sukmawarti (2022), the development of problem-based teaching materials can improve students' understanding of learning mathematics, especially in Integer material.

1.1. Problem Statement

It was observed and widely known that students have a lack of interest in mathematics learning; the difficulty of class VI students is in terms of memorizing the arithmetic operations of addition, subtraction, multiplication, and division in positive and negative integers. Not only that, but also, to make matters worse, out of 17 students in class VI, only a few students

understand positive and negative integers.

The mathematics learning activity only uses thematic books given by the government as learning resources. Students and teachers only use books provided by the government to study. However, to improve student achievement in the learning process, teachers and students still need additional learning resources for them to use.

1.2. Related Research

There was a study conducted by Nisa (2017). PBL is a learning model that uses real-world problems presented at the beginning of learning. Then, the problem is investigated to find out the solution to the problem. However, based on the facts obtained during the research, it shows that mathematical competence, especially students' mathematical problem-solving ability, was low. The low ability of students' mathematical problem-solving skills will affect the quality of learning.

Teacher activity in managing learning in Cycle I was classified as good, while in Cycle II, it was classified as very good, while student activity during learning in Cycle I and Cycle II was classified as good. On the other hand, students' problem-solving ability in the aspect of understanding problems was still low, which was 60%, then after cycle II there is an increase to 100%.57 In the aspect of making problem plans in cycle I, 77.77% was obtained, then after cycle II, there was an increase to 90.90%. In the aspect of making problem plans in cycle I, 72.22% was obtained, then after cycle II, there was an increase to 100%. In the aspect of re-checking and drawing conclusions, it was still low, which was in cycle I, 11.11% was obtained, but after cycle II, students' ability in the aspect of re-checking and drawing conclusions decreased to 9.09%. In the researcher learning outcomes in cycle I, 78% achieved learning completeness; in cycle II, students' learning completeness reached 90.90%, and students' learning completeness in the final test reached 95.65%.

Research conducted by Sukmawati (2022). The results of this study are relevant to the teaching materials that will be developed with positive and negative integer material that will be discussed in this study. The purpose of this study is to improve students' mathematical problem-solving abilities. This type of research is development research consisting of five stages, namely: analysis, design, development, implementation, and evaluation. In Sukmawati's study, the results of the validation of material experts obtained an average of 91.7. While the validation of media experts obtained an average of 63.5 and the validation of grade IV teachers obtained an average of 78.8, from the average results, it was obtained that the validation of experts and grade IV teachers on Mathematics teaching materials with PBL is "very valid and practical".

Yuristia's (2022) study found that the developed module was very valid in terms of language (3.8 valid), material (3.6 valid), design (3.33), and the average validation of expert lecturers (3.57)—all very high. The teacher's practicality test scored 76% quite practical, 100% very practical benefits, and 100% very practical timeliness. The teacher's practicality presentation scored an average of 92% very practical. Student scores were 93.26 very practical, 93.26 student interest was very practical, 94.71 the process of use was very practical, 95.19 the time available was very practical, and 90.38 the assessment was very practical for their practicality in increasing creativity. The average percentage of very practical students was 93.36. The PBL-based science learning module was declared valid, useful, and applicable in grade IV of elementary school.

Based on the three studies, it can be seen that these studies are relevant to this study, namely that they both develop teaching materials with the PBL model. The difference between the three studies conducted by the researcher is that the researcher uses teaching materials to strengthen the material in learning while the three researchers focus on improving mathematical problem-solving skills. This study focuses on positive and negative integers for grade VI Elementary School. This study is adjusted to the needs of students in understanding positive and negative integers with the PBL model. This study produces teaching materials in the form of stories.

1.3. Research Objectives

1. How is the development of mathematics teaching materials for 6th-grade elementary school students in the materials of integers using problem-based learning?
2. What are the practicalities of learning integer material using problem-based learning?
3. What is the feasibility of teaching materials developed based on problem-based learning?

2. Theoretical Framework

Teaching materials are a collection of logical resources that students can use to learn and adapt to the existing curriculum. Cahyadi, (2019) stated that a set of teaching materials containing content or learning materials to achieve learning objectives is called teaching materials.

2.1. Types Teaching Materials

According to Kurnia et al., (2019), there are various printed and non-printed teaching materials. Books, handouts, modules, and student tasks (worksheets) are examples of general printed teaching materials used. Handouts are all something accepted by students at the time following activity learning. Therefore, handouts are created with meaning to help students obtain information or material learning as reference sources for students.

2.2. Teaching Materials Elements

There are six components of teaching materials (Pilendia, 2020). Those elements are:

- 1) Learning instructions: Instructions for students and teachers can be found in this section. It explains how teachers should teach students and how students should learn the content in this teaching material.
- 2) Competency standards, basic competencies, and indicators of learning achievement must be listed in the teaching materials as competencies that students must master. Therefore, the goals that students must achieve are very clear.
- 3) Supporting information is a variety of additional information that can improve a teaching resource. It is hoped that students will be able to learn the material faster. If imitated, students' knowledge will be more comprehensive.
- 4) After studying the teaching material, students are given exercises as a form of homework to practice their skills. As a result, they will maturely perfect and master the skills they learn.
- 5) Work instructions are also called worksheets, which are sheets containing instructions to students in a series of procedural steps to carry out various activities related to practice or other activities.
- 6) Evaluation is one component of the evaluation procedure. This is because a number of questions directed at students in the evaluation portion measure how well students have mastered the competencies they have mastered through participation in the learning process.

2.3. Teaching Materials Purposes

Referring to the teaching materials that the researcher has mentioned earlier, none other than teaching materials have a very specific purpose, and the purpose of this teaching material is to provide more valid results. According to Misrawati & Suryana (2021), the objectives of teaching materials include:

- 1) Providing teaching materials that are in line with curriculum needs while also considering student needs, especially teaching materials that are in accordance with student characteristics and their social settings or environments.
- 2) Helping students in obtaining selected learning materials other than textbooks which are

sometimes difficult to obtain.

- 3) Making it easier for teachers to teach. Setiawan & Jatmikowati (2021), the purpose of teaching materials in this case is to greatly assist educators and teachers in delivering learning or the teaching and learning process to students. In addition, teaching materials encourage students to participate in learning, allowing them to avoid relying solely on books or texts that are difficult to find. Instead, teaching materials will help students learn effectively.

2.4. Problem-Based Learning

This learning model incorporates problems as in the real world, daily life cannot be separated from facing problems. To stimulate high-level thinking skills, this learning model trains and develops problem-solving skills based on real-world problems faced by students every day. A conducive atmosphere for negotiation, openness, and democracy must be maintained. Sepulveda et al. (2021) recommend the importance of the PBL model: The learning model known as PBL or PBL uses real problems as a context for students to learn critical thinking, problem-solving skills, and knowledge acquisition.

According to Nurkhin et al., (2020), PBL is an unstructured curriculum and teaching model that encourages students to play an active role as everyday problem solvers and helps them develop stimulating problem-solving strategies as well as basic knowledge and skills. The two definitions above show that PBL is a learning environment guided by real-world problems. Meanwhile, Sari et al., (2021) The PBL model is a learning model where students are expected to learn knowledge related to these problems as well as have the skills to solve them. In this model, students participate in trying to solve problems by going through several stages of the scientific method.

The PBL model is a teaching model that trains and develops students' abilities to solve problems based on real-world problems faced by students in everyday life to encourage a higher order (Hendarwati et al., 2021). The PBL model is learning where students use authentic problems to learn and empower students, and the purpose of these is to increase their self-confidence (Ambarwati & Kurniasih, 2021).

2.4.1. Characteristics of Problem-Based Learning

Based on the hypothesis made by Widiastuti & Kurniasih, (2021) explains the characteristics of problem-based learning, which include:

- 1) Learning focuses on students' experiences that develop in PBL and further on students as individuals who learn. As a result, constructivism theory gives credence to PBL, which encourages students to learn on their own.
- 2) Real problems for organizing learning focus. The problems given to students are real problems so that they are easy to understand and can be used later in their professional lives.
- 3) Independent learning is how new information is learned. Students try to find their own sources, both from books and other information, because they may not know and understand all the information needed when they are solving problems.
- 4) PBL is carried out in small groups to facilitate scientific interaction and the exchange of ideas in an effort to develop science collaboratively. Group formation requires the assignment of different responsibilities and the achievement of different goals.
- 5) The teacher only acts as a facilitator during the learning process. However, the teacher must always monitor how student activities develop and encourage them to achieve their goals.

2.4.2. PBL Steps

Masriyah et al., (2020) stated that the PBL model has the following steps:

- 1) The instructor explains the learning objectives. The teacher encourages students to take part in several activities that focus on problem-solving.
- 2) By setting topics, assignments, and schedules, the teacher helps students determine and organize learning tasks related to the problem.
- 3) The teacher encourages students to collect data on the problem, test hypotheses, solve problems, conduct experiments to obtain explanations, and conduct experiments.
- 4) The teacher helps students plan and prepare appropriate work, such as reports and helps them with various assignments with their classmates.
- 5) The teacher helps students reflect on or evaluate investigations and learning methods.

2.4.3. Strengths and Weaknesses of Problem-Based Learning

Ramadhani et al., (2019) argued that the PBL model has the following advantages:

- 1) Encourages students to be able to solve problems in real-world situations.
- 2) Through learning activities, students can build their own knowledge.
- 3) Learning is centered on problems so that material that is not related to students does not need to be considered. Students tend to have to memorize or store information.
- 4) Students are involved in scientific activities through group work.
- 5) Students are accustomed to utilizing information obtained from interviews, observations, the internet, and libraries.
- 6) Students can evaluate their own progress in class.
- 7) In discussions or presentations of their work, students can communicate scientific ideas effectively.
- 8) Individual student learning difficulties can be overcome through peer teaching and group work.

Anazifa & Djukri (2017) stated that in addition to its advantages, the PBL model also has disadvantages as the following:

- 1) PBL cannot be applied to all subjects; there are components where instructors actively participate in presenting the material. PBL is more suitable for learning that requires specific problem-solving skills.
- 2) It will be difficult to provide tasks in a class with many different students.

3. Method

The research model conducted in this study was research and development (R&D). R&D is research that produces products or teaching materials Sugiyono (2013: 407). The ADDIE model is used in the study because it is more dynamic, efficient, and supportive of program performance. This model has five stages, namely 1.) Analysis. The first stage is carried out, namely needs analysis; this stage greatly influences the process of making teaching materials based on problem-based learning, which will be used to ensure that the products to be developed are in accordance with user needs. The Elementary School that is the place of research is at SDN 2 Ringin, which is located in Ringin, Pamotan District, Rembang Regency, Central Java Province. At the time of data collection carried out by the researcher, namely from the sixth-grade teacher of SDN 2 Ringin, namely Mrs. Pini S.Pd., in the form of interviews and distribution of teacher needs analysis questionnaires and student needs analysis questionnaires for grade VI of SDN 2 Ringin. The technique used to analyze the results of data collection is through interviews and needs analysis questionnaires through descriptive analysis

methods. 2.) Design. After carrying out the first stage, namely analysis, the researcher began to develop the teaching materials to be made. The teaching materials to be developed have a design that will be designed to meet the 33 needs of teachers and students in the learning process of class VI SDN 2 Ringin on the material of Integer Arithmetic Operations in this study, the design of learning media made by the researcher is a teaching material containing integer arithmetic operations made in the form of a story. The teaching materials will be made as interesting as possible with a technology-based form of printed book teaching materials so that students feel interested when learning begins so that students can focus on understanding the material presented. Stage 3.) Development. The next stage, namely the development stage, is carried out after the design of the teaching materials has been made. The researcher developed learning media in the form of teaching materials based on PBL in the form of stories to be used by class VI students of SDN 2 Ringin. At this stage of media development, several preparations need to be made, such as: a) Preparing class VI textbooks and textbooks from the government, as well as student books. b) Developing concepts, such as researchers making guidelines and designs, materials that will be displayed in the development of PBL teaching materials in the form of stories. c) Creating display designs in Adobe Illustration, which include cover designs, frames, and images. 34 d) Developing validation instruments in developing media, including media expert instruments, material expert instruments, teacher response questionnaires, and student response questionnaires. PBL teaching material products in the form of stories were successfully created, for the next stage is product validation carried out by media expert validators and material expert validators carried out by PGSD lecturers at PGRI Semarang University 4.) Implementation at the next stage is carried out by implementing products that have been created and developed. Students can use PBL-based teaching materials actively. This is done to solve problems related to real problems and can be solved by students and improve students' understanding related to integer material in class VI at SDN 2 Ringin. Researchers have validated the media and learning materials that will later be applied to grade VI students of SDN 2 Ringin. Implementation is also useful for assessing the teaching materials made by researchers to be able to make students understand, enjoy, or not. The following are the steps in implementing the development of PBL-based teaching materials. 5.) Evaluation. The evaluation stage aims to determine whether the mathematics learning module is valid and practical after being tested on mathematics teachers and students and validated by a team of experts.

3.1. Research Design

After carrying out the first stage, which is the analysis, the researcher developed the teaching materials. The teaching materials to develop have a design that will be crafted to meet the needs of teachers and students in the learning process of class VI of SDN 2 Ringin on the material "Integer Arithmetic Operations" in this study. In the analysis and design meeting, we utilized several different sources. First, our design is based on previous research on teaching and learning integers, especially models (Bofferding et al., 2018; Yilmaz et al., 2019) and metaphors (Chiu, 2001; Nürnberger-Haag, 2018) used to support students' understanding of integer operations. The design of the learning media created by the researcher is a teaching material containing integer arithmetic operations made in the form of fictional stories.

3.2. Participant

The researcher conducted this research at SDN 2 Ringin, Pamotan District, Rembang Regency, Central Java Province. The subjects of the research were 6th-grade teachers of SDN 2 Ringin. The data were collected from 17 students.

3.3. Data Collection

This study used several instruments to collect data for the project. Each is used to demonstrate the validity, reliability, and efficacy of the study. The data obtained are as follows.

1. Observation

Nasution (in Sugiyono. 2013) suggests that observation is the basis of all science. Scientists can only work Based on data, that is, facts about the world of reality obtained through observations

are collected with the help of various very sophisticated tools. Observation is used to collect preliminary data about the learning process in class VI. In this case, the researcher used unstructured observation. Researchers observing teachers obtain information about learning media used in learning activities, especially in the context of grade VI Mathematics lessons at SDN 2 Ringin.

2. Interview

According to Kurniawan (2020), In a free guided interview, the interviewer combines a free interview that is free to ask questions to respondents but still related to the desired data combined with a guided interview, execution in which the interviewer has brought guidelines on what is asked in the outline.

Table 1. Interview Instrument

No	Question	Answer
1.	Can the PBL model be applied to everyone? Mathematics materials especially regarding material number round?	
2.	How method Pini's mother is inside overcome? What are the shortcomings of this PBL model?	
3.	is There is factor reason main the failure application of learning models Problem-Based Learning?	
4.	Is PBL more effective than other method?	
5.	Is it in class VI that you teach? Already apply emancipated curriculum?	
6.	What solution will you give? when implementing PBL in integer material?	
7.	is source learning to use students and teachers only form book from government Mom?	
8.	When Mother explained about material number round is There is problems that arise like student No understand Mom?	
9.	Then, how Mother's way of coping if student Not yet understand about material number round as explained by Mrs. Pini?	
10.	How many Lots students who understand about the material in the book that you gave me?	
11.	Inside book print who knows from government nor dar party school is student Can do questions about material number round that?	
12.	How many are there? amount student boys in 6 th grade	
13.	How many are there? amount female students in class VI?	
14.	How many are there? amount all those in class VI of SDN 2 Ringin?	
15.	What makes student Spirit in Study the mathematics?	

3. Documentation

According to Sugiyono (2013: 476), documentation is a way used to obtain data and information in the form of books, archives, documents, numeric writing, and images in the form

of reports and information that can support research.

4. Validation Sheet

The Validation Sheet will verify the presentation method. By using this method, expert lecturers and mathematics teachers will be validators. This survey identifies modifications to tools and projects that will be used in addition to revisions. The current poll uses a rating scan (measurement scale) with five different ratings, namely 5, 4, 3, 2, and 1.

5. Student Response Questionnaire

A questionnaire is a research instrument that contains a series of questions or statements to collect data or information that respondents must answer freely according to their opinions. The student response questionnaire is used to measure the practicality aspect. The questionnaire aims to obtain data regarding students' opinions about the learning process they experience using the data presentation learning module. This questionnaire is in the form of a Likert scale with 4 assessment categories, namely: strongly agree (score 4), agree (score 3), disagree (score 2), strongly disagree (score 1). The basis for compiling this student response questionnaire is an assessment in which students are asked to assess themselves in relation to one, process, and level of achievement of competencies learned, namely: cognitive competence, affective competence, psychomotor competence, self-confidence, introspection, and objectivity.

6. Learning Activity Observation Sheet

The purpose of the activity observation sheet is to assess its usefulness. In addition, the observation sheet is to provide an understanding of the ongoing module learning process, identifying difficulties faced when implementing learning modules in the classroom. On the Guttman scale, there are two types of assessments for observing learning activities: positive and negative. In addition, to evaluate the learning process with the mathematics learning module, observers are asked to provide comments on each aspect being evaluated. Researchers will collect information from direct observation of learning activities. The reason for ordering this perception sheet alludes to Sudjana's hypothesis about the perspective in assessing educational and fostering experiences, namely: "curriculum consistency, implementation by teachers and students, student learning motivation, student activities, interaction between students and teachers, and teacher teaching skills.

3.4. Data Analysis

Sugiyono (2013: 407) argues that research and development methods are research methods used to produce certain products and test the effectiveness of these products, which produces learning teaching material products. The ADDIE model was used in this study because it is more dynamic, efficient, and supports program performance. The model has five stages the five components of the ADDIE development model are interconnected and have a systematic structure. This means that applications cannot be sorted randomly from the first stage to the fifth stage. When compared to other design models, these five stages are very simple. Because it is simple and organized, this design model is easy to understand and use.

1. Preliminary Study Stage

The preliminary study stage conducted by the researcher was to make observations and interviews with grade VI teachers of SDN 2 Ringin. In addition, it also gave question sheets to grade VI teachers and distributed questionnaires for teacher needs analysis and targeted analysis of student needs for grade VI SDN 2 Ringin. This was done to find out the problems that occurred during learning in class VI. From the results that have been found in the initial introduction, the media in the form of teaching materials used is less interesting, less active students in learning in the classroom, and lack of student understanding of integer material. In the ongoing learning, teachers only use package books from the government but also have not increased the interest in learning grade VI students. This has not attracted students to follow learning in class.

2. Development Stage

The model used in the research and development procedure used by researchers uses basic research steps (Research and Development). According to Hishamudin's (2016) ADDIE model, there are five stages in research and data collection, namely: Analysis, Design, Development Stage, Implementation, and Evaluation.

3. Data Collection Methods

Observation, Interview, and Documentation

4. Research Instruments

1) Validation Sheet

The Validation Sheet verifies how it is presented. Using this method, expert lecturers and mathematics teachers will become validators. The survey identifies tool and project modifications that will be used in addition to revisions. The poll currently uses a rating scan (measurement scale) with five different ratings, including 5, 4, 3, 2, and 1.

2) Student Response Questionnaire

A questionnaire is a research instrument that contains a series of questions or statements to capture data or information that respondents must answer freely according to their opinions. Student response questionnaires are used to measure practical aspects. The questionnaire aims to obtain data on students' opinions about the learning process they experience using the data presentation learning module. This questionnaire is in the form of a Likert scale with 4 categories of assessment, namely: strongly agree (score 4), agree (score 3), disagree (score 2), strongly disagree (score 1). The basis for the preparation of this student response questionnaire is an assessment from which students are asked to assess themselves in relation to one, process, and level of achievement of competencies learned based on jihad theory & Haris, namely: cognitive competence, affective competence, psychomotor competence, self-confidence, introspection, and objectivity.

3) Learning activity observation sheet

The purpose of activity observation sheets is to assess their usefulness. In addition, the observation sheet is to provide an understanding of the ongoing module learning process, identifying difficulties encountered when implementing learning modules in the classroom.

5. Data Analysis Techniques

1) Validity Analysis

In the validity analysis assessment, questionnaires are used to test validity in the following ways:

The validator tabulates the data provided by the math instructor. Assessment aspects are evaluated using score provisions for data tabulation as follows: 1 = disagree, 2 = disagree less, 3 = agree, and 4 = strongly agree.

2) Practicality Analysis

To see the responses of students in the developed module, a questionnaire will be distributed which will be analyzed.

3) Feasibility analysis

Media feasibility assessment scale, materials, Teacher response responses. From the results analysis of validity by expert validators material and media experts, each got a score end from media expert validators 97.91% with revision once, from material validator, expert got a score final 97.5% with revision three times then results from material validators and media expert validators were included into the very valid category. Whereas from evaluation analysis, practicality gained from results the teacher's responsescore of 97%, including in the very practical category; for results from analysis, eligibilityis obtained from the teacher's response

was 97%, so including into the Very practical and responsive category response participant educate get a score of 94,21% incl into the category worthy to use. Shaped data interviews, observation, and documentation including qualitative data, while data in the form of quantitative can be seen from calculation scores obtained from expert validators material, media expert validator, teacher response, and students response.

3.5. Validity and Reliability

3.5.1. Product Validation

After the product design/draft stage is complete, the teaching material product will be validated or assessed by media validation experts and material experts. Evaluation of the product is carried out to find out what is lacking in the product that has been designed, such as suggestions, criticisms, and input on the teaching materials that have been made. Evaluation and validation are very necessary to determine the level of feasibility and practicality of the teaching materials being developed. There are several stages of evaluation and validation of teaching materials, including:

- 1) Construct Validation. Construct validation carried out by 2 lecturers as media experts and experts material as material revision or repair teaching materials to become more good.
- 2) After validation of lecturer media experts and experts' materials, getting advice from the lecturer media/ product experts, teaching materials are carried out revision so that when the test is returned, it is already worth using in activity learning.
- 3) Teaching materials that have been assessed by the lecturer media experts and the lecturer expert material then tested in the field involving the sixth-grade teacher at SDN 2 Ringin to get it evaluation appropriateness products.
- 4) After everything is done and evaluated by an expert, then the teaching materials/books are printed on the material number round class VI SDN 2 Ringin.

3.5.2. Reliability

The results of this study showed that the analysis of the practicality of learning on integer material using PBL obtained a score of 94.21% and was said to be very practical. Meanwhile, the feasibility of teaching materials developed based on the PBL approach on integer material was obtained at 97% and was said to be very feasible.

4. Findings

The findings in this study are divided into three parts, namely a description of the results of the preliminary study, a description of the development result, and a discussion of the research results.

4.1. Description of Preliminary Study

In the first step, researchers have made observations, and interviews at SDN 2 Ringin, Pamotan District, Rembang Regency. The observations made by researchers are related to PBL or problems that grade VI students do not understand or do not know about, and grade VI teachers also do not understand and have not applied PBL in class VI. The limitations of student books are few and too superficial so students find it difficult to learn them. The enthusiasm for learning and enthusiasm to progress students also give the impression of being less marked by the presence of students who do not pay attention to the teacher's explanation. This is because, in teaching, teachers still use conventional methods (lectures) and lack of use of media in learning.

4.2. Description of Development Result

The steps for developing mathematics teaching materials for integers based on the PBL approach are as follows:

4.2.1. Analysis

The analysis was conducted to find out the problems in learning integers in class VI of SDN 2 Ringin and to determine the needs of students. In the analysis step, there are three activities carried out. The first step is an initial analysis, an interview was conducted with the class VI teacher of SDN 2 Ringin to obtain information related to learning activities in the classroom regarding integers. Based on the results of interviews conducted by researchers with class VI teachers of SDN 2 Ringin, it is known that the school has implemented Independent Curriculum and several classes have implemented the Independent Curriculum in stages. Based on this, the researcher provides a solution by developing mathematics teaching materials for integer operations material based on the PBL Approach with interesting and content and can facilitate teachers so that students are more active and not bored with teaching materials that previously made students inactive and become more active. The second step taken is student analysis, by distributing/distributing a needs questionnaire to students in class VI of SDN 2 Ringin. Based on the results of the questionnaire from students, many do not understand and cannot solve problems related to integers. So the researcher will provide a solution related to teaching materials in the form of problem-solving activities. The third step is analyzing the material that is in accordance with the Independent Curriculum teacher's book and paying attention to the learning outcomes that need to be achieved by students. The material contained in this teaching material is integer operations material.

4.2.2. Design

In this study, the design of learning media created by the researcher is a teaching material containing integer arithmetic operations. The teaching material created is technology-based in the form of printed book teaching materials so that students feel interested when learning begins, so that students can focus on understanding the material presented.

4.2.3. Development Stage

At this stage of media development, several preparations need to be made, such as: (1), Preparing grade VI textbooks from the government, as well as student books, (2) Preparing concepts, such as researchers making guidelines and designs, materials that will be displayed in the development of teaching materials based on PBL in the form of stories, (3) Creating a display design in Adobe Illustration which includes cover design, frames, and images, (4) Preparing validation instruments in developing media including media expert instruments, material expert instruments, teacher response questionnaires, and student response questionnaires. The results of this initial product development were validated by teaching materials from both media experts and learning material experts. Media expert validation was carried out by a team of experts consisting of media experts and material experts. In the first media expert validation, there was still a first revision obtained in the fairly practical category and can be seen in the following table.

Table 2. Assessment Rubric Learning Media Expert & Learning Material Expert

No	Aspect	Criteria	Mark			
			VG	G	F	NG
1.	Aspects of Teaching Material Cover Design	1. Cover background	4			
		2. Cover images	4			
		3. Text clarity	4			
		4. Does the cover represents the content?	4			
2.	Aspects of Teaching Material Design	The colors used in teachingmaterials	4			

			Images used in teaching materials using the PBL model	4
			The structure of mathematics teaching materials with the PBLmodel	4
			Text size on the cover teaching materials already in accordance	4
			size the letters used in teaching materials	4
			The image size on the cover what teaching materials	4
			The image size used in the content what teaching materials ? Already in accordance	4
			Text clarity on the cover	3
			Text clarity in the content	4
			Numbers clarity in the book	4
3.	Aspects of Storybook Content		material teaching materials are easy for students to understand class VI	4
			teaching materials provide learning about material of positive and negative integers using the PBLmodel	4
			the material in the teaching materials is alluring student to keep studying	4
			teaching materials have consistent images and texts	3
4.	Aspect of Appropriateness		Student's curiosity on learning book containing integers material	4
			How far is students' knowledge regarding the PBLteaching material	4
			Student's understanding to teaching materials of integers using the PBLmodel	4
			Students' motivation on integer problem solving	4
			Students' concentration on integer problem solving	4
			Feedback that students get after being taught by teachers using teaching materials that have been developed with the PBLmodel in the form of stories.	4
5	Aspect of Material Suitability		Conformity of CP, TP, and KKTP in teaching materials	4
			Learning objectives in teaching materials in accordance with the material studied	4
			The material containing positive and negative integers using the PBLmodel	4
6.	Aspect of Language		The language used is very easy to understand	4
			The text is properly written	4
			The language is simpel enough to	4

			understand	
			Students with various learning speed are all facilitated	4
7.	Aspect of Presentation of Material		The presentation of the material in the teaching materials is already in accordance with the teaching materials	3
			The story in form of questions are already available in teaching materials	4
			explanation of the number line in teaching materials already clear	3
			questions in form stories in teaching materials already available	4
8.	Aspect of Evaluation		The appropriateness of pictures	4
			Conformity of evaluation	4
			Clarity of questions	4
			Presentation of variation of question in teaching materials	4
9.	Aspect of Characteristics of problem-based learning		The learning focused on students growing experience	3
			It learns about solution to problems with students	4
			Learning independent/ how information just learned	4
			PBM is implemented in small groups	4

Source: Sukmawarti (2022); Febriandi (2020).

4.2.4. Application

In the next stage, development is carried out by implementing the products that have been created and developed. Students can use the PBLteaching materials based actively, this is done to solve problems related to real problems and can be solved by students and improve understanding of students related to integer material in class VI at SDN 2 Ringin. Researchers have validated the media and learning materials that will later be applied to class VI students of SDN 2 Ringin. Implementation is also useful for assessing the teaching materials made by researchers to make students understand, enjoy and not. The trial was carried out for three days of meetings. The activity of the Ull trial of mathematics teaching materials on integer operations based on the PBLapproach. At the first meeting, the researcher first confirmed and gave a letter to the school, especially to the Principal of SDN 2 Ringin. and provided an explanation regarding the researcher to conduct research at SDN 2 Ringin so that class VI students of SDN 2 Ringin could also prepare themselves. On the second day, the researcher went to the field in class VI of SDN 2 Ringin and introduced students to the Mathematics Teaching Materials on Integers Based on the PBLapproach that had been developed.

In the second meeting, the researcher introduced, explained and applied the teaching materials that had been developed to class VI students of SDN 2 Ringin. Learning began with several points according to the learning syntax book. The first point began by orienting students to problems related to integers. With the help of concrete media such as thermometers applied to the number line. Other concrete media such as congklak applied to the addition and subtraction arithmetic operations taught to students. At the second meeting, students were explained about reading, writing, determining place values, composition and decomposition by applying concrete media called circle patterns. Organizing students to learn related to the first problem, third guiding individual and group investigations means that students when solving problems must be made in groups, fourth developing and presenting work at this fourth point students will be asked about the definition of integers after that, fifth analyzing and evaluating the problem solving process evaluation means that at the last stage

a joint evaluation will be held.

At the third meeting, students were explained about multiplication and division, applying concrete media such as an abacus. Students were asked to fill out a student response questionnaire containing several statements related to the teaching materials that the researcher developed. Teachers will also be asked to fill out a teacher response questionnaire. This aims to find out the responses and responses of students and teachers regarding the teaching materials that the researcher has developed and implemented in class VI of SDN 2 Ringin.

Table 3. Rubric (Teacher Response) Teaching Materials for Mathematics in Integer Operation with PBL Approach in the form of a story titled "The Integer Story"

No	Statement	Information			
		VA	A	SDA	DA
1.	Description materials, pictures, as well as illustrations contained in teaching materials are not clear and difficult to apply to student				1
2.	Material in mathematics teaching materials related with life everyday	4			
3.	On use mathematics teaching materials number round teacher still need another reference for teach			2	
4.	Mathematics teaching materials related with solution problem	4			
5.	Mathematics teaching materials containing about capable questions help finish problem mathematical student	4			
6.	Use language in mathematics teaching materials easy to understand	4			
7.	Mathematics teaching materials use simple language	4			
8.	Letters used in mathematics teaching materials difficult to read		3		
9.	Mathematics teaching materials makes it easier student in the learning process , so in learning effective	4			
10.	Use mathematics teaching materials makes it easier student in the learning process , so learning become efficient	4			
11.	Using learning media more save cost in do activity learning	4			
12.	Learning with using print based media form book teaching	4			

materials are very popular student

- | | | |
|-----|--|---|
| 13. | Learning with using print media form teaching materials can be used without There is limitation time | 4 |
| 14. | Use of based media the PBL approach is difficult student in Study | 2 |
| 15. | Learning media form mathematics teaching materials on the material number round can help student solve problem in a way together | 4 |

Suggestions, comments, or critics

With the existence of the teaching materials developed, it is helpful for student to solve problem related with integer material.

The questionnaire results showed the teachers' responses stated in the table above, showing average ratings from teachers regarding Integer Mathematics Teaching Materials with the approach. Very agree/very good response scored as much as 97% from all responses.

4.2.5. Evaluation

The evaluation of the ADDIE development model is carried out in every stage, starting from the stage of analysis, design, development, and implementation as well as evaluation. This is in use for producing product development-appropriate teaching materials. At stage analysis, information-related problems in learning, availability of teaching materials, and participant education need to be evaluated to find the right solution. Solutions provided by researchers that are developing Mathematics Teaching Materials Based on Integer Material with problem-based learning.

4.2.6. Research Results

In the results of the study conducted by researchers in class VI of SDN 2 Ringin, teachers did not use the PBL learning model teaching materials in mathematics subjects on integers. Teachers only use textbooks owned by students in the learning process. So, what is conveyed by the teacher is not easily understood by students because students feel bored, so they do not focus on the learning given. In learning mathematics, especially in integers, students need the development of learning models such as PBL in mathematics subjects on integers so that learning is not too monotonous. With the development of teaching materials, it can make it easier for students to understand learning. Most students consider their learning difficult using calculations, so many students do not like the learning because, from the beginning, they consider the learning to be scary, so students' interest in learning decreases.

Therefore, the solution that can be provided by researchers from this problem is that teachers must be able to make new innovations to attract students' attention in the teaching and learning process. To create an active, effective, creative, and innovative learning process that is fun and understandable. Teachers must be able to use learning models. Therefore, the solution that can be applied is to create new teaching materials so that they can attract students' attention by using the PBL model so that it can increase students' interest in learning. By using the PBL model, learning mathematics on integer material can solve problems in everyday life and understand the material quickly. The PBL model is an effort to change learning that has so far been centered on teachers to be centered on students. According to Ngalimun (2016), PBL is an innovative learning model that can provide active learning conditions for students. The PBL model is a model that involves students being able to learn knowledge related to the problem and have the skills to solve problems.

This research method is categorized into the Research & Development using the ADDIE model. Sugiyono (2013) stated that development research is a research method used to produce certain products with certain stages through expert tests and tests in the field to determine the effectiveness of the products developed.

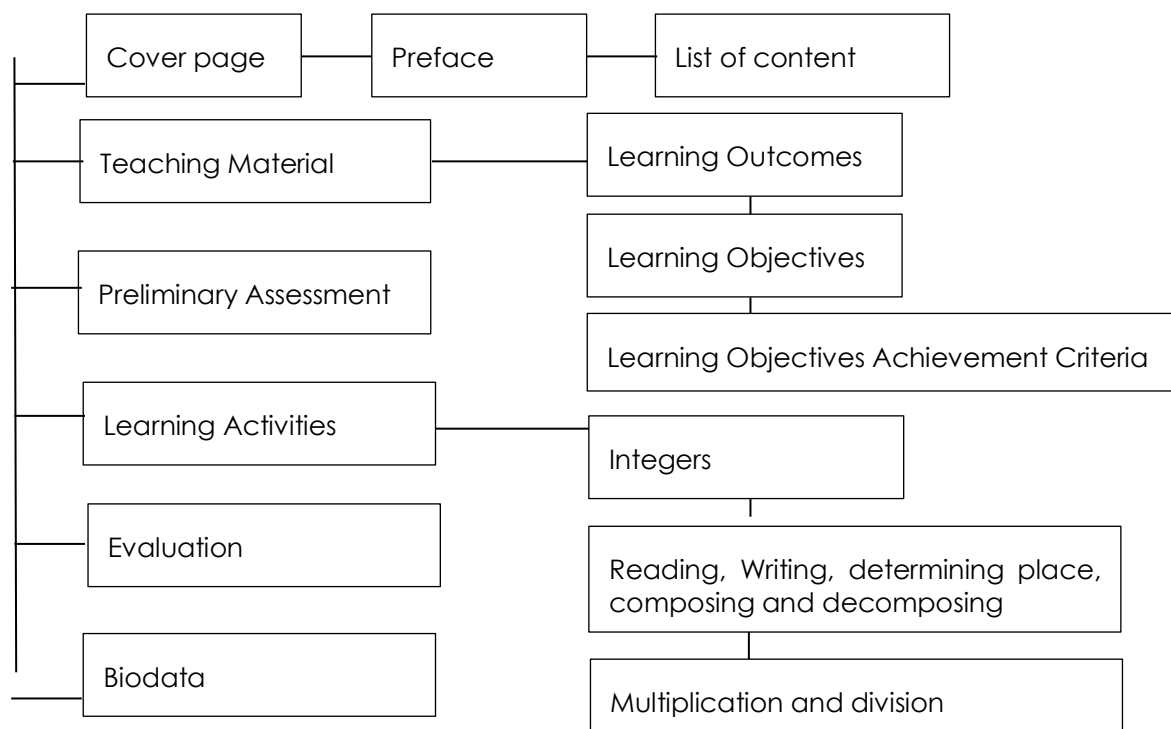


Figure 1. Teaching Material Design Chart

This stage involves creating, developing, modifying, and conducting field trials of teaching materials. The process of creating these materials is based on the results of the analysis and design stages. Researchers use data collected from these previous stages to develop materials that align with students' needs. Teaching materials for integer mathematics for grade VI, developed with the PBL model, were tested with students and validated by experts, including media and content experts. During the development phase, activities include creating teaching materials based on findings from the analysis and design stages. After development, the materials are submitted for content validation by subject-matter experts. Elements validated in the content include material coverage and presentation, language clarity, and visual components. Once validated by content experts, the teaching materials are reviewed by media experts, who evaluate design aspects such as the title page, chapter pages, competency framework, summaries, student worksheets, and final exercises. After receiving feedback from both content and media experts, revisions are made to the teaching materials based on their input.

As shown in Figure 2, the learning day begins with students praying together, taking attendance, asking and answering questions, and receiving motivation. Afterward, the researcher conducts the core learning activities. In this core activity, the researcher introduces a thermometer as a tool, which is then applied to a number line to demonstrate positive and negative numbers in everyday contexts. Additionally, the traditional game *congklak* is used to illustrate the addition and subtraction of whole numbers. Following this, the researcher provides problem-solving questions related to the thermometer and demonstrates methods for adding and subtracting positive and negative numbers using a number line. The researcher also shows how *congklak* can be applied to practice addition and subtraction operations. In the next stage, students are divided into small groups to solve problems and discuss their solutions. When the researcher demonstrates how to use the thermometer and *congklak* for addition

and subtraction, the students are very enthusiastic and engaged in the learning process. The activity concludes with an evaluation question in the form of a student worksheet to measure the students' understanding.

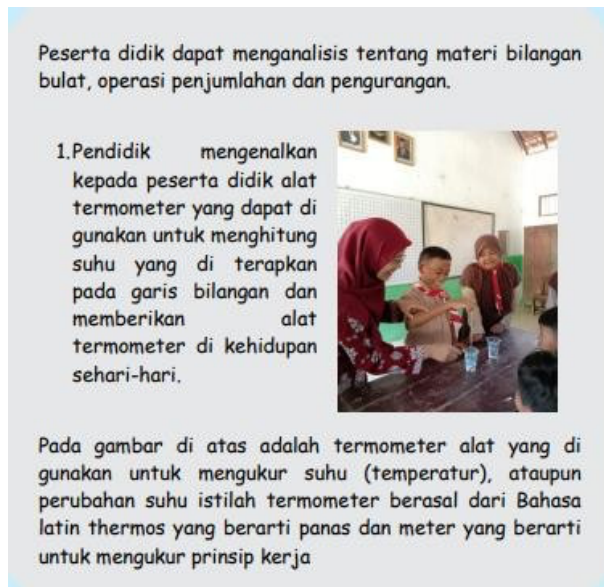


Figure 2. Learning Activity on September 2, 2023

Based on the results of the first-day observation, it is concluded that most students already understand; however, there are still current students who do not yet understand.



Figure 3. Observation activity learning will be on September 3, 2023

Based on Figure 3, on the second day of learning, the researcher begins by greeting the students and providing motivation. The focus of this day is to help students learn skills related to reading, writing, determining place value, and performing the composition and decomposition of whole numbers. In the core activities, the researcher provides a concrete tool in the form of circular patterns made from colored folio paper to help students understand. The researcher demonstrates this concrete tool to make it easier for students to grasp the concepts quickly. The researcher also demonstrates methods for reading, writing, identifying place value, and performing composition and decomposition. Next, the researcher introduces problems for the students to solve in small groups. Afterward, the groups discuss their answers to ensure clarity. In the final stage, the researcher distributes the Student Worksheet for grade VI. The students appear very enthusiastic and engaged in the learning activities.



Figure 4. Observations activity learning will be held on September 4, 2023

Based on Figure 4, the final learning day (Day 3) focuses on students using concrete media, specifically an abacus, to practice multiplication and division operations. To help students tackle everyday challenges, the teacher demonstrates how to use the abacus to solve multiplication and division problems related to daily life. After this, students work in small groups to solve problems, discuss their solutions, and create reports. The lesson concludes with a Student Worksheet provided to students.

Table 4. Validity Result Summary

No	Validity Test Subjects	Validity Results	Information
1	Media Validator	97.91%	Very Valid
2	Material Validator	97.5%	Very Valid
3	Teacher's Questionnaire	85%	Very Practical
4	Students' Questionnaire	78.5%	Worthy

Based on the analysis of assessment data provided by media experts, the score obtained was 97.91%, categorized as "very valid." Similarly, the analysis of assessment data provided by material experts resulted in a score of 97.5%, also in the "very valid" category. Based on the analysis of the teacher response questionnaire, the score obtained was 97%, categorized as "highly appropriate." The analysis of the student response questionnaire resulted in a score of 94.21%, placing it in the "feasible" category. Thus, the development of teaching materials for whole numbers using a PBL model is deemed feasible for use in learning. The validity result can be interpreted by using the parameters as shown in the following tables:

Table 5. Achievement Level Description

Percentage	Description
86-100 %	Very Valid
76-85%	Valid
60-75%	Quite Valid
55-59%	Less Valid
0-54%	Invalid

Source : (Sugiyono, 2013)

Table 6. Validity Criteria

Achievement Level	Information
81-100 %	Very Practical
61 – 80 %	Practical
41 – 60 %	Quite Practical
21 – 40 %	Less Practical
0 – 20 %	Impractical

Source : (Sugiyono, 2013)

Table 7. Feasibility Criteria

Interval	Criterion
81% - 100%	Very Feasible
61% - 80%	Feasible
41% - 60%	Decently Feasible
21% - 40%	Not Feasible
0% - 20%	Very Not Feasible

Source: Sugiyono (2013:123)

Evaluation Stage: At this stage, it is essential to evaluate all stages that have been completed to ensure that the developed teaching materials align with the objectives and meet students' needs. Based on the evaluation results, the teaching materials are revised as necessary, based on data analysis from previous stages. To assess the validity and practicality of the developed teaching materials, an instrument was prepared to measure these aspects.

5. Discussion

Analyze Stage (Analysis) The analysis is conducted to determine learning needs and identify problems. This stage aims to identify issues that students encounter during the learning process. The steps in the analysis stage include: (1) interviewing class teachers and students, (2) distributing questionnaires to students, (3) analyzing materials, (4) examining learning resources, and (5) evaluating learning achievements. This in-depth analysis includes interviews with several students to understand their needs and challenges in the learning process.

Design Phase (Designing) Based on the results of the analysis, the next step is planning the teaching materials. At this stage, the initial design of a printed teaching material book is created, focusing on whole-number operations to simplify the material development process. The planning is done manually, resulting in a framework for the teaching materials to be developed.

Development Stage (Development) In this stage, teaching materials are developed according to the results of the analysis and design stages. Teaching materials are created with careful planning, beginning with the cover, content, and conclusion sections. In the development process, editing is done using Canva. The steps for creating the teaching materials are as follows (Kurniawati, et al., 2016): (1) creating teaching materials in Microsoft Word to facilitate text and image editing; the materials cover indicators of problem-solving skills; (2) using other

software, such as Adobe Flash or Adobe Photoshop, to edit images and animations or downloading animations from various online sources; (3) once the materials are complete, they are saved in PDF format.

Implementation Stage (Implementation) At this stage, the teaching materials are validated by three validators. This is a trial stage, conducted simply with a limited test involving 17 students. After testing the materials, students complete a questionnaire to assess practicality. The purpose of this test is to determine the usability or ease of use of the teaching materials. Teaching materials are considered practical if the evaluation results indicate a "good" or "practical" category based on set criteria. If the results are not yet practical, revisions will be made according to the respondents' feedback. Evaluation Stages (Evaluation) The evaluation stage is the final stage, where improvements (revisions) are made based on suggestions, comments, and input from students, teachers, and the three validators.

6. Conclusion

The conclusion of this study is that the development of mathematics teaching materials for integers for grade VI using PBL can be developed using the ADDIE model with five stages, namely: (1) Analysis, (2) Design, (3) Development, (4) Implementation, and (5) Evaluation. The results of this study indicate that the analysis of the practicality of learning on integers using PBL obtained a score of 75.82% and was said to be very practical. Meanwhile, the feasibility of teaching materials developed based on the PBL approach on integers obtained 85% and was said to be very easy.

Limitation

Mathematics Teaching Materials for Integer Operation materials based on the PBL approach have several limitations in their development, including Mathematics Teaching Materials for Integer operation material based on the PBL approach can only be used in grade VI on integer material. Mathematics Teaching Materials for Integer Operation Material Based on the PBL approach, it only contains special material, namely related to integers in the form of stories, so that students can understand better and solve problems well.

Recommendation

The suggestion in this study is that the development of teaching materials has the following characteristics and steps. In further research, the trial questions should be tested for reliability before being used.

Acknowledgments

The researcher would like to thank the media expert Validator and the material expert Validator who have helped to assess the teaching materials that the researcher has made so that they become better teaching materials. The researcher would also like to thank the teachers who have helped in the smooth running of the research carried out in elementary school.

Conflict of Interest

The Author(s) declare(s) that there is no conflict of interest.

References

- Anazifa, R. D., & Djukri, D. (2017). Project-based learning and problem-based learning: Are they effective to improve student's thinking skills?. *Jurnal Pendidikan IPA Indonesia*, 6(2), 346-355. <https://doi.org/10.15294/jpii.v6i2.11100>
- Andreescu, T., Cordeiro, K., & Andreescu, A. (2019). *Awesome math: Teaching mathematics with problem based learning*. John Wiley & Sons.

- Ambarwati, D., & Kurniasih, M. D. (2021). Pengaruh Problem Based Learning berbantuan media Youtube terhadap kemampuan literasi numerasi siswa. *Jurnal cendekia: jurnal Pendidikan matematika*, 5(3), 2857-2868. <https://doi.org/10.31004/cendekia.v5i3.829>
- Angko, N. (2017). Pengembangan bahan ajar dengan model addie untuk mata pelajaran matematika kelas 5 SDS Mawar Sharon Surabaya. *Kwangsan: Jurnal Teknologi Pendidikan*, 1(1), 1-15. <https://doi.org/10.31800/jtp.kw.v1n1.p1--15>
- Bishop, J., & Verleger, M. A. (2013, June). *The Flipped Classroom: A Survey of the Research Paper presented at 2013 ASEE Annual Conference & Exposition, Atlanta, Georgia*. <https://doi.org/10.18260/1-2--22585>
- Cahyadi, R. A. H. (2019). Pengembangan bahan ajar berbasis ADDIE model. *Halaqa: Islamic Education Journal*, 3(1), 35-42. <https://doi.org/10.21070/halaqa.v3i1.2124>
- Chang, L. C., & Lee, G. C. (2010). A team-teaching model for practicing project-based learning in high school: Collaboration between computer and subject teachers. *Computers & Education*, 55(3), 961-969. <https://doi.org/10.1016/j.compedu.2010.04.007>
- Chiu, M. M. (2001). Using metaphors to understand and solve arithmetic problems: Novices and experts working with negative numbers. *Mathematical thinking and learning*, 3(2-3), 93-124. <https://doi.org/10.1080/10986065.2001.9679970>
- Fadillah, K., & Sukmawarti, S. (2022). Pengembangan Bahan Ajar Matematika Berbasis Masalah Pada Mata Pelajaran Bilangan Bulat Di Sekolah Dasar. *Elementary School Journal PGSD FIP UNIMED*, 12(4), 332-339. <https://doi.org/10.24114/esjpgsd.v12i4.40188>
- Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the national academy of sciences*, 111(23), 8410-8415. <https://doi.org/10.1073/pnas.1319030111>
- Hendriana, H., Johanto, T., & Sumarmo, U. (2018). The Role of PBL to Improve Students' Mathematical Problem-Solving Ability and Self Confidence. *Journal on Mathematics Education*, 9(2), 291-300. <https://eric.ed.gov/?id=EJ1194294>
- Hendarwati, E., Nurlaela, L., & Bachri, B. S. (2022). The collaborative problem based learning model innovation. *International Proceeding of Community Services*, 2(1), 97-106. <https://doi.org/10.30651/ipcs.v2i1.24513>
- Hsu, T. C. (2005). Research methods and data analysis procedures used by educational researchers. *International Journal of Research & Method in Education*, 28(2), 109-133. <https://doi.org/10.1080/01406720500256194>
- Izzaturahma, E., Mahadewi, L. P. P., & Simamora, A. H. (2021). Pengembangan media pembelajaran video animasi berbasis ADDIE pada pembelajaran tema 5 Cuaca untuk Siswa Kelas III Sekolah Dasar. *Jurnal Edutech Undiksha*, 9(2), 216-224. <https://doi.org/10.23887/jeu.v9i2.38646>
- Triayuni, T. *Pengembangan Buku Pengayaan Kimia Berbasis STEM (Science, Technology, Engineering & Mathematic) pada Materi Elektrokimia* (Bachelor's thesis, Jakarta: FITK UIN Syarif Hidayatullah Jakarta). <https://repository.uinjkt.ac.id/dspace/handle/123456789/60390>
- Kurnia, F., & Yuanita Bahasa Indonesia: Y. (tahun 2019, Desember). Spesifikasi Dari Berbasis Stem Pengajaran Bahan Di Dalam Sains Sedang Belajar Di Dalam Itu Era Dari Industri Revolusi 4.0. Dalam *Prosiding Seminar Nasional Pendidikan Biologi* (Vol. 2, No. 1, hal. 1-6). <https://proceedings.radenfatah.ac.id/index.php/semnaspbio/article/view/467/266>
- Kurnia, TD, Lati, C., Fauziah, H., & Trihanton, A. (2019, Oktober). Model Addie Untuk bahan ajar berbasis pengembangan kemampuan pemecahan masalah dengan bantuan 3D pageflip. *Prosiding Seminar Nasional Pendidikan Matematika (SNPM)* (Vol. 1, No. 1, hlm.

- (Halaman 516–525). <https://www.academia.edu/download/90831393/844-1705-1-PB.pdf>
- Lewis, K. E., Sweeney, G., Thompson, G. M., & Adler, R. M. (2020). Integer number sense and notation: A case study of a student with a mathematics learning disability. *The Journal of Mathematical Behavior*, 59, 100797. <https://doi.org/10.1016/j.jmathb.2020.100797>
- Masriyah, K. R., & Hanifah, U. (2020, July). Identification of Student'Critical Thinking Ability in Solving Open Ended Mathematics Problem Viewed From Cognitive Styles. In *MSCEIS 2019: Proceedings of the 7th Mathematics, Science, and Computer Science Education International Seminar, MSCEIS 2019, 12 October 2019, Bandung, West Java, Indonesia* (p. 177). European Alliance for Innovation. <https://doi.org/10.4108/eai.12-10-2019.2296534>
- Mitchell, R., Charalambous, C. Y., & Hill, H. C. (2014). Examining the task and knowledge demands needed to teach with representations. *Journal of Mathematics Teacher Education*, 17, 37-60. <https://doi.org/10.1007/s10857-013-9253-4>
- Misrawati, M., & Suryana, D. (2022). Bahan Ajar Matematika Berbasis Model Pembelajaran Tematik terhadap Kemampuan Berhitung Anak Usia Dini. *Journal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 6(1), 298-306. <https://doi.org/10.31004/obsesi.v6i1.1249>
- Nisa, K. (2017). Application of the PBL model For increase ability solution problem mathematics students. Thesis. (Padang State University, Padang, 2017).
- Nindiwati, D., Subandowo, M., & Rusmawati, R. D. (2021). Pengembangan Bahan Ajar Matematika untuk Siswa Kelas V Sekolah Dasar. *Edcomtech*, 6(1), 140-150. <http://dx.doi.org/10.17977/um039v6i12021p140>
- Nugrahaeni, W. A., & Wulandari, D. (2022). Pengembangan Bahan Ajar E-book Berbasis Lingkungan Pada Muatan Pembelajaran IPA Kelas IV. *Joyful Learning Journal*, 11(2), 55-59. <https://doi.org/10.15294/jjj.v11i2.57347>
- Nurkhin, A., Kardoyo, K., Pramusinto, H., Setiyani, R., & Widhiastuti, R. (2020). Applying blended PBL to accounting studies in higher education; Optimizing the utilization of social media for learning. *International Journal of Emerging Technologies in Learning (IJET)*, 15(8), 22-39. <https://doi.org/10.3991/ijet.v15i08.12201>
- O'Flaherty, J., & Phillips, C. (2015). The use of flipped classrooms in higher education: A scoping review. *The internet and higher education*, 25, 85-95. <https://doi.org/10.1016/j.iheduc.2015.02.002>
- Palayukan, H., Lembang, S. T., Sitoru, A. G., Rapa, S. D., & Heri, H. (2023). Analisis semiotik: representamen siswa dalam menyelesaikan operasi bilangan bulat. *JPMI (Jurnal Pembelajaran Matematika Inovatif)*, 6(4), 1699-1708. <https://doi.org/10.22460/jpmi.v6i4.17860>
- Pilendia, D. (2020). Pemanfaatan adobe flash sebagai dasar pengembangan bahan ajar fisika: Studi literatur. *Jurnal Tunas Pendidikan*, 2(2), 1-10. <https://ejournal.ummuba.ac.id/index.php/pgsd/issue/view/24>
- Putri, DP (2019). Pengembangan Bahan Ajar Berbasis Realistic Mathematic Education(RME) . *Jurnal Tarbawi: Jurnal Ilmu Pendidikan*, 15 (1), 75-87. <https://ejournal.iainkerinci.ac.id/index.php/tarbawi/article/view/336/263>
- Ramadhani, R., Umam, R., Abdurrahman, A., & Syazali, M. (2019). The effect of flipped-problem based learning model integrated with LMS-google classroom for senior high school students. *Journal for the Education of Gifted Young Scientists*, 7(2), 137-158. <https://doi.org/10.17478/jegys.548350>
- Sari, Y. I., Utomo, D. H., & Astina, I. K. (2021). The Effect of Problem Based Learning on Problem Solving and Scientific Writing Skills. *International Journal of Instruction*, 14(2), 11-26. <https://doi.org/10.29333/iji.2021.1422a>

- Saryadi, W., & Sulisworo, D. (2023). Development of e-module based on the discovery learning to improve the student creative thinking skills. *JTAM (Jurnal Teori Dan Aplikasi Matematika)*, 7(1), 11-22. <https://doi.org/10.31764/jtam.v7i1.10185>
- Sepulveda, P., Cabezas, M., García, J., & Fonseca-Salamanca, F. (2021). Problem-based learning: Perception of the teaching-learning process of preclinical sciences by students of Kinesiology. *Educación Médica*, 22(2). <https://doi.org/10.1016/j.edumed.2019.01.004>
- Setiawan, B. A., & Jatmikowati, T. E. (2021). Pelatihan pengembangan bahan ajar handout berbasis aplikasi canva bagi guru di SMA Baitul Arqom. *Abdi Indonesia*, 1(1), 1-8. <http://jurnal.unmuhjember.ac.id/index.php/ABDI/article/view/5232>
- Sugiyono (2013). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Alfabeta. Bandung
- Sulistyo, W. D., Suprpta, B., Nafiah, U., Wijaya, D. N., & Wicaksana, H. (2022). Interactive Map and Videosphere-Based Discovery Learning Model Design for Paleolithic Sites in South Kalimantan for History Learning. *Anatolian Journal of Education*, 7(2), 85-96. . <https://doi.org/10.29333/aje.2022.727a>
- Suryani, M., Jufri, L. H., & Putri, T. A. (2020). Analisis kemampuan pemecahan masalah siswa berdasarkan kemampuan awal matematika. *Mosharafa: Jurnal Pendidikan Matematika*, 9(1), 119-130. <https://doi.org/10.31980/mosharafa.v9i1.597>
- Sutrisno, S. (2021). Analisis dampak pembelajaran daring terhadap motivasi belajar siswa madrasah ibtidaiyah. *Jurnal Riset Madrasah Ibtidaiyah*, 1(1), 348380. <https://doi.org/10.32665/jurmia.v1i1.190>
- Tapia-Nunez, S. (2021). The effect of PBL and game-based learning on student achievement and student engagement (Order No. 28321294). Available from ProQuest Dissertations & Theses Global. (2519024765). Retrieved from <https://www.proquest.com/dissertations-theses/effect-problem-based-learning-game-on-student/docview/2519024765/se-2>
- Yuristia, F., Hidayati, A., & Ratih, M. (2022). Pengembangan Modul Pembelajaran IPA Berbasis Problem Based Learning pada Pembelajaran Tematik Sekolah Dasar. *Jurnal Basicedu*, 6(2), 2400-2409. <https://doi.org/10.31004/basicedu.v6i2.2393>