Development of Problem Based Learning Model Learning Devices to Improve Students' Mathematical Computational Thinking Ability

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Abstract. This study aims to: 1) Produce valid, practical and effective quality learning tools, which are developed based on the Problem Based Learning model for class VIII SMP Negeri 3 Pantai Labu; 2) Analyze the increase in students' mathematical computational thinking skills by using the Problem Based Learning model learning tools. This research is a development research using the 4-D development model which consists of four stages, namely define, design, develop, and disseminate. Learning tools resulting from this study are Learning Implementation Plans (RPP), Student Books (BS), Student Worksheets (LKPD), and Students' Mathematical Computational Thinking Ability Tests. Based on the research results obtained 1) Problem Based Learning model learning tools have met the valid, practical, and effective criteria in terms of each criterion; 2) There is an increase in students' Mathematical Computational Thinking skills by using the Problem Based Learning model learning tool seen from the N-gain value in trial I of 0.36 (criterion "moderate") increased to 0.51 (criteria "moderate") in the test try II.

Keywords: Development of Learning Devices, Problem Based Learning model learning, students' mathematical computational thinking abilities

1 Introduction

As science and technology advance quickly, students must develop a variety of abilities to compete in the global marketplace. Problem-solving abilities are among the 21st century skills that need to be fostered in the classroom. An essential component of the mathematics curriculum is problem solving. Problem solving activities are good for developing important aspects of math skills, such as B. applying rules to non-routine problems, finding patterns, generalizing, mathematical communication, and more. One of the problem solving techniques that has a very wide range of applications is computational thinking.

Computational thinking or computational thinking (CT) according to Wing is a way to find solutions to problems from input data by using an algorithm as well as by applying the

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techniques used by software in writing programs[1]. In this case, computational thinking is a necessary skill to help solve problems faced by individuals in everyday life. Computational thinking skills can design learning activities that aim to understand computational thinking ability approaches in solving problems and developing solutions to solve the same problem if needed [2]. The computational thinking indicator consists of 4 parts, including: (1) decomposition; (2) pattern recognition; (3) thinking algorithms; (4) generalization and abstraction.

The existence of student mathematical skills at a worldwide level hows that Indonesian students' capacity to develop complicated issues utilizing computer programming techniques continues to be relatively poor. TIMSS study results from 2015 place Indonesia at number 44 out of 49 participating nations, according to Nizam, 2016. The 2018 PISA (Program for International Student Assessment) rankings placed 73rd out of 79 countries[3]. While kids are studying mathematics in the classroom, many professors still employ basic questions and do not teach students how to count. Most of the time, students can resolve issues by following the teacher's advice. It is still unclear in this scenario how capable the students' problem-solving and thinking skills are. Researchers have found a connection between the teacher-planned arithmetic lessons and the pupils' poor mathematical computer thinking. We eagerly await the outcome of teacher learning. As a result, initiatives to ameliorate these circumstances include raising learning quality through the use of learning tools. "Students who were taught with instructional materials performed better than those who were taught without," according to Olayinka's research[4]. This implies that students who are applied with learning devices are better than learning devices.

The purpose of learning devices is to facilitate the execution or management of learning activities by teachers in the classroom. "A good learning tool is a learning tool that can be applied to the learning process so that it can make students active during the learning process[5]. It takes meticulous preparation to create useful learning tools. Learning resources must be adjusted to the needs and surroundings of the pupils. Additionally, instructional materials must be set up to meet the needs of the local kids. Learning resources and media, learning models, assessment tools, and learning implementation plans (RPP) are all examples of teaching materials.

Researchers at Pantai Labu Public Middle School 3 found that students tended to memorize mathematical concepts without understanding their meaning or content because the learning

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[1] Wing, J.M. *Computational Thinking* (Communications of the ACM, Nomor 3, Volume 49) (2006)

[2] Kalelioglu, F., Gulbahar, Y., i& Kukul, iV. A Framework ifor iComputational Thinking Based on ia Systematic Research Review. Baltic Journal of Modern Computing, 4(3), 583 (2016)

[3] OECD (*Organisation for Economic Co-operation and Development*). Programme For International Student Assessment (PISA) Result From PISA 2018. Paris: OECD Publishing (2018)

[4] Olayinka, AB. Effects of Instructional Materials on Secondary Schools Students' Academic Achievement in Social Studies in Ekiti State, Nigeria. WorldJournal of Education. Vol. 6 No. 1 (2016)

[5] Kusumaningrum. S. *Pengembangan Perangkat Pembelajaran Berbasis Pendekatan Saintifik dengan Model Pembelajaran PjBL untuk Meningkatkan Keterampilan Proses Sains dan Kreativitas Siswa Kelas X*. Tesis. Yogyakarta: Program Pascasarjana UNY (2015)

materials used by teachers at the school were still centered on curriculum material. The Ministry of Education and Culture announced the student textbooks that are used in the classroom at SMP Negeri 3 Pantai Labu. Although the book was created using the 2013 curriculum's core knowledge and fundamental skills, it does not help students' numeracy skills.. Student books must be supported by Student Worksheets (LKPD). Teachers use LKPD to monitor student learning. With the LKPD, we hope that there will be active participation from students so that they can provide wider opportunities to build knowledge about themselves. Rohman and Amri stated that a concept can be found by students with the help of worksheets, applying and integrating the concepts found, functioning as study guides, strengthening and practical instructions[6]. The reality of researchers in the field shows that teachers do not design worksheets and use them in learning. The teacher only gives practice questions from the student handbook. As a result, LKPD must be employed when teaching math in a classroom. Since textbooks contain all of the curriculum needed in the learning process, it is clear from the argument above that textbooks are crucial to the learning process. The choice of models, the learning tactics employed by the instructor, the learning resources, and the teacher's commitment to carrying out learning by leading students to the desired learning all have a significant impact on how learning is implemented in the classroom. target. We therefore require a learning model that may enhance pupils' computational and mathematical thinking abilities. Problem-based learning is one of the Computational thinking or computational thinking (CT) according to Wing is a way to find solutions to problems from input data by using an algorithm as well as by applying the techniques used by software in writing programs[7]. In this case, computational thinking is a necessary skill to help solve problems faced by individuals in everyday life. Computational thinking skills can design learning activities that aim to understand computational thinking ability approaches in solving problems and developing solutions to solve the same problem if needed [8]. The computational thinking indicator consists of 4 parts, including: (1) decomposition; (2) pattern recognition; (3) thinking algorithms; (4) generalization and abstraction.

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The purpose of learning devices is to facilitate the execution or management of learning activities by teachers in the classroom. "A good learning tool is a learning tool that can be applied to the learning process so that it can make students active during the learning process[11]. It takes meticulous preparation to create useful learning tools. Learning resources must be adjusted to the needs and surroundings of the pupils. Additionally, instructional materials must be set up to meet the needs of the local kids. Learning resources and media, learning models, assessment tools, and learning implementation plans (RPP) are all examples of teaching materials.

Researchers at Pantai Labu Public Middle School 3 found that students tended to memorize mathematical concepts without understanding their meaning or content because the learning materials used by teachers at the school were still centered on curriculum material. The Ministry of Education and Culture announced the student textbooks that are used in the classroom at SMP Negeri 3 Pantai Labu. Although the book was created using the 2013 curriculum's core knowledge and fundamental skills, it does not help students' numeracy skills.. Student books must be supported by Student Worksheets (LKPD). Teachers use LKPD to monitor student learning. With the LKPD, we hope that there will be active participation from students so that they can provide wider opportunities to build knowledge about themselves. Rohman and Amri stated that a concept can be found by students with the help of worksheets, applying and integrating the concepts found, functioning as study guides, strengthening and practical instructions[12]. The reality of researchers in the field shows that teachers do not design worksheets and use them in learning. The teacher only gives practice questions from the student handbook. As a result, LKPD must be employed when teaching math in a classroom. Since textbooks contain all of the curriculum needed in the learning process, it is clear from the argument above that textbooks are crucial to the learning process. The choice of models, the learning tactics employed by the instructor, the learning resources, and the teacher's commitment to carrying out learning by leading students to the desired learning all have a significant impact on how learning is implemented in the classroom. target. We therefore require a learning model that may enhance pupils' computational and mathematical thinking abilities. Problem-based learning is one of the.

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2 Theoretical framework

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2.1 Development of Learning Devices

The message content in the curriculum that needs to be communicated to pupils includes learning tools. The syllabus, learning implementation plans (RPP), teaching materials, and learning accomplishment examinations are among the devices that Astuti (2021) defines as learning devices.

The standards for the quality of a piece of content put forth by Nieven (2007) are referenced in the criteria that were utilized to design learning tools. When a material satisfies the criteria for a high-quality product, such as validity, applicability, and efficacy, it is considered to be of high quality. According to the aforementioned opinion, the concept of learning tools used in this study refers to a group of learning support items, including student books, lesson plans, and worksheets for students.

Student Book. Student Books are student study assignment guides that cover a topic, concept-based research activities, science activities, information and examples of how to apply science in everyday life. According to Trianto (2011: 227) Student books are guidelines for students in learning in class and independent learning. This student book also serves as a study guide, both in class and for self-study.

The student book components compiled include: (1) core competencies; (2) basic competence; (3) achievement indicators; (4) learning experience; (5) math problems and questions that lead students to discover concepts and solve problems; and (6) independent exercises for students to complete outside class hours.

Learning Implementation Plan (RPP). RPP, which in this study is based on the steps of the problem-based learning paradigm, is a lesson plan that consists of an introduction, core activities, and a conclusion. RPP development must start with a comprehension of its meaning and goal, as well as with the theoretical and practical mastery of its constituent aspects. The principles of developing lesson plans, according to Trianto (2011: 108) must be followed when creating lesson plans. These principles are: (1) The competencies planned in the lesson plans must be clear, concrete, and easy to understand; (2) RPP must be simple and flexible; and (3) RPP is developed to be comprehensive, intact, and its achievements are clear.

Student Worksheets (LKPD). Learner Worksheets (LKPD) are sheets that contain information and instructions from the teacher to students so that learning activities can be carried out independently by students through activities that can be developed through students' thinking processes.

The steps for preparing LKPD: (1) formulating KD that must be mastered, (2) determining assessment tools, (3) preparing material from various sources and (4) paying attention to the structure of LKPD, including: (a) titles, (b) study instructions, (c) competencies to be achieved, (d) supporting information, (e) assignments.

2.2. Students' Mathematical Computational Thinking

Computational thinking is part of problem-solving skills, but computational thinking places more emphasis on thinking about solving problems with logic us. In contrast to critical thinking which is more focused on the ability to convey logical reasons to identify everything that’s elevant in solving problems. According to Ismail (2018) computational thinking includes two major steps, namely the process of reasoning followed by decision making or problem solving. According to Ioannidou (2011) computational thinking or what is called computational thinking is a series of thought patterns that include: understanding problems with appropriate descriptions, reasoning at several levels of abstraction, and developing automatic solutions. Based on the description above,

Based on the definition of computational thinking above, the researcher used indicators of students' mathematical computational thinking according to the 4 computational thinking skills provided in Table 1 below.

Table 1. Indicators of students' mathematical computational thinking

No	Indicators of Students Mathematical Computational Thinking	Sub-Indicators
1	Decomposition	Students are able to identify information that is known from the problems given Students are able to identify the information asked from the problems given
2	Pattern recognition	Students are able recognize patterns or characteristics that are the same/ different in solving a given problem in order to build a solution
3	Alghoritmic Thinking	Students are able to determine the logical steps use to compile a solution to a given problem
4	Generalizing and abstracting patterns	Students are able to determine the general pattern of similarities/ differences found in a given problem Students are able to draw conclussions from patterns found in a given problem

2.3 Problem-Based Learning Models

A learning approach known as "problem-based learning" teaches and fosters problem-solving abilities using actual challenges faced by real pupils. According to Arends (2008), problem-based learning is a type of instruction in which students learn how to solve real-world issues in order to enhance their knowledge, acquire new skills, become more independent, and gain confidence.

Five primary processes listed in Table 2 are linked to the conceptual framework known as the problem-based learning model, which defines the systematic process of structuring learning experiences.

Table 2. Problem Based Learning Model Syntax

Phase	Step	Teacher Activities
1	Problem Orientation	1. Explain learning objectives 2. Describe the logistics required 3. Motivate students to engage in selected problem-solving activities
2	Organizing student learning	4. Help students define and organize learning tasks related to these problems
3	Guiding individual/ group investigation	5. Encourage students to collect appropriate information, carry out experiments, to get explanations and problem solving
4	Develop and present the work	6. Students are able to mention the general patterns of similarities/ differences found in the problems given
5	Analyze and evaluate the problem solving process	7. Teachers help students to reflect or evaluate their investigation and the processes the use

3 Method

The Tiagarajan, Semmel, and Semmel, or H. 4-D model (Four-D model), development is used in this research, which is categorized as a type of development research. The study creates the tools and instructions that are required. This research product includes a model for problem-based learning as well as all the learning and research tools required to create such tools. It is valid, applicable, and effective. creation of instructional resources for students, including Mathematics Achievement Tests, Student Books, Student Worksheets, and Learning Implementation Plans (RPP). Using numerical pattern material, this study was carried out for eighth-graders at SMP Negeri 3 Pantai Labu for the 2022–2023 academic year.

The subject of this study is a grade VIII student of SMP Negeri 3 Pantai Labu for the 2022/2023 academic year. This research experiment was conducted in two different classes, namely Class VIII-1 and Class VIII-2, where each class numbered 32 students. The subject of this study is a problem-based learning model learning tool on the developed numerical model material.

The process for creating learning tools in this study is based on the Thiagarajan, Semmel, and Semmel development model, also known as the 4-D model (Four D Model), which has four stages: definition, planning, development, and dissemination. The following describes each stage of creating the learning tool:

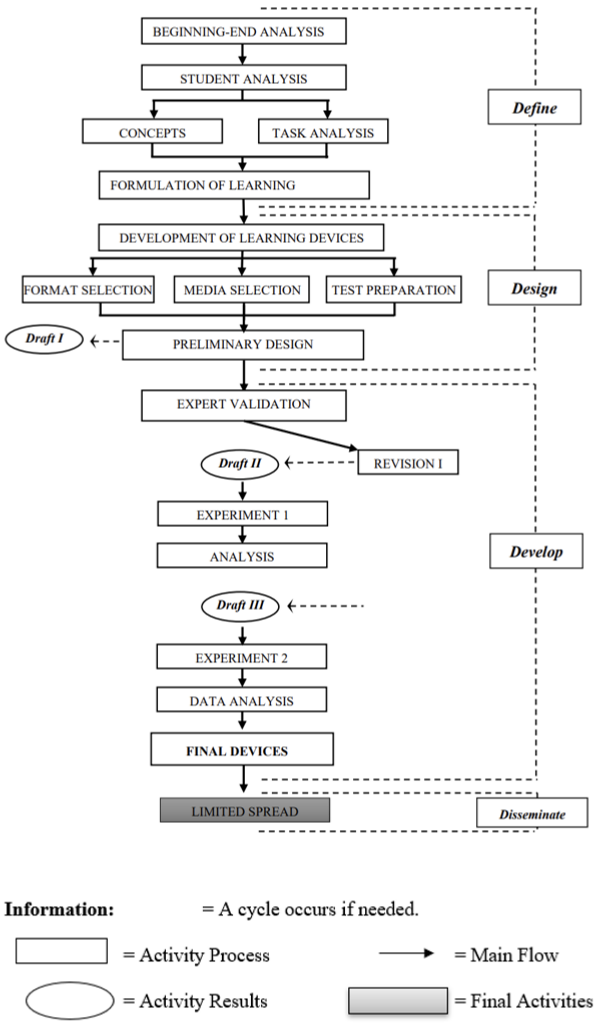

Figure 1. 4-D Model Learning Device Development Chart (Modified from Trianto, 2011)

During the defining stage, a number analytical tasks—including initial-end analysis, student analysis, task analysis, concept analysis, and formulation of learning objectives—were completed as a reference for the first product design. The design comes next. At this stage, work is done on the initial design, test preparation, media selection, and format phases. RPP, BS, and LKPD examinations of students' mathematical computational thinking abilities are part of the initial creation of the learning materials for number pattern content during this phase. Draft I is the name given to this first draft. The specific actions conducted during the development stage (develop) include expert validation, research instrument trials, and trials. Additionally, the results of the field testing were examined and then corrected. The final stage involved spreading information through activities that were only partially conducted at the subject-teacher deliberation forum at the school where the research was conducted.

Technical tests and non-tests were the two types of data collection methods used in this study. While non-technical examinations are conducted using validation sheets, observations, and questionnaires, technical assessments are conducted using tools to assess students' abilities in mathematical calculation thinking.

To ascertain the reliability, applicability, and efficacy of the created learning tools, data analysis was done. Five professionals in the field of mathematics education provided their comments to support the learning tool's authenticity. The validator records an evaluation for each RPP, BS, LKPD, Student Mathematical Computational Thinking Ability Test on each validation sheet of the learning tool for the topic of number patterns. Additionally, as indicated in Table 4 below, the Va value or total mean value is included in the interval for assessing the degree of validity of the Problem Based Learning model learning device:

Table 3. Criteria for the Level of Validity

No	Va or the average value of total	Validity Criteria
1	$1\leq Va < 2$	Invalid
2	$1\leq Va < 2$	Less valid
3	$1\leq Va < 2$	Pretty valid
4	$1\leq Va < 2$	Valid
5	$1\leq Va < 2$	Very valid

with:
Va= the value of determining the validity level of the Problem Based Learning model learning device.
If the minimum level of validity reached is a valid, the requirements state that the learning tool for the designed Problem Based Learning learning model has a good degree of validity. If the level of validity attainment is insufficient, it must be revised based on the advice (correction) of experts. Verify the learning tool for the Problem Based Learning model's applicability by examining the opinions or replies of experts who claim that it requires little to no change. Observe how learning device data is being used. The interval for determining the level of implementation of problem-based learning devices is known as the value of the implementation of this learning[13], as shown in Table 5 below:

Table 4. Percentage of Learning Implementation Qualifications

Performance Percentage	Category
$1k \geq 90$	Very good
$80 \leq k < 90$	Good
$70 \leq k < 80$	Enough
$60 \leq k < 70$	Not enough
< 60	Very less

k = implementation of learning devices

The implementation of the Problem Based Learning model learning device is stated to be practical or simple to employ if k 80 or is in the minimal good category (Minarni et al., 2020). The following criteria must be met for learning devices to be considered effective: 1) students'

[13] Sudjana. *Metode Statistika*, Tarsito: Bandung (2005)

mathematical computational thinking ability is achieved, which means that at least 80% of students who participate in to learning receive a minimum score of 60 or moderate; 2) the learning time used meets the ideal time set in terms of student activity; and 3) at least 80% of students gave the learning tools that were developed a favorable response.

By comparing student scores from test results taken before and after treatment, scores acquired by students before and after utilizing the produced learning tools were examined. The N-gain formula from Hake is used to calculate the amount of increase before and after learning[14]:

$$N - gain = \frac{score\ postest - score\ pretest}{score\ ideal - score\ pretest}$$

With the gain index criteria as in Table 6 below:

Table 5. Normalized Gain score criteria

Gains Score	Interpretation
g>0.7	Tall
$0.3 < g \leq 0.7$	Currently
$g \leq 0.3$	Low

4 Results and discussion

4.1 Results

Defining Stage (Define). Activities at this stage are the beginning-end analysis, student analysis, task analysis, concept analysis, and the formulation of learning objectives. The results of each activity in the defining stage are described as follows:

a. Beginning-End Analysis*(Front-end analysis)*

According to the findings of observation and analysis of the teaching materials used at SMP Negeri 3 Pantai Labu, there are still flaws in the materials that teachers use, which subtly affect students' poor mathematical thinking abilities. Teachers continue to employ the lecture approach, and because there is no discussion method, pupils are less engaged. Because of the teacher-centered learning that is produced by the use of learning aids, pupils do not actively participate in their education. In addition, teachers do not use the right learning tools because as stated in the RPP, teachers make lesson plans with innovative learning models or approaches (recorded in the RPP) but do not implement them properly and correctly. RPP is not proposed according to the needs or characteristics of students, nor is it made by considering the context of the student's environment. In addition, the examples and questions in the student book do not support the development of students' mathematical-computational thinking. Students also do not use LKPD, which is designed to use specific learning models to support learning activities. Students are only given routine questions and the content focuses more on the final result of the material than the student's activities. This is claimed to be

[14] *Hake, R. R. Analizing Change/*Gain *Scores. Woodland Hills: Dept. Of Physics, Indiana Universit (1999)*

caused by the weak mathematical thinking and arithmetic of students. Valid, practical, and problem-based learning models are needed to build, train, and further develop students' mathematical and computational thinking.

b. Student Analysis *(Learner analysis)*

Based on the presentation of the mathematics teacher at the school, it was discovered that the average student was between the ages of 12 and 14 after making observations about the features of eighth-grade SMP Negeri 3 Pantai Labu pupils. Children between the ages of 12 and 14 are considered to be in the stage of formal operational cognitive development, according to Piaget (in Trianto, 2012). Children may now apply their cognitive processes to both concrete and abstract issues. In order to aid students' mathematical abilities, especially their skills in mathematical computational thinking, it is extremely appropriate if learning mathematics begins with physical or abstract items that are near to their life.

The tools used so far have not paid attention to student analysis, therefore it is necessary to develop learning tools that are adapted to student characteristics. With the application of this learning tool, it is hoped that it can improve students' mathematical computational thinking skills.

c. Concept Analysis *(Concept analysis)*

This stage is aimed at identifying, detailing and systematically compiling the concepts that will be studied by students in the number pattern material that will be taught by the teacher, namely by making concept maps that will make it easier for students to understand the subject matter. The results of this analysis form a number pattern concept map as follows:

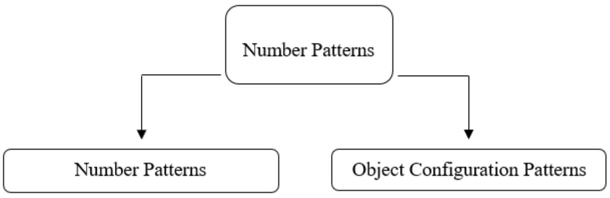

Fig 2. Number Pattern

d. Task Analysis*(task analysis)*

The details of the analysis that have been identified for class VIII students of SMP Negeri 3 Pantai Labu are the 2013 Curriculum in the form of core competencies (KI) and basic (KD) that students should master for Number Pattern material

e. Formulation of Learning Objectives *(Specifying instructional objectives)*

Adjustment to indicators of students' computational mathematical thinking abilities with the reasons in this study students' computational mathematical thinking abilities need to be improved so that they need to be translated into learning objectives as targets that need to be achieved.

Design Stage (Design)

a. Format Selection Results (Format Selection)

The LKPD format is created based on the requirements of the Ministry of National Education and is designed in color to engage and motivate students to learn. The results of the selection of student book formats are based on the regulations of the BSNP (National Education Standards Agency). Indicators of students' computational mathematical thinking skills are discussed in the context of the test format for pupils. The use of the resulting full design is expected to have an influence on improving the mathematical computational thinking abilities of students at SMP Negeri 3 Pantai Labu by adapting it to the Problem Based Learning learning model as a unit.

b. Media Selection Results (Media Selection)

The outcomes of the media selection were modified in light of the task analysis, concept analysis, and SMP Negeri 3 Pantai Labu student characteristics. Based on this, printed media in the form of student books and LKPD are the media used. Books were chosen by the researcher because they may be directly used by students to support the communication process in learning.

c. Test Preparation

The arrangement of tests depends on the definition of the learning objectives and the indicators of ability that need to be measured. The examinations that are created are adapted to the cognitive level of the students. A scoring manual with answer keys and instructions for each test item is used to evaluate test.

d. Results of the initial design (Initial Design)

The result of the design activity is the writing of learning devices. This result resulted in an initial draft of the student book (BS) and LKPD for each meeting, tests of students' mathematical computational thinking abilities, scoring guidelines and alternative solutions. All results on the results of this initial design are called draft I

Development Stage (Develop). At the development stage, the initial step is to validate Draft I with specialists before conducting field tests. The produced learning tools underwent expert validation with an emphasis on format, content, graphics, and language. Expert validation yields validation values, alterations, critiques, and recommendations. It serves as a foundation for revision and refinement of the created learning tools by researchers. The learning tool that emerged from the revision is referred to as draft II and has satisfied the necessary.

Improvements were made to the experiments in Class VIII-1 in Draft II with 32 students in order to create educational aids that satisfy all predetermined performance standards. Following the revision of Design II, Design III was created and tested on 32 students in grades VIII–2. Experiment II was performed to evaluate Draft III as a problem-based learning tool that satisfies all of the established valid, practical, and effective criteria.

Stage of Spread (Disseminate)

Based on the results of data analysis in trial II, learning tools developed through Problem-Based Learning models has become the final tool (draft III) because meets the valid, practical, and effective criteria. So then the learning device in the form of draft III is distributed in a way provide learning device products developed through Problem Based Learning learning model to the MGMP forum for SMP Negeri 3 Pantai Labu

4.2. Discussion

Practicality of Learning Devices in Trial I

a. Expert/Practitioner Assessment of Learning Devices

The results of expert and practitioner assessments of the practicality of Problem Based Learning model learning tools can be seen in Table 7 below:

Table 6. Validator Recommendations for Learning Devices

No	Validator	Learning Tools				
		RPP	BS	LKPD	TKBK Prestes	TKBK Postest
1	Validator 1	TR	TR	TR	TR	TR
2	Validator 2	TR	TR	TR	TR	TR
3	Validator 3	RK	RK	RK	RK	TR
4	Validator 3	TR	TR	TR	TR	TR
5	Validator 4	TR	TR	TR	TR	TR

b. Implementation of Learning Devices

The implementation of learning at the first meeting was 64.17, while for the second meeting it was 78.33. However, when viewed as a whole, all the learning tools used for the two meetings have an average implementation of 71.25 in the sufficient category ($70 \leq k < 80$). Thus it can be concluded that the implementation of learning from the first meeting to the second meeting is in sufficient criteria.

The Effectiveness of Learning Devices in Trial I

a. Analysis of Achievement of Computational Thinking Ability in Classical

The level of achievement in classical mathematical computational thinking skills of students in trial I can be seen in Table 8 below:

Table 7. Achievement Level of Computational Thinking Ability Classically in Trial I

Category	Prestest		Posttest	
	Number of students	Classical Achievement Percentage	Number of Students	Classical Attainment Percentage
Achieved	15	46,88%	24	75%
Not achieved	17	53,12%	8	25%
Amount	32	100%	32	100%

Based on the data in Table 7 above shows that the achievement of students' mathematical computational thinking ability in the pretest was 46.88% while in the posttest it was 75%. An overview of the percentage of achievement criteria classically on students' mathematical computational thinking skills in trial I is presented in Figure 3 below:

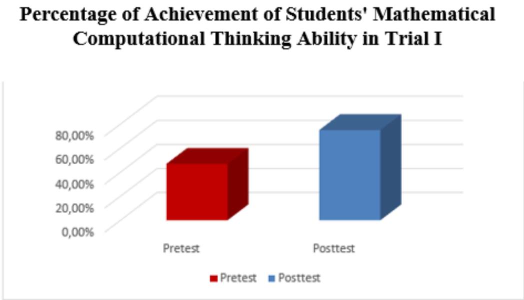

Fig.3 Percentage of Achievement of Students' Mathematical Computational Thinking Ability in Trial I

b. Student Activity Analysis

The average percentage of student activity time in trial 1 will be described in Table 9 below:

Table 8. Average Percentage of Ideal Time for Student Activities in Trial I

Meeting	Percentage of Achievement of Ideal Time Student Activity per Aspect of Observasion (%)				
	1	2	3	4	5
II	23.53	17.65	27.45	29.41	3.92
II	24,39	15.85	28.05	29.27	2.44
Average Percentage	23.96	16.75	27.75	29.34	3.18

Based on Table 8 it can be seen that the average percentage of student activity time for each category at the first meeting is23.53%;17.65%;27.45%;29,41% And3.92%. The average percentage of student activity timefor 2 meetings is 23.96%; 16.75%; 27.75%; 29.34% and 3.18%.The average percentage of student activity time is also presented in Figure 4 below:

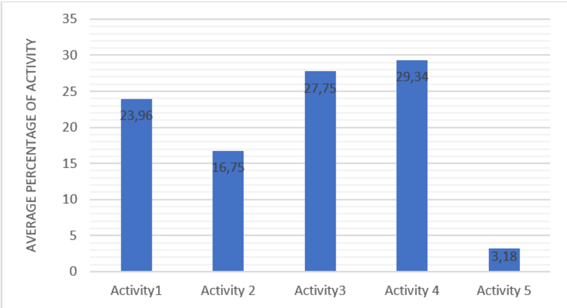

Fig.4 Percentage of ideal student activity time in trial I

c. Student response

According to the study of the student response questionnaire results, the typical proportion of students who gave each of the following positive replies is as follows: (1) Students who express satisfaction with the learning device components are 76.25%; (2) Students say that 94.53% of the components and learning activities are still novel; (3) Students who expressed interest in participating in learning mathematics in other materials, such as learning carried out; (4) Students who stated that the language in student books, worksheets, and tests was clear to the extent of 79.04%; and (5) Students who expressed interest in the appearance of students. In trial I, the overall average of the students' favorable reactions was 85.15%.

Practicality of Learning Devices in Trial II The practicality of model-based learning devices Problem Based LearningIn terms of the results of the observation of the implementation of trial II learning at the first meeting it was 85.48, while for the second meeting it was 92.38. However, when viewed as a whole, all the learning tools used for the two meetings have an average implementation of 88.93 in the good category ($80 \leq k < 90$). Thus it can be concluded that the implementation of learning at the first meeting to the fourth meeting is in good criteria.

The Effectiveness of Learning Devices in Trial II

a. Analysis of Achievement of Computational Thinking Ability in Classical

The level of achievement in classical mathematical computational thinking skills of students in trial II can be seen in Table 9 below:

Table 9. Achievement Level of Computational Thinking Ability Classically in Trial II

Category	Prestest		Posttest	
	Number of students	Classical Achievement Percentage	Number of Students	Classical Attainment Percentage
Achieved	21	65.60%	28	87.5%
Not achieved	11	34,40%	4	12.5%
Amount	32	100%	32	100%

Based on the data in Table 10 above shows that the classical achievement of students' mathematical computational thinking skills in the pretest was 65.60% while in the posttest it was 87.50%. An overview of the percentage of achievement criteria classically on students' mathematical computational thinking skills in trial II is presented in Figure 5 below:

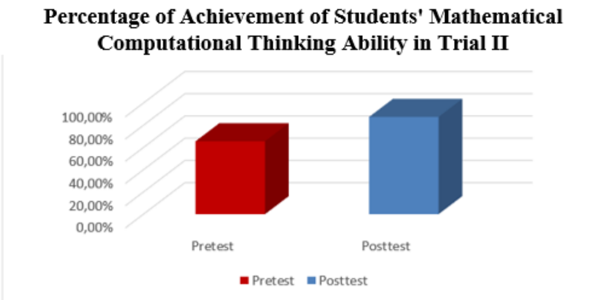

Fig.5 Percentage of Achievement of Students' Mathematical Computational Thinking Ability in Trial II

b. Student Activity Analysis

The average percentage of student activity time in trial II is described in table 10 below:

Table 10. Average Percentage of Ideal Time for Student Activity in Trial II

Meeting	Percentage of Achievement of Ideal Time Student Activity per Aspect of Observasion (%)				
	1	2	3	4	5
II	25.42	16.95	27.12	28.81	1.69
II	24,00	16.00	29,00	30,00	1.00
Average Percentage	24.71	16.47	28.06	29.41	1.35

Based on Table 10, it can be seen that the average percentage of activity time for each category at the first meeting was 25.42%;16.95%;27,12%;28,81% And1.69%. The average percentage of student activity timefor 2 meetings is 24.71%; 16.48%; 27.12%; 29.41% and 1.35%.The average percentage of student activity time is also presented in Figure 6 below:

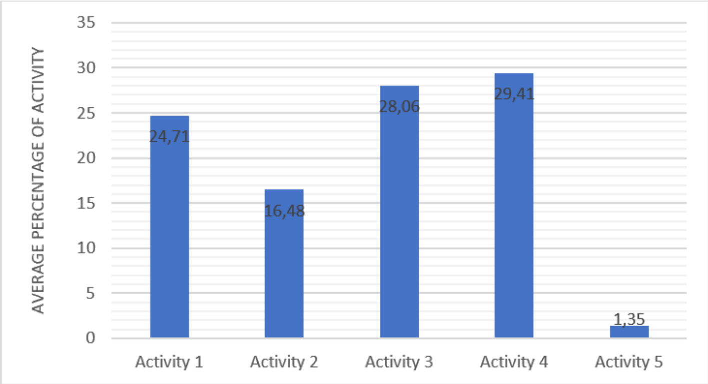

Fig.6 Percentage of ideal student activity time in trial II

c. Student response

According to the study of the student response questionnaire results, the typical proportion of students who gave each of the following positive replies is as follows: The percentage of students who say they are satisfied with the learning device's components is 93.12%; the percentage of students who say the components and learning activities are still new is 96.88%; the percentage of students who say they are interested in participating in mathematics learning on other materials, such as learning carried out, is 90.62 percent; the percentage of students who say the language in student books, worksheets, and tests is clear is 88.54%; and the percentage of students who say they are interested in the trial II, the overall average of the students' favorable reactions was 92.78%.

Improvement of Students' Mathematical Computational Thinking Ability Test

The increase in students' computational mathematical thinking skills in trials I and II was seen through the N-Gain formula from the pretest and posttest results of students' computational mathematical thinking abilities. The results of N-Gain calculations on mathematical communication skills can be seen in Table 12 below:

Table 11. Results *of N-Gain* Mathematical Computational Thinking Ability of Trial II students

N-Gain	Interpretation	Number of students	
		I	II
g>0.7	Tall	3	8
0.3< g ≤0.7	Keep	21	20
g≤ 0.3	low	8	4

As can be seen from the table above, there 3 students who received N-Gain scores in the range g > 0.7 in trial I and there were 8 students who experienced an increase in the high category; there were 21 students who received N-Gain scores in the range 0.3 g 0.7 in trial I and 20 students who experienced an increase in the moderate category; and there were 8 students who received N-Gain scores in the range g 0.3 in trial I and there category. So the average obtained in trial I was 0.36 in the medium category and in trial II rose to 0.51 in the medium category

5 Conclusion

Based on the results of the analysis and discussion in this study, the following conclusions are obtained:

The learning tools developed based on the Problem Based Learning model in improving students' mathematical computational thinking skills have met the practical criteria where 1) The response of the expert or validator team stated that the learning tools can be used with small revisions and 2) the implementation of the developed learning tools has an average implementation 88.93 with good category. Learning tools developed based on the Problem Based Learning model in improving students' mathematical computational thinking skills have met the effective criteria where 1) Classical achievement of students' mathematical computational thinking skills is 87. Improving students' mathematical computational thinking skills taught using Problem Based Learning model learning tools seen from the N-gain value stated from trial I of 0.36 increased to 0.51 in trial II

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