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DEVELOPMENT OF COMPUTATIONAL THINKING-BASED E-LKPD TO IMPROVE STUDENTS' MATHEMATICAL LITERACY SKILLS IN INTEGER MATERIALS

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Abstrak

Rendahnya literasi matematika siswa, khususnya dalam merumuskan, menggunakan, dan menafsirkan konsep bilangan bulat dalam konteks nyata, menunjukkan bahwa pembelajaran yang berlangsung belum mampu menghubungkan konsep abstrak dengan situasi sehari-hari. Pembelajaran konvensional dan keterbatasan bahan ajar digital yang terintegrasi dengan *Computational Thinking* membuat siswa kurang terfasilitasi untuk berpikir logis dan sistematis dalam menyelesaikan masalah. Penelitian ini bertujuan untuk mengembangkan E-LKPD berbasis *Computational Thinking* untuk meningkatkan kemampuan literasi matematika siswa kelas VII SMP. Penelitian ini menggunakan metode *Research and Development* (R&D) dengan model pengembangan ADDIE yang meliputi lima tahap : analisis, desain, pengembangan, implementasi, dan evaluasi. Subjek uji coba terdiri dari siswa kelas VII di SMP Negeri 4 Kota Madiun. Instrumen penelitian mencakup lembar validasi, angket respon siswa, serta soal *pretest* dan *posttest*. Teknik pengumpulan data menggunakan angket, observasi, wawancara, tes. Analisis data dilakukan dengan mengolah skor dari lembar validasi, angket respon siswa, serta hasil *pretest dan posttest* menjadi persentase untuk menilai kualitas isi, tampilan, dan pengalaman penggunaan produk. Hasil validasi menunjukkan bahwa E-LKPD tergolong sangat valid, dengan persentase kevalidan ahli materi sebesar 86,25% dan ahli media sebesar 85,7%. Kepraktisan E-LKPD dinilai cukup praktis, dengan persentase 82,17% pada uji coba terbatas dan 82% pada uji coba lapangan. Efektivitas E-LKPD juga tergolong cukup efektif, ditunjukkan dengan peningkatan hasil belajar siswa melalui nilai N-Gain sebesar 67,5% (uji terbatas, kategori cukup efektif) dan 61,5% (uji lapangan, kategori cukup efektif).

Kata kunci : Bilangan bulat; *computational thinking*; E-LKPD; literasi matematika.

Abstract

The low mathematical literacy of students, especially in formulating, using, and interpreting integer concepts in real contexts, shows that the learning that takes place is not able to connect abstract concepts with everyday situations. Conventional learning and the limitations of digital teaching materials integrated with Computational Thinking make students less facilitated to think logically and systematically in solving problems. This research aims to develop Computational Thinking-based E-LKPD to improve the mathematical literacy skills of grade VII junior high school students. This research uses the Research and Development (R&D) method with the ADDIE development model which includes five stages: analysis, design, development, implementation, and evaluation. The test subjects consisted of grade VII students at SMP Negeri 4 Madiun City. The research instruments include validation sheets, student response questionnaires, and pretest and posttest questions. Data collection techniques use questionnaires, observations, interviews, tests. Data analysis was carried out by processing scores from validation sheets, student response questionnaires, and pretest and posttest results into percentages to assess the quality of content, display, and experience of using products. The validation results showed that E-LKPD was classified as very valid, with a validity percentage of material experts of 86.25% and media experts of 85.7%. The practicality of E-LKPD is considered quite practical, with a percentage of 82.17% in limited trials and 82% in field trials. The effectiveness of E-LKPD is also quite effective, as shown by the increase in student learning outcomes through N-Gain scores of 67.5% (limited test, category of quite effective) and 61.5% (field test, category of quite effective).

***Keywords** : Computational thinking, E-LKPD, integers, mathematical literacy.*

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INTRODUCTION

Mathematics is a basic science that plays an important role in developing logical, critical, and analytical thinking skills. According to Darwani et al. (2020) mathematics learning must foster the ability to conceptual comprehension, adaptive reasoning, strategic competence, procedural fluency, and productive disposition. One of the competencies that is highly emphasized in modern mathematics learning is mathematical literacy, which is Dinni (2018) is defined as the ability to formulate, use, and interpret mathematics in a variety of real-life contexts. In integer material, mathematical literacy has an important role because it is related to the understanding of negative numbers, calculation operations, and their application in everyday situations such as temperature changes, financial transactions, or position changes.

In the past decade, a number of studies have shown that digital learning media such as E-LKPD are able to improve the quality of learning. According to Mayer (2017), the use of digital media can strengthen students' understanding through the integration of visuals, texts, and interactive activities. Kiswari et al. (2023) found that E-LKPD based on computational thinking can improve students' critical thinking skills. Margaretha et al. (2024) also stated that the integration of mathematical literacy and CT in E-LKPD is able to strengthen problem-solving skills and conceptual understanding. In addition, Hanifah et al. (2025) emphasized that the use of interactive E-LKPD increases students' engagement and understanding of various mathematical concepts. These findings confirm that the use of digital media has the potential to help students understand mathematical concepts more deeply.

However, literature reviews show that there is a research gap. Most previous studies only integrated computational thinking or mathematical literacy separately. In fact, Maharani et al. (2019) stated that CT is a high-level thinking approach that is able to support structured and logical problem solving through the process of decomposition, abstraction, pattern recognition, and algorithms. However, there has not been much research that combines CT and mathematical literacy in one integrated digital learning device, especially in integer materials. In addition, most research focuses more on critical thinking or problem-solving skills, rather than directly targeting improving mathematical literacy through a synthesis of the two approaches. This is the basis for the novelty of this research.

Based on observations at SMP Negeri 4 Madiun City, students' mathematical literacy skills were found to be still low. According to Mastuti (2017) students need to go through the stages of enactive, iconic, and symbolic representation in order to understand abstract concepts. However, in practice, students find it difficult to connect the concept of symbolic integers with real situations, resulting in their weak ability to formulate problems, formulate mathematical models, and interpret calculation results. Learning is also still teacher-centered so that it does not provide space for students to build understanding independently.

To overcome these problems, learning media that is able to facilitate students actively, interactively, and contextually is needed. The computational thinking approach provides a systematic framework of thinking that is in line with the opinion that learning will be more meaningful when students are directly involved in the process of

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knowledge construction through problem-solving activities (Ariandi, 2017; Salsabila & Muqowim, 2024). By integrating CT and mathematical literacy into E-LKPD, students can be directed to understand integer concepts through real context while thinking logically and structured. In line with the theory of constructivism, the active learning experience through digital media will help students build knowledge independently and meaningfully (Abdurahman et al., 2025; Resti et al., 2024).

Based on this background, this research was conducted with the aim of developing E-LKPD based on computational thinking to improve students' mathematical literacy skills in integer material. In particular, this study aims to determine the level of validity, practicality, and effectiveness of the E-LKPD developed so that it can be an alternative to digital teaching materials that are innovative, contextual, and in accordance with the demands of the Independent Curriculum.

METHOD

This research was carried out at SMPN 4 Madiun City. The subjects in this study are grade VII students for the 2024/2025 school year. The selection of subjects was carried out using *purposive sampling techniques* by considering the involvement of the independent curriculum and the readiness of teachers in the implementation of literacy-based learning and *computational thinking*. The limited trial involved 10 students in grade VII C, while the field trial involved 28 students in grade VII A. The material used in this study was integers associated with *computational thinking* and mathematical literacy.

The instruments used include: (1) validation sheets to assess the validity of products by material and media experts, (2) student response questionnaires to assess the practicality of E-LKPD, and (3) *pre-test* and *post-test questions* in the form of descriptions to measure students' mathematical literacy skills. Validation of the instrument is carried out by experts before it is used in data collection.

This research is a research *and development that* aims to produce a product in the form of E-LKPD based on *computational thinking* (CT) to improve students' mathematical literacy skills. The development model used is the ADDIE model which consists of five stages, namely:

1. Analyze

The stages of analysis in this study include four types of analysis, namely: (1) performance analysis to find out problems that arise in the learning process; (2) student analysis to find out the characte-ristics and skills of students, (3) material analysis to find out relevant materials in the development of teaching materials, (4) analysis of learning objectives to find out students' abilities and competencies.

Pada tahap *Analyze*, peneliti melakukan observasi pembelajaran dan wawancara guru untuk mengidentifikasi masalah yang muncul dalam proses belajar, khususnya terkait kesulitan siswa memahami bilangan bulat. Peneliti juga menganalisis karakteristik siswa melalui angket dan wawancara untuk mengetahui kemampuan awal, kebutuhan, serta kesiapan mereka dalam menggunakan media digital. Selain itu, peneliti menelaah kurikulum dan materi bilangan bulat untuk menentukan konten yang relevan dalam pengembangan E-LKPD. Berdasarkan hasil analisis tersebut, peneliti

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merumuskan tujuan pembelajaran yang mencakup indikator literasi matematika dan langkah-langkah computational thinking yang harus dicapai siswa.

2. Design

The stages of design in this study are as follows.

a. E-LKPD Planning

The E-LKPD design based on *computational thinking* was pre-pared based on the results of student needs analysis. The E-LKPD design process begins with determining the E-LKPD framework, learning objectives, materials, instructions for use, and evaluation.

b. Compiling Research Instruments

The preparation of research instruments includes:

1) Product Validation Sheet

The validation sheet is used to assess the validity of the E-LKPD media developed. E-LKPD products are validated by two validators, namely material experts, and media experts. The aspects assessed include material content, language, and display design. The material expert validation sheet consists of 10 questions. Meanwhile, the media expert validation sheet consists of 4 questions on the display aspect, 4 questions on the language aspect, and 6 questions on the media usability aspect. The data collection technique used a Likert scale questionnaire 1–4 in printed form. The validation sheet is prepared based on the Likert scale to assess the feasibility of the content, language, and appearance of the product according to the indicators that have been set.

2) Student Response Questionnaire

The student response questionnaire was used to evaluate the practicality of the E-LKPD that had been made. The student response questionnaire consisted of 15 questions with 8 positive questions and 7 negative questions. Student response questionnaires were given to 10 students in class VII-C in the limited trial and 27 students in class VII-A in the field trial. The data collection technique used a questionnaire based on the Likert scale 1–4 which was given to the respondents in the form of a printed sheet.

3) Pretest and Posttest Questions

The pretest and posttest questions consist of 2 questions that are used to measure the effectiveness of the E-LKPD teaching materials that have been developed. The effectiveness of E-LKPD was measured through a comparison of *pretest* and *posttest* scores given before and after the use of the product in the field trial class. Pretest and *posttest sheets* were given to 10 students in class VII-C in the limited trial and 27 students in class VII-A in the field trial.

3. Development

a. Product Development Results

The product development stage is in the form of initial design, preparing material about integers. The teaching materials developed are literacy-based E-LKPD with *a computational thinking* approach to improve students' abstraction skills on integer material.

b. Validation of research products and instruments

The product validation stage is carried out by material experts and media experts to assess the quality of E-LKPD from the aspects of content, language, and display. Meanwhile, the validation of the instrument which includes student response questionnaires and test questions is carried out by instrument experts to ensure that the

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measuring tools used are feasible, relevant, and in accordance with the research indicators. The validator will provide assessments and recommendations for improvements to the products that have been developed.

c. Product Revision

Validation and revision are carried out repeatedly until an E-LKPD product that meets the criteria is very feasible, namely that it has met the standards of feasibility of content, language, display, and suitability for integrating mathematical literacy and computational thinking according to the validators. The revision process is stopped when the product no longer requires major repairs and has been declared ready for testing at the implementation stage.

4. Implementation

The stages of implementation in this study are as follows.

a. Limited Trial

A limited trial was conducted to test the practicality of the teaching materials, namely the extent to which E-LKPD is easy to use, understand, and interesting for students in small groups of 10 students. The trial process begins with giving a pretest to find out the student's initial ability, followed by the use of E-LKPD in learning activities, then students do a posttest to see changes in ability, and ends with filling out a response questionnaire to assess their ease of use and learning experience.

b. Field Trials

Field trials were conducted to test limited trials were conducted to test the practicality of E-LKPD, namely the extent to which E-LKPD is easy to use, understand, and attractive to students in small groups of 10 students. The trial process began with the provision of a pretest to determine the initial ability of the students, followed by the use of E-LKPD in learning activities, then students did a posttest to see the improvement of their abilities, and ended with filling out a response questionnaire to assess their ease of use and learning experience which had been developed to a large class of 28 students. The trial was carried out with steps, namely, giving *a pretest*, then learning to use E-LKPD based on *computational thinking*, then giving *a posttest*, and filling out a questionnaire.

5. Evaluation

The evaluation stages in this study are as follows.

a. Validity analysis according to Handayani et al., (2024) using the formula:

$$\text{Value} = \frac{\text{Scores obtained}}{\text{Maximum score}} \times 100\ \% \quad (1)$$

The combined validity of the 3 validators is:

$$v = \frac{vah_1 + vah_2 + vah_3}{3} \quad (2)$$

Table 1. Validity level categories

No	Score	Category
1	$85\% < V \leq 100\%$	Very valid
2	$70\% < V \leq 85\%$	Quite valid
3	$50\% < V \leq 70\%$	Invalid
4	$0\% \leq V \leq 50\%$	Invalid

The developed E-LKPD is declared valid if the combined assessment results from validators are more than 70%.

b. Practicality analysis based on the Likert Scale according to Wahdati et al. (2024) with the formula :

$$P = \frac{f}{N} \times 100\% \quad (3)$$

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Table 2. Category of practicality level

No	Numbers	Categories of practicality
1	$85\% < P \leq 100\%$	Very practical
2	$70\% < P \leq 85\%$	Quite practical
3	$50\% < P \leq 70\%$	Less practical
4	$0\% \leq P \leq 50\%$	Impractical

The developed E-LKPD is declared practical if the results of the practicality assessment by students are more than 70%.

c. Effectiveness analysis using N-Gain formulas (Triyono et al., 2024) :

$$\text{N} - \text{Gain} = \frac{\text{Post} - \text{Pre}}{\text{Skor max} - \text{Pre}} \times 100\% \quad (4)$$

Table 3. Categories of effectiveness levels

No	N-Gain Percentage (G)	Level Reach
1	$G < 40\%$	Very ineffective
2	$40 \leq G < 56$	Ineffective
3	$56 \leq G \leq 75$	Quite effective
4	$G > 75$	Highly effective

The developed E-LKPD is declared effective if the results of the effectiveness assessment by students are more than 55%.

RESULTS AND DISCUSSION

This research produced a product in the form of E-LKPD based on mathematical literacy with *a computational thinking approach* aimed at improving students' abstraction skills in integer material. The development process through the ADDIE stages has been carried out systematically, starting from needs analysis, initial design, product development, trial implementation, to product effectiveness evaluation. The results of the research are described through three main aspects, namely validity, practicality, and effectiveness. The stages are as follows.

1. Analyze

The results of the analysis stages in this study, namely: (1) The results of observations and interviews show that students have difficulty understanding integers in a real context and learning is still conventional, (2) the material developed includes the concept and operation of integers and their application, compiled to encourage mathematical literacy and *computational thinking*, (3) the school has adequate facilities such as student laptops, internet access, and LCD projectors that support E-LKPD-based digital learning.

The difference in the number of points occurs because in the results section, the researcher only presents analysis findings supported by direct data in the form of observations, interviews, and school facility conditions, while the analysis of learning objectives is not displayed as a separate point because it has been integrated in the process of determining material and preparing indicators at the design stage. Thus, the learning objectives do not appear as separate findings, but are implicitly covered in the other two points so that only three aspects of the analysis are written in the results section that have clear empirical evidence.

2. Design

The stages of design in this study are as follows.

a. E-LKPD Planning

E-LKPD is designed with the main components: cover, instruc-tions for use, learning objectives, materials, student activities, practice questions, reflections, and final evaluation. The material is prepared with *a*

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Computational Thinking approach and real-life context-based questions, such as tempera-ture, transactions, and game scores, to strengthen mathematical literacy.

1) *Student Response Questionnaire Sheet*

The student response question-naire sheet consists of 15 questions that are used to assess aspects of interest, material, and language in the E-LKPD that has been created.

2) *Pretest and Posttest Questions*

Pretest and posttest questions from 2 questions used to measure the effectiveness of the E-LKPD teaching materials that have been developed. The pretest and posttest questions are in the form of descriptions and are arranged based on the mathematical literacy indicators in Table 4. Beside that, the mathematical literacy questions used in this study are presented in Table 5.

Table 4. Indicators of mathematical literacy

Aspects of Mathematics Literacy	Indicator
Summarizing the problem	Students identify important information from the context of the problem and compile it in the form of a mathematical model.
Using math	Students perform calculations based on the mathematical model that has been formulated.
Interpreting solutions	Students relate the results of the calculations to real situations.
Evaluating solutions	Students examine and compare the results of calculations in decision-making.

Source : (Muslimah & Pujiastuti, 2021)

Table 5. Literacy questions

Sections	Text Contents
Title	Math Competition Questions
Description	In a math competition, there are three students: Rega, Ani, and Ilham. The competition consisted of 20 questions. The correct answer gets 20 points, Wrong answer 10 points, unanswered question answer does not affect the score.
Student Information	○ Price: 17 true, 2 false, 1 not answered, penalty -10 points. ○ Ani: 15 true, 5 false ○ Inspiration: 15 true, 3 false, 2 not answered.
Questions	a. What is the total score of Rega, Ani, and Ilham? b. Who gets the highest score?

3. Development

The stages of development in this study are as follows.

a. E-LKPD Design

The results of the development of integer E-LKPd based *on computa-tional thinking* are presented in Figure 1.

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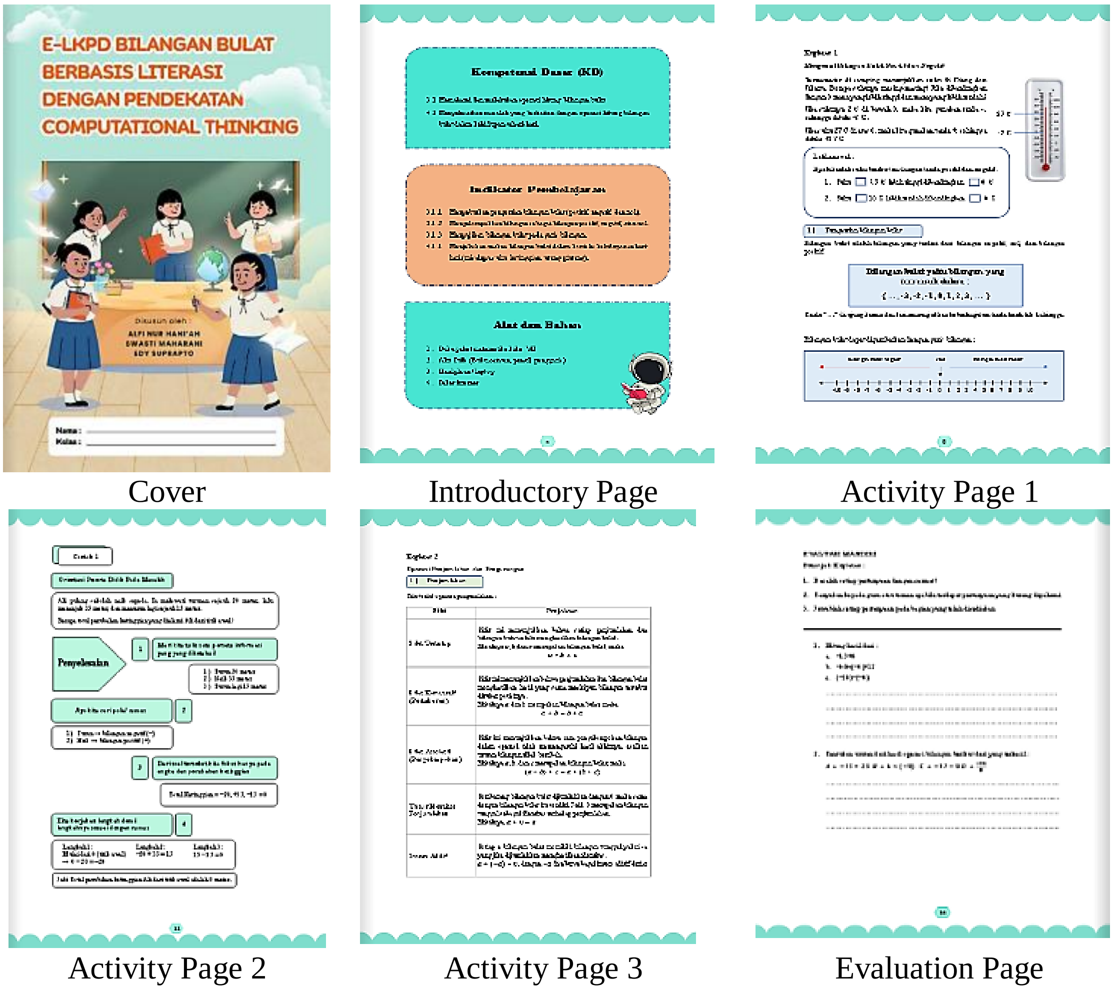

Figure 1. Result of E-LKPD development

The description based on the result of E-LKPD (Figure 1), are as follows:

1) The E-LKPD cover page contains the title of the material studied in the E-LKPD, the identity of the author and the user identity column.
2) The introductory page contains basic competencies, learning indicators, tools and materials, and instructions for use.
3) Activity page 1 contains an explanation of the meaning of positive and negative integer material, drawing the line Numbers.
4) Activity page 2 contains an explanation of integer material addition and subtraction and there are examples of exercises question.
5) Activity page 3 contains an explanation of integer multiplication and division material and there are questions for students.
6) The evaluation page contains integer practice questions with different question types.

The results of the initial design development of the E-LKPD can be accessed through the following link. https://drive.google.com/file/d/1yHOTwJ8i5tHRfvFYmw3BO-5VwdFCdsWF/view?usp=sharing.

b. E-LKPD Validation

The validation of the E-LKPD product showed that material experts gave a score of 86.25% and media

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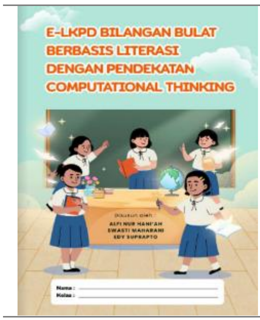
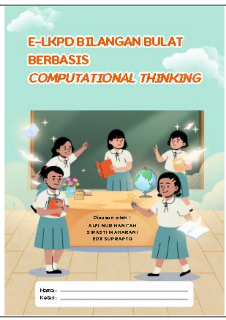
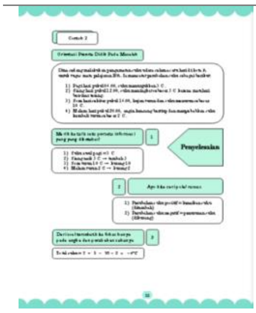
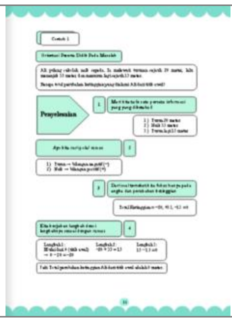
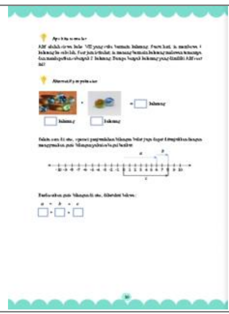
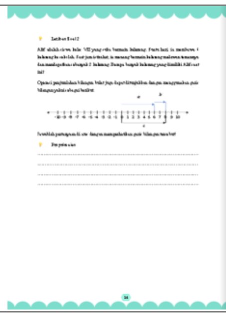
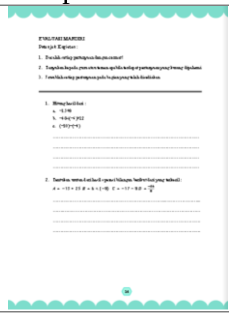
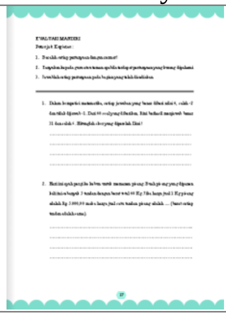
experts gave a score of 85.71%, both of which are in the very valid category. The assessment includes aspects of content, language, and display design that are considered appropriate, clear, and easy for students to understand. With these results, E-LKPD was declared feasible for use in the trial stage with minor revisions as improvements.

c. Product Revision

The revision of the E-LKPD includes improving the title to better match the scope of the material, adding sample questions and their solutions that are adjusted to computational thin-king indicators, as well as improving sentences, layouts, and question forms to make them clearer, systematic, and easier for students to understand.

The results of the product revision are presented in Table 6.

Table 6. Product revisions

Before	After
	
Title fixes	
	
The improvement of the addition of sample problems and their solutions is adjusted with computational thinking indicators**.**	
	
Improved sentences and their layout	
	
Correction of sentences and question forms	
	
Correction of sentences and question forms	

The results of the E-LKPD revision can be accessed through the following link. https://drive.google.com/file/d/1_g1itf6VCHlAl1Xmn36pwXeOH_28R1-I/view?usp=sharing.

4. Implementation

a. Limited trial

The results of the limited trial showed that E-LKPD based on computational thinking was quite practical with a practicality percentage of 82.17% based on student response questionnaires. In addition, there was an increase in students' mathe-matical

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literacy abilities as shown by the N-Gain score of 67.5%, which is included in the category of quite effective. These findings show that E-LKPD is able to help students understand integer material better in small groups.

Figure 2. Limited trial documentation

b. Field trials

The results of the field trial showed that E-LKPD based on computational thinking obtained a practicality level of 82%, thus meeting the practical criteria because it exceeded the feasibility limit of >70%. In addition, the improvement in students' abilities is shown by an N-Gain score of 61.5%, which is included in the category of quite effective based on the >55% criterion. These findings confirm that E-LKPD is effectively used on a wider scale and is suitable for use in actual learning conditions.

Figure 3. Field trial documentation

5. Evaluation

a. Valid

The results of the limited trial showed that E-LKPD based on computational thinking had a practicality level of 82.17%, thus meeting the practical criteria because it exceeded the feasibility limit of >70%. In addition, the improvement in students' abilities is shown by an N-Gain value of 67.5%, which means that E-LKPD is in the category of being quite effective because it exceeds the effectiveness limit of >55%. Overall, the results of the limited trial show that E-LKPD is feasible for use at a wider implementation stage. The E-LKPD developed by the researcher obtained a validity percentage for subject matter experts of 86.25%, and media experts of 85.71%. Based on these results, E-LKPD can be categorized as very valid.

b. Practicality

The level of E-LKPD practicality was measured by questionnaires of students' responses to limited trials and field trials. The practicality of E-LKPD that has been tested in limited classes obtained the results listed in Table 7.

Table 7. Practicality of E-LKPD limited trial

Practicality of E-LKPD	
Total combined scores	493
Maximum score	600
Combined percentages	82,17%
Category : Quite Practical	

Based on Table 7, it can be seen that the result of the level of practicality is 82.17%. This percentage figure is classified as quite practical. The practicality of E-LKPD that has been tested in limited classes obtained the results listed in Table 8.

Table 8. Practicality of E-LKPD Field Trial

Practicality of E-LKPD	
Total combined scores	1329
Maximum score	1620
Combined percentages	82%
Category : Quite Practical	

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Based on Table 8, it can be seen that the result of the practicality level is 82%. This percentage figure is classified as quite practical.

c. Effective

The results of the E-LKPD effectiveness percentage that have been developed can be measured using N-Gain (normalized gain) analysis through a comparison of pre-test and post-test scores, which illustrates the extent of the improvement in students' abilities after using E-LKPD compared to the initial ability before learning. The effectiveness of E-LKPD that has been tested in a limited class obtained the results listed in table 9.

Table 9. E-LKPD effectiveness of the trial is limited

Effectiveness of E-LKPD	
Rata-rata *pre-test*	46
Post-Test Average	80
N-Gain *Percentage*	67,5%
Category : Quite Effective	

Based on Table 9, it can be seen that the results of the limited trial of the effectiveness level of E-LKPD developed through a comparison of *pre-test* and *post-test* scores are 67.5%. So, it can be classified as quite effective.

Table 10. The Effectiveness of E-LKPD Field Trials

Effectiveness of E-LKPD	
Rata-rata *pre-test*	29,8
Post-Test Average	71,1
N-Gain *Percentage*	61,5%
Category : Quite Effective	

Based on Table 10, it can be seen that the results of field trials show that the effectiveness level of E-LKPD developed through a comparison of *pre-test* and *post-test* scores is 61.5%. So, it can be classified as quite effective.

The results of the study show that E-LKPD based on Computational Thinking (CT) has proven to be valid, practical, and quite effective in improving students' mathematical literacy in integer material. These findings can be explained through a logical cause-and-effect relationship between CT characteristics such as decomposition, pattern recognition, abstraction, and algorithms and the demands of mathematical literacy which includes the ability to formulate, use, and interpret mathematical concepts in a real context. In other words, when students are directed to break down problems into small pieces (decomposition), recognize regularity (pattern recognition), ignore irrelevant information (abstraction), and formulate solution steps (algorithmic thinking), they not only understand the concept of integers mechanically, but also meaningfully relate them to everyday situations. It is a "new story" that the integration of CT not only improves the ability to think at a higher level but also directly strengthens mathematical literacy in content that was previously considered abstract.

The main finding in this study is a significant increase in students' mathematical literacy skills, as evidenced by the N-Gain score on the limited test of 67.5% and on the field test of 61.5%, both of which are in the category of "quite effective". In addition, the results of very high media and material validation results show that E-LKPD is not only feasible in terms of content and appearance, but also able to facilitate a structured learning process according to computational thinking. This achievement confirms that the developed E-LKPD has succeeded in bridging the gap between abstract integer concepts and the real context faced by students.

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Several factors are the cause of the positive result. First, the use of attractive visual displays helps students process information faster and more effectively, according to the principles of multimedia learning. Second, the interactive activities that are arranged gradually provide *cognitive scaffolding*, so that students can build understanding through a directed learning experience. Third, the CT approach used is in accordance with the stage of cognitive development of junior high school students who are in the transition phase from concrete to abstract, so that the preparation of algorithmic steps helps them think more structured. In addition, the integration of everyday contexts such as temperatures, transactions, or game scores encourages students to apply concepts meaningfully, rather than just memorize procedures.

This research has several advantages. The integration of mathematics literacy and CT in one digital device is an innovative effort that has rarely been done in previous research, thus making a new contribution in the field of mathematics learning media development. In addition, the use of the ADDIE model makes the development process more systematic, and the high validation results indicate mature product quality. However, this study also has limitations, namely the relatively small number of test subjects and the scope of material that only focuses on integers, so the generalization of the findings is still limited. In addition, pretest-posttest instruments that consist of only two description questions can limit the breadth of measuring mathematical literacy ability.

When compared to previous research, these findings consistently state that CT-based E-LKPD can improve critical thinking and problem-solving skills (Marina et al., 2025; Sodikin et al., 2025). This result is also in line with proving that interactive digital media is able to increase students' understanding of concepts and learning motivation (Bahrudin & Yogihati, 2022; Lin et al., 2017; Safitri et al., 2022). The novelty of this research lies in the integration of two important domains of mathematical literacy and CT in one digital device focused on integer material, something that has not been the main focus of previous studies. Thus, this research strengthens and expands the existing theoretical foundation, as well as filling in the *research gap* found in the introduction.

Practically, this research provides important implications for mathematics learning, especially in supporting the implementation of the Independent Curriculum which emphasizes literacy, problem-solving, and the use of technology. CT-based E-LKPD can be an alternative digital media that encourages students to think more logically, systematically, and reflectively. For teachers, this study shows that integrating CT is not only relevant in ICT subjects, but also very effective in strengthening the understanding of mathematical concepts. Meanwhile, for media developers, the results of this research can be a reference in designing learning tools that are more contextual, interactive, and adaptive. Thus, the contribution of this research is not only at the theoretical level but also on the practice and development of educational policies that encourage literacy and computational thinking.

CONCLUSIONS

Based on the results of the research and data analysis that has been carried out, it can be concluded that the

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development of E-LKPD based on mathematical literacy with *a computational thinking* (CT) approach is effective in improving mathematical literacy skills in integer materials in integer material. The developed product proved to be very valid based on expert assessments, very practical according to student responses, and very effective from the increase in N-gain score results of the abstraction ability test. The integration of mathematics literacy and CT in one learning tool has proven to be capable of provide a contextual, interactive learning experience and encourage students to think logically, systemati-cally, and abstractly in solving mathematics problems.

The development of similar E-LKPD can be applied more broadly by covering a wide range of other math materials and being tested in more diverse school contexts to measure its effectiveness more generally. Teachers and developers of teaching materials are also advised to continue to integrating literacy and computational thinking approaches to create learning that not only conveys content, but also develops high-level thinking skills in students. Further research can explore the influence of this E-LKPD on other abilities, such as problem-solving or mathematical communication.

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