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23 - 24 September 2019
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Medan, North Sumatra - Indonesia

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Rundown of The 4th Annual Internatioanal Seminar on Transformative Education and Educational Leadership (AISTEEL) 2019
Garuda Plaza Hotel, Medan, 23 – 24 September 2019

1st day (Monday, September 23, 2019)

Time	Activities	PIC
15.00 – 20.00	Registration in Garuda Plaza Hotel	committee

2nd day (Tuesday, September 24, 2019)

Time	Activities	PIC/Moderator
07.00 – 08.30	Poster Sessions 1	Section Poster 1
08.30 - 09.00	**Opening Ceremony** 1. MC Speech 2. Traditional Welcome Dance 3. Indonesian National Anthem 4. Pray 5. Chairperson Report 6. **MoU signing between Unimed and PSU - Thailand** 7. Welcoming speech of Director of Postgraduate School 8. Welcoming speech and official opening of Rector of State University of Medan	MC
09.00 – 09.40	Plenary Lecture 1: **Prof. Dr. Syawal Gultom, M.Pd** (State University of Medan– Indonesia)	Moderator Section
09.40 – 10.25	Plenari Lecture 2 **Prof. W. L. Quint Oga-Baldwin** (Department of Education, Faculty of education and Integrated Art and Sciences, Waseda University - Japan)	Prof. Amrin Saragih, PhD (Panel)
10.30 – 11.15	Plenari Lecture 3 **Prof. Dr. Wu-Yuin Hwang**(Graduate Institute of Network Learning Technology National Central University, NCU - Taiwan)	
11.15 – 12.00	Plenari Lecture 4 **Prof. Dr. Ekkarin Sungtong** (Dean of Faculty of Education Prince of Songkla University - Thailand)	Mangara Simanjorang, PhD (Panel)
12.00 – 12.45	Plenari Lecture 5 **Asst. Prof. Patcharin Panjaburee, Ph.D.(**Mahidol University – Thailand)	
12.45 – 13.30	**Lunch Break/** Poster Sessions 2	Section Poster 2
13.30 – 15.30	**Parallel Session 1**	
15.30 – 16.00	Break/ Poster Sessions 3	Section Poster 3

15.50 – 18.00	**Parallel Session 2**	Moderator/Operator
18.00 – 19.00	Break/ Prayer	
19.00 – End	Banquet (Gala Dinner) - Announce of Best Presenter - Announce of Best Poster	Consumption Section

Proceedings of the 4th Annual International Seminar on Transformative Education and Educational Leadership (AISTEEL 2019)

Preface

The 4th Annual International Seminar on Transformative Education and Educational Leadership (AISTEEL 2019) was held in Garuda Plaza Hotel, Medan City-Indonesia on 23-24 September 2019. This seminar is organized by Postgraduate School, Univesitas Negeri Medan and become a routine agenda at Postgraduate program of Unimed now.

The AISTEEL is realized this year with various presenters, lecturers, researchers and students from universities both in and out of Indonesia participating in, the seminar with theme "Education, Learning and Leadership Innovation."
The plenary speakers coming from various provinces in Indonesia have been present topics covering multi disciplines. They have contributed many inspiring inputs on current trending educational research topics all over the world. The expectation is that all potential lecturers and students have shared their research findings for improving their teaching process and quality, and leadership.

The fourth AISTEEL presents a keynote speaker and 4 distinguished invited speakers from Indonesia, Japan, Taiwan, and Thailand. In addition, presenters come from various Government and Private Universities, Institutions, Academy, and Schools. Some of them are those who have sat and will sit in the oral defence examination.

There are 310 articles submitted to committee, some of which are presented orally in parallel sessions, and others are presented through posters. The articles have been reviewed by double blind reviewer and 172 of them were accepted for published by Atlantis Press indexed by International Indexation and 96 papers are published by digital library indexed by google scholar.
The Committees of AISTEEL invest great efforts in reviewing the papers submitted to the conference and organizing the sessions to enable the participants to gain maximum benefit.

Grateful thanks to all of members of The 4th Annual International Seminar on Transformative Education and Educational Leadership (AISTEEL 2019) for their outstanding contributions. Thanks also given to publisher for producing this volume.

The Editors

Bornok Sinaga
Rahmad Husein
Juniastel Rajagukguk

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Development of Mathematical Learning Devices Based on Model Problem Based Learning (PBL) to Improve Mathematical Communication Skills of School IT Jabal Noor Students Class VII

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***Abstract*—The purpos study are to produce mathematical learning tools that are valid, practical and effective through Problem-Based Learning (PBL) model to improve mathematical communication skills of VII grade students of Jabal Noor IT Middle School. Specific objectives in this study are to: 1) produce mathematical learning devices that are valid, practical and effective to be used in the teaching and learning process. 2) to improve students' mathematical communication skills using learning tools developed based on the PBL model. This research is a development research developed with a 4-D model, namely defining, designing, developing, disseminating. Learning devices. Learning models developed in this study include the Learning Implementation Plan (RPP), Student Book (BS), Student Activity Sheet (LKPD). In addition, researchers have also developed research instruments that consist of tests of students' mathematical communication learning abilities. After being analyzed using learning tools it can be concluded that there is an increase in students' mathematical communication skills, where the average increase in mathematical communication skills of students from trial I and trial II in the trial I is 0.48 points with an increase in mastery of learning in 23% classics.**

Keywords— Development of Learning Devices; Problem Based Learning Model (PBM); Mathematical Communication Ability

I. INTRODUCTION

Education is very important and cannot be separated from life. The importance of education, so that it becomes a benchmark for the progress of a nation. An advanced nation is a nation that has quality human resources, both in terms of spiritual, intelligence and skill. So that with quality human resources a nation will be able and proactively answer the challenges of an ever-changing era. Mathematics is one of the subjects studied by students starting from Elementary School, Middle School, even to High Education.

This is intended to equip students with logical, analytical, systematic, critical and creative thinking and the ability to work together (Permendiknas Number 22, 2006: 345) in other words after passing a long and continuous mathematics learning process, students are expected to emerge. who think critically, creatively, systematically, are able to analyze and work together.

In line with the statement above, this is also stated in Permendiknas (2006: 346), that there are 5 objectives of mathematics learning, namely: (1) understanding mathematical concepts, explaining the interrelationships between concepts, flexible, accurate, efficient and precise in solving problems; (2) using reasoning on patterns and traits, making mathematical manipulations in making generalizations, compiling evidence, or explaining mathematical ideas and statements; (3) solving problems that include the ability to understand problems, design mathematical models, complete models and interpreting solutions obtained; (4) communicating ideas with symbols, tables, diagrams, or other media to clarify the situation or problem; (5) having an attitude of appreciating the usefulness of mathematics in life, namely having curiosity, attention and interest in learning mathematics, as well as being tenacious and confident in problem solving. Based on cases and findings in the field, the low mathematical communication skills of students are caused by several factors, among others: first, the learning plan that the teacher has is not in accordance with the quality criteria of the learning device. The learning plan is only as an administrative supplement, the teacher has not developed his own learning plan, the learning process seems situational and not directed. This causes passive and less motivated students to learn. Second, students do not have a Student Activity Sheet or often called LKPD so that the process of developing students' mathematical communication skills is not well developed. Third, the problems presented in

the learning support book used have not been able to measure mathematical communication skills that are in accordance with the expected indicators. Of the several factors above, the learning device becomes the dominant factor in the low mathematical communication skills of students. To be able to develop mathematical communication skills a supportive learning device is needed. Turning from this, there is a challenge for teachers to be able to develop their own learning tools.

Suhadi (2007: 24) said that the learning tools in question included a number of materials, tools, media, instructions and guidelines that would be used in the learning process. According to Trianto (2011: 96) suggests that learning devices are devices that are needed and used in managing the teaching and learning process. Learning tools can be in the form of Student Books (BS), syllabus, Learning Implementation Plans (RPP), Student Activity Sheets (LKPD), Evaluation Instrument or Learning Outcomes Test (THB), and learning media ". The importance of learning tools in learning activities so that development is a very demanded thing for every teacher and prospective teacher.

The Learning Implementation Plan (RPP) according to Permendiknas number 41 of 2007 is a learning plan developed in more detail referring to the syllabus to direct students' learning activities in an effort to achieve basic competencies. RPP contains the steps that will be carried out by the teacher in learning activities. RPP according to Trianto (2011: 214) is a guide to the steps that will be carried out by the teacher in learning activities arranged in the activity scenario. This RPP serves as a guide for teachers during the learning process. RPP will assist teachers in organizing standard material, as well as anticipating students and problems that may arise in learning. Both the teacher and students know for sure the goals to be achieved and how to achieve them. Thus, the teacher can maintain the situation so that students can focus on learning that has been designed.

Another learning tool that supports the learning process besides lesson plans is a textbook. Mathematical topics contained in mathematics textbooks have developed steadily for more than hundreds of years of publishing. Through a textbook, a teacher will be able to diagnose and evaluate students' mathematical performance. Textbooks allow a teacher to provide exercises to provide reinforcement of concepts and skills that have been studied before and can also provide enrichment regarding mathematical concepts and mathematical skills that are considered important and new to students.

In addition to the above problems, the language used in the textbook to inform the concepts provided is important to communicate what will be delivered. The language used in the textbook will determine the level of absorption of students in the information provided. The better the language used, the better the level of readability of the textbook. Spencer et al (2008) state that "so that teachers can make effective instructional decisions needed to eliminate problems with content areas in textbooks, teachers not only question the content but also the level of reading textbooks".

To develop learning devices a learning model is needed. Based on problems in the field that a learning model is needed that empowers students more, which does not require students to memorize facts, but the model that encourages students to construct knowledge in their own minds so that its effects are not good for the development of students' mathematical abilities does not continue to negative attitude towards mathematics. To achieve this, an appropriate, appropriate and relevant learning model is needed. One model that is considered appropriate is the Problem Based Learning model. The reason why choosing the PBL model in students' mathematical communication is because PBL models are constructive in that students focus more on developing thinking skills and problem solving skills, as well as skills in communication and collaboration in conducting investigations, and social skills that require reflection from various perspectives. Students are asked to make the most of specialist skills and group members where the role of the teacher is as a facilitator and architect.

II. THEORETICAL FOUNDATION

A. Mathematical communication skills

Iriantara (2014: 1) describes the communication is at the heart of the learning process. Communication is a process in which two or more persons to form or exchange information with each other, which in turn will arrive on a deep mutual understanding. Iriantara (2014: 4) adds that communication can generally be defined as an event each convey information or a message from a person / institution to others. In communication science, there are three forms of communication are known linear communication with one-way communication, relational and interactive communication, convergent communication which is characterized by multi-direction. Communication skills are very important to have learners to improve students understanding of the usefulness of mathematics itself.

By Baroody (Ansari, 2009: 11) there are five aspects of communication, namely (representing), listening (listening), reading (reading), discussion (discussion), and writing (writing).

1) Representation (Representing): Representations are: (1) new forms as a result of the translation of a problem or idea; (2) Translating physical diagrams or models into symbols or words. Representation can help children explain concepts or ideas and make it easier for children to get a resolution strategy.

*2) Listening (Listening):*Hearing is an important aspect of discussion. Students cannot comment well if they cannot take the essence of the topic of discussion. The importance of

listening critically can also encourage students to think of answers to that question.

3) Reading (Reading): Reading is an activity of reading texts actively to find answers to questions that have been compiled. Active reading also means reading that is focused on paragraphs that are estimated to contain relevant answers to questions.

4) Discussion (Discussing): Discussion is a means to express and reflect on the minds of students. For that reason, discussions need to be trained to students. Students are said to be capable in a discussion if they have adequate reading, listening and courage skills. Discussion can also benefit listeners because it provides new insights for them.

5) Writing (Writing): Writing is an activity carried out consciously to express and reflect on the mind. Writing is a useful tool of thinking because through thinking, students gain mathematical experience as a creative activity.

B. Method Definition Model Problem Based Learning

Problem-based learning is often known as Problem Based Instruction or Problem Based Learningmerupakan learning models using the problem as a starting point learning.

Problems that can be used as learning tools are problems that meet the real world context (real world), which are familiar with the daily lives of students. Eggen and Kauchak (2012: 307) mention Problem Based Learning is a set of teaching models that use problems as a focus for developing problem solving skills. Dewey (Trianto, 2011: 91) learning based on problems is the interaction between stimulus and response, is the relationship between the two directions of learning and the environment. The environment gives input to students in the form of help and problems, while the brain's nervous system functions to interpret the aid effectively so that the problems faced can be investigated, assessed, analyzed and sought for solutions properly.

In line with that, Arends (2008: 41) states that the Problem Based Learning model is a learning model in which participants are taught authentic problems with the intention of compiling their own knowledge, developing inquiry and higher-level thinking skills, developing Communication for Students and adding traits student confidence. Tan (Rusman, 2011: 232) adds that problem-based learning is the use of various kinds of intelligence needed to confront real-world challenges, the ability to deal with everything new and the complexity that exists.

The PBL method focuses on the challenges of making students' minds visible when solving problems, Like most learning innovations, PBL is not developed based on learning theory or psychological theory even though the PBL process involves the use of metacognition and selfregulation, the PBL method is known as progressive active learning and is a learning approach that is no longer teacher-centered (teacher-centered) but must be student-centered (student-centered, and use unstructured problems as a starting point for learning) (Minarni, 2013: 162)

Problem-based learning helps students to process information that has formed in their minds and collects their own knowledge about the social world and its surroundings. This learning is suitable for Problem Based Learning, the teacher has a role to present problems, ask questions, and facilitate investigation and dialogue. In addition, the teacher provides support and encouragement that can increase the growth of inquiry and students' intellectual abilities. This learning model can also increase the growth and development of student learning activities both individually and in groups. In this learning, the teacher guides and gives minimal instruction to students in solving problems. Teachers are required to be able to create a conducive learning atmosphere so that they can help students practice in the process of solving the problems given.

1) *Characteristics of the Model Problem Based Learning Method :* The Problem Based Learning model has the following characteristics:
   a) *Submitting questions or problems*: Arends (2008: 42) says that the problems and questions asked must meet 5 criteria, namely: (a) authentic, that is the problem is based and taken from everyday life, in accordance with the experience of students, and in accordance with academic principles; (b) it is clear, that the Problem must be clearly formulated, in the sense that it does not create new problems for students which ultimately make it difficult to resolve students; (c) easy to understand, that is the problem given should be easily understood by students. In addition, problems are prepared and made according to the level of development of students; (d) wide and in accordance with the learning objectives, the problems that are formulated and formulated should be broad, meaning that the problem includes all the subject matter to be taught, the available space and resources. In addition, the problems that have been prepared must be based on predetermined learning goals; and (e) useful, that is, the problems compiled and formulated must be beneficial, both for students as problem solvers and teachers as problem makers. A useful problem is a problem that can improve students 'ability to think and solve problems and to arouse students' learning motivation.

   b) *Focus on the relationship between discipline:* although problem-based learning may be centered on certain subjects (science, mathematics, and social sciences), the problems that will be investigated have been chosen so that in solving them, students review the problem from many subjects.

c) *Authentic investigation*: Problem-based learning requires students to conduct authentic investigations to find real solutions to real problems. Students must analyze and define problems, develop hypotheses and make predictions, collect and analyze information, conduct experiments (if needed), make references, and form conclusions.

d) *Produce / work and show it off*: Problem-based learning requires students to compile the results of their research in the form of work (writing and completion) and showcase their work. This means that the results of student problem solving are displayed or made a report.

e) *Collaboration*: In problem-based learning tasks in the form of problems must be solved together between students and students, both in small groups and in large groups.

2) Method Steps: Learning models are conceptual frameworks that describe systematic procedures in organizing learning experiences to achieve certain learning goals and are guidelines for learning designers and teachers in designing and implementing teaching and learning activities. The Problem Based Learning model is a conceptual framework that describes a systematic procedure in organizing learning experiences that refers to the five main steps seen in TABLE.I

TABLE I. SYNTAX OF MODEL PROBLEM BASED LEARNING

Stage	Teacher's Behavior
Stage 1 Student orientation on problems	The teacher explains the learning objectives, explains the logistics needed, proposes phenomena or demonstrations or stories to raise problems, motivates students to be involved in solving selected problems.
Stage 2 Organizing students to learn	The teacher helps students to define and organize learning tasks related to the problem.
Stage-3 Guiding individual and group investigations	The teacher encourages students to gather appropriate information, carry out experiments to get explanations and problem solving.
Stage 4 Develop and present the work	The teacher assists students in planning and preparing suitable works such as reports, videos, and models and helps them share tasks with their friends.
Stage 5. Analyze and evaluate the problem solving process	The teacher helps students to reflex or evaluate their investigations and the processes they use.

3) Enhancing Students' Mathematical Communication Capabilities through the Development of Problem-Based Learning Devices : Communication is a very important part of learning mathematics. With communication students are able to solve problems or draw conclusions. Mathematical communication can build social activities in mathematics learning. Indicators of communication skills in learning mathematics are: (1) explaining ideas or situations from an image or graph given in their own words in writing (Writing); (2) state a situation with a picture or graph (drawing); and (3) state the situation in the form of a mathematical model (Mathematical Expression). To improve students' mathematical communication skills in rectangular material, a learning device was prepared that was validated by experts. Learning tools in the form of: are Learning Implementation Plans (RPP), Student Books (BS) and Student Participant Activity Sheets (LKPD) that are oriented to the problem-based learning model. Problem-based learning is a learning model that is faced with a problem at the beginning of learning, which then the students try to solve the problems given. Through solving these problems students learn skills that are more basic with problem-oriented; organizing students to learn; guiding individual and group investigations; develop and present the work; analyze and evaluate. With the development of learning tools oriented to the problem-based learning model it is expected that students' mathematical communication skills will increase.

III. RESEARCH METOD

Learning tools developed in this study are learning devices with problem-based learning models that include Learning Implementation Plans (RPP), Student Books (BS), Student Activity Sheets (LKPD). Besides that, researchers have also developed research instruments consisting of tests of students' mathematical communication learning abilities. The subjects in this study were VII grade students of Jabal Noor IT Middle School in the odd semester of the 2018/2019 academic year while the objects in this study were problem-based learning devices for fraction material.

A. Research Procedures for Development of Learning Devices

In this study were divided into two stages, the first stage is the development of learning tools. Development of learning tools which include (i) RPP validity; (ii); Student book validation (BS); (iii) the validity of the LKPD; (iv) validity of test instruments for mathematical communication skills; and (v) validation of the Communication questionnaire instrument learning students. The second stage is the implementation of learning devices that are considered appropriate for use.

The stages of developing the learning device are detailed as follows:

*1) Defining Phase :*The purpose of the defining phase is to define and define the conditions of learning. Through analysis determined the objectives and limitations of the material for the learning device. The phases in this stage are preliminary analysis.

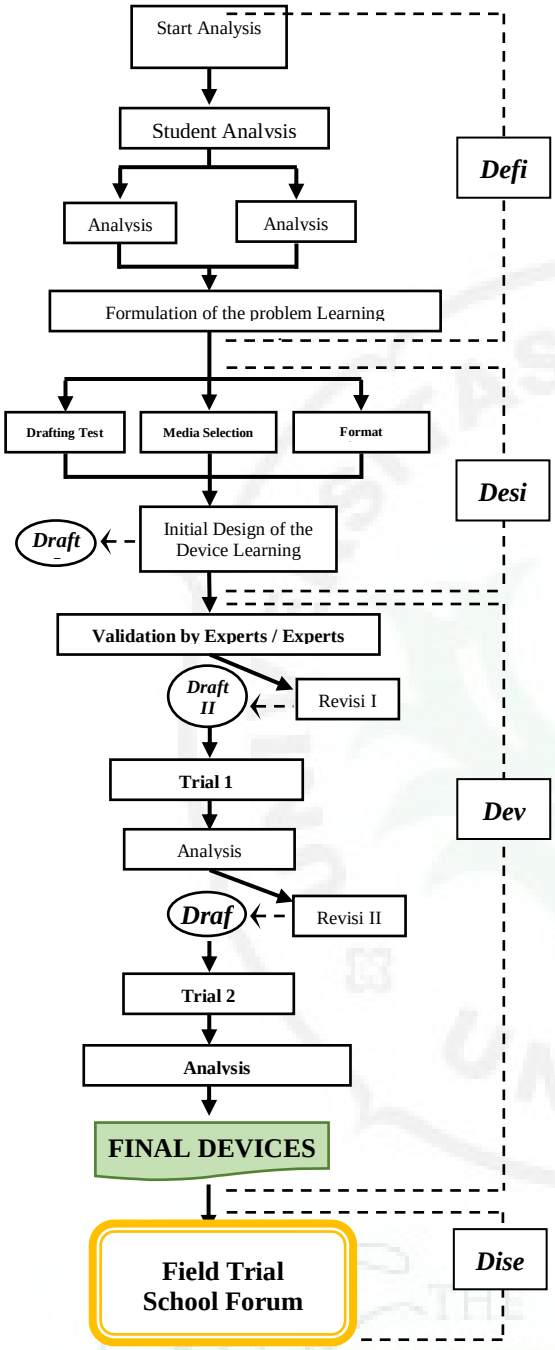

Fig.1 Chart of development of 4-D model learning devices

2) Development Phase: The purpose of development phase is to produce a good final draft. In the draft 1 learning device and the research instrument was validated to the experts, then the test instrument for mathematical communication skills was tested on classes outside the sample. Then a field trial is carried out, which aims to obtain direct input on the learning devices that have been prepared so as to produce the final device.

3) Dissemination Phase: The Dissemination Stage is obtained by the final device that has met the criteria of valid, practical and effective But in this study the fourth stage was not carried out because of limited time, funds and also researchers, it is expected that further research can be continued.

B. Research design

The trial design used in the development of the instrument was One-group pretest-posttest design. As follows:

Test	**Treat**	**Test**
T_1	x	T_2

Where :
T_1= *Pre – tes* students' mathematical communication skills
T_2= *Post – tes* students' mathematical communication skills
X= Treat in the form of learning with devices developed based on problems

Then, the data from the field trial results were analyzed and then revised to get the final learning device (final draft).

C. Instruments and Data Collection Techniques

To measure the validity and effectiveness of mathematics learning tools, research instruments were developed and developed.

All validation sheets in this study are used to measure the validity of learning devices and instruments needed. All of the validation sheets were adapted and modified according to the needs of the problem-based learning model. Some validation sheets used include: (a) validation sheet of the Learning Implementation Plan (RPP); (b) Student Activity Sheet validation sheet (LKPD); (c) Student Book validation sheet (BS); (d) validation sheet for Mathematical Communication Ability Tests (TKKM) of students. This validation sheet contains components that are assessed to include: format, language, illustrations, and contents. Indicator of each component.

D. Expert and Practitioner's Assessment Sheet About the Implementation of Learning Devices

This assessment sheet is used to measure the implementation of learning devices based on mastery of the theory and experience of experts and practitioners. Based on the mastery of the theory and experience, for example by using the Observation Sheet for the implementation of Learning Tools. The implementation of this learning device is measured from three aspects of observation / assessment, namely: (1) the implementation of the learning model syntax, (2) the implementation of the social system, and (3) the management reaction principle. Observations are made during learning. Assessment of implementation of the application of syntax, social system, reaction principle consists of 5 (five) rating scales, namely, very low (value 1); low (value 2);

enough (value 3); high (value 5) and very high (value 5). Before the learning implementation observation sheet is used, it is first tested to determine the degree of reliability of the implementation observation sheet. To carry out observations / assessments of the implementation of learning syntax, two observers were involved. Observation data from two observers will be analyzed using the percentage of agreement formula by Grinnell (in Bornok, 2008).

$$R = \frac{Agreements\,(A)}{Disagreements(D) + Agreements(A)} x100\% \quad (1)$$

Information:
R is the instrument reliability coefficientAgreements, (A) are the magnitude of the frequency of matches between the data of two observers, Disagreements (D) is the amount of frequency that does not match between the data of two observers.

The provisions of agreement and disagreement for observation sheet instruments / syntax assessment of learning management are set as follows:

- agreement stated for combination (4.4), (4.3), (3,4), (3,3), (2,2), (2,1) and (1,1);
- disagreement is expressed for combinations (4.1), (1.3), (2.3), (3.2) and (4.2). This observation sheet instrument meets the reliability criteria if R ≥ 75%.

E. Data Analysis Techniques

The data in this study consisted of qualitative and quantitative data. Quantitative data was obtained through analysis of the students' answers to the test of mathematical communication skills of students. Qualitative data was obtained through the results of device validation sheets, observations and questionnaires. Qualitative data were analyzed descriptively to support the completeness of quantitative data. Data obtained were analyzed and directed to answer the question whether the learning materials developed were valid, practical, and effective or not.

Data from validation results are analyzed to answer whether the learning device is valid or not and whether the learning devices developed can be implemented in the classroom or not. The results of validation of the learning approach can directly validate the media and learning devices. Data from observations and questionnaires are used whether the media and practical learning devices to be used. While the results of student learning test data are used to determine whether the learning device is effective against student learning outcomes which includes tests of students' mathematical communication skills. Data from observations, questionnaires and tests on student learning outcomes were obtained through trials.

In this case there are still many other techniques that can be used in carrying out the assessment.

IV. RESULTS AND DISCUSSION

This research is development research that produces a learning device that meets valid, practical and effective criteria. Learning tools developed include, Learning Implementation Plans (RPP), Student Books (BS), Student Activity Sheets (LKPD), tests of mathematical communication skills of students. Learning devices were developed using the 4-D development model from Thiagarajan, et al. Which includes four stages, namely the defining stage, the design stage (design) and the stage of development (develop) and dissemination (disseminate). Each stage is carried out continuously. Furthermore, the learning device in this study is designed based on problems and aims to improve the communication skills of students.

Tests of mathematical communication skills compiled consist of 5 items about posttest. Each question is designed to refer to indicators of mathematical communication skills, namely (1) writing mathematics; (2) drawing mathematics; and (3) make mathematical models / mathematical expressions. Post-test questions are questions in fractions. The tests compiled at this phase are designated as draft I.

The results of expert validation have values of validation, correction, criticism, and suggestions that are used as a basis for revising and improving learning devices. The learning tool for the revision is a learning device that has met the valid criteria and hereinafter referred to as draft II. Data on the validator's assessment of the learning plan can be seen in the Annex that supports the research. In making revisions, the researcher refers to the results of the discussion by following the suggestions and instructions of the validator. The average indicator value for each aspect of the validity assessment of the implementation plan of learning from each expert and practitioner is presented in the following table:

TABLE. II: AVERAGE VALUE OF INDICATORS FOR EACH ASPECT OF EVALUATING THE VALIDITY OF THE LEARNING PLAN

No.	Rated aspect	Average Indicator Value For Every Aspect of the Validator					Value Aspect
		I	II	III	IV	V	
I.	Format	4.6	4,6	4	4,4	4,8	4,48
II.	Fill In	4,33	4,55	4	4,55	4,44	4,37
III.	Language	4,5	4,75	4	4,25	4.5	4,4
Value of Va or Average Value of Total Aspects							4,4

The average indicator values in Table-2 above are obtained from the results of the number of indicator values for each aspect given by each expert and practitioner with the number of indicators in that aspect. Aspect values are obtained from the results of the average number of indicators given by experts and practitioners for each aspect of the assessment with many experts and practitioners as assessors. Furthermore the value of Va or the average value of the total aspect is 4.4. This value is obtained from the results of the number of aspect values with the many aspects of the validity assessment of the contents of the plan for implementing learning. The value of

Va is 4.4, if referred to the criteria for determining the level of validity of the set learning device previously, it was concluded that the learning plan developed had a level of validity at the level of ‘‘ Valid ‘‘.

In addition to the validation value, the validator's correction is also obtained as an improvement for RPP errors and weaknesses. Then the RPP is revised according to the advice of each validator. The suggestions and improvements of each validator can be seen in TABLE III.

TABLE. III. RPP REVISION BASED ON RESULTS OF VALIDATION BY THE EXPERT TEAM

No	Validator	Suggestions for Revisions	After Revision
1	Validator 1	- Methods: Combination of Question and Answer, Discussion, Percentage and Assignment. - Approach: Problem Based Learning (PBL)	- Methods: Problem Based Learning (PBL) - Approach: Scientific
2	Validator 2	- Time allocation is detailed	- Allocation of time has been specified
3	Validator 3	- The word percentage is replaced by the presentation	- Already repaired
4	Validator 4	- Improve typing and language that is still ambiguous	- Already repaired
5	Validator 5	- Adjust time allocation	- Adjust the time allocation properly.

The average indicator value for each aspect of the validity assessment of students' books from each expert and practitioner is presented in the following table:

TABLE IV: AVERAGE VALUE OF INDICATORS FOR EACH ASPECT OF EVALUATING THE VALIDITY OF STUDENTS' BOOKS

No.	Rated aspect	Average Indicator Value For Every Aspect of the Validator					Value Aspect
		I	II	III	IV	V	
I.	Format	5	4.8	3.6	4.2	4.4	4.4
II.	Language	4.66	4.5	3.83	4.5	4.5	4.3
III.	Illustration	4.6	5	3.4	4.4	4.4	4.36
IV	Fill In	4.33	4.77	4	4.55	477	4.48
Value of Va or Average Value of Total Aspects							4.38

The average indicator value in Table-4 above is obtained from the results of the number of indicator values for each aspect given by each expert and practitioner with the number of indicators in that aspect. Aspect values are obtained from the results of the average number of indicators given by experts and practitioners for each aspect with many experts and practitioners as assessors. Furthermore the value of Va or total mean value is 4.38 obtained from the results of the number of aspects of the value with the many aspects of the validity assessment of the contents of the students' books. The value of Va is 4.38, if referred to the criteria for determining the level of validity of the learning device that has been previously set in Chapter III, it is concluded that the book of students has a level of validity is at the level of "Valid".

In addition to the validation value, the correction from the validator is also obtained as an improvement for the students' mistakes and book weaknesses. Then the students' books are revised according to the advice of each validator. The suggestions and improvements from each validator can be seen in table 4.4

TABLE V. REVISION OF STUDENT BOOKS BASED ON RESULTS OF VALIDATION BY THE EXPERT TEAM

NO	VALIDATOR	SUGGESTIONS FOR REVISIONS	AFTER REVISION
1	Validator 1	- Pay attention to the writing thoroughly.	- Already repaired
2	Validator 2	-	- Already repaired
3	Validator 3	- On the problem of the word uruh told to try to replace with the word ‘asked for '	- The word 'told' has been replaced with the word 'asked for'
4	Validator 4	-	-
5	Validator 5	-	-

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No.	Rated aspect	Average Indicator Value For Every Aspect of the Validator					Value Aspect
		I	II	III	IV	V	
I.	Format	5	4.75	3.5	4.25	4.5	4.4
II.	Language	4.5	4.66	4	4.33	4.33	4.36
III	Fill In	4.66	4.66	4	4.5	4.5	4.4
Value of Va or Average Value of Total Aspects							4.38

The average indicator value in Table-6 above is obtained from the results of the number of indicator values for each aspect given by each expert and practitioner with the number of indicators in that aspect. Aspect values are obtained from the results of the average number of indicators given by experts and practitioners for each aspect with many experts and practitioners as assessors. Furthermore, the value of Va or the average value of the total aspect is 4.38 obtained from the results of the number of aspects of the value with the many aspects of the validity assessment of LKS. The value of Va is 4.38, if referred to the criteria for determining the level of validity of the learning device that has been previously set in the Previous Discussion, it is concluded that the student activity sheet has a level of validity is at the "**Valid**" level.

In addition to the validation value, the correction from the validator is also obtained as an improvement for the students' mistakes and book weaknesses. Then the students' books are revised according to the advice of each validator. The suggestions and improvements of each validator can be seen in TABLE VII.

TABLE VII. REVISION OF LKPD BASED ON RESULTS OF VALIDATION BY THE EXPERT TEAM

NO	VALIDATOR	SUGGESTIONS FOR REVISIONS	AFTER REVISION
1	Validator 1	- The place provided to write down the settlement so that it is revised	- The place of completion has been enlarged
2	Validator 2	- Improve inappropriate language	- Already repaired
3	Validator 3	-	-
4	Validator 4	- Fix typing errors.	- Already repaired
5	Validator 5	-	-

Based on the results of the validation conducted by the expert, it was concluded that the instruments to be used in this study were feasible to use. Assessment of aspects of feasibility is presented as follows.

TABLE VIII. FEASIBILITY TEST RESULTS OF RESEARCH

No.	Instrument type	Assessment Aspect			Kes
		Instructions	Fill in	Language	
1.	Observation sheet for student activities	V	V	V	LD
2.	Questionnaire for students' responses	V	V	V	LD
3.	Test of mathematical communication skills...	V	V	V	LD

nd practitioners) stating Valid for each **indicator of the assessment aspect**. LD is the conclusion of the assessment of all experts and practitioners that the instrument developed is **worthy of use**

Based on the results of the analysis of the answers of the students at the time of the test, the data obtained from the mathematical communication skills of students in the VIIA class can be seen in the supporting attachments. The value of students' mathematical communication skills at the pretest and posttest is presented in the following table.

TABLE IX. VALUE OF COMPLETENESS OF TRIAL I KKM STUDENTS IN CLASS VII$_A$

Value Interval	Predicate	Pretest Value Frequency	Frequency of Posttest Value
3,49 – 4,00	A	0	0
3,04 – 3,48	B	0	6
2,56 – 3	C	3	13
< 2,56	D	23	7
total		**26**	**26**
Average Score		**40,2**	**69,15**
Standard Deviation Score		**12,35**	**7,52**
Completeness (%)		**11,5%**	**73,1%**

Based on the table above, it is known that the average score of students at the pretest is 40.2 with a standard deviation of 12.35 with completeness of 11.5%. After analyzing the reasons for the low value of the pretest of students is because they have forgotten the material on the questions given so that students are unable to answer the questions given correctly. and at the post test the average score of students was 69.15 with a standard deviation of 7.52 with completeness of 73.1%. After learning using the students' tools, most students have obtained mastery learning, but still in the B grade, there have been no students who have received an A grade and some students have not achieved mastery learning. After analyzing the answers of students, the device only gives an easy example of the problem and the material on the device is still difficult to understand. The answers of other students are because they have not been taught by using a device and with an atmosphere of learning. This shows that there is a need for revisions to the learning device.

The value of mathematical communication skills during trial I found in table 9 above can then be presented in the following diagram.

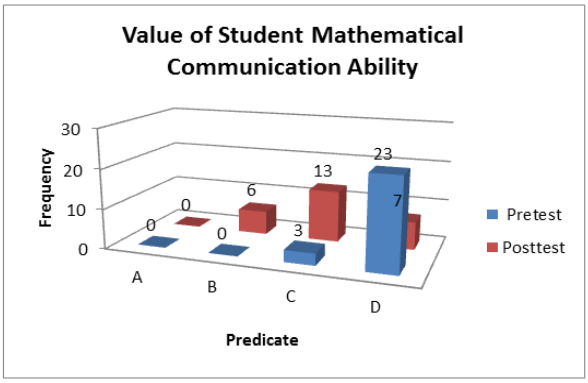

Fig. 2. Value diagram of mathematical communication skills Test I

The diagram above shows that the learning process using learning media has not yet reached the learning objectives related to students 'mathematical communication skills, where learners' mastery of 73.1% is still below the minimum required completeness (75%).

Based on the results of the analysis of the answers of students during the formative test data obtained mathematical communication skills of students of class VIIA which can be seen in the supporting attachments. The value of students in fraction numbers is presented in the second trial table as follows:

TABLE X. VALUE OF MATHEMATICAL COMMUNICATION CAPABILITIES CLASS VII$_A$ STUDENTS

Value Interval	Predicate	Pretest Value Frequency	Frequency of Posttest Value
3,52 – 4,00	A	0	12
3,01 – 3,51	B	5	10
2,56 – 3,00	C	10	3
< 2,56	D	11	1
total		**26**	**26**
Average Score		**66,8**	**84,73**
Standard Deviation Score		**9,03**	**8,8**
Completeness (%)		**57,69%**	**96,15%**

Based on the table above, it is known that the average score of students at pretest is 66.8 with a standard deviation of 9.03 and the completeness of students in achieving their learning goals is 57.69% of 26 students. The value of the students' mathematical communication skills when the formative test found in table 10 above can then be presented in the following diagram.

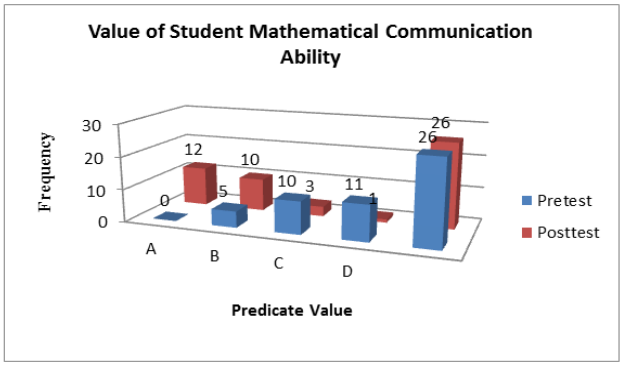

Fig. 3. Test Value Diagram of Trial Mathematical Communication Ability II

The diagram above shows that there are significant differences between the pretest and posttest values at the time of the pretest that none of the students achieved completeness. While the frequency of the scores of students at the posttest who received A score were 12 people (46.15%) while those who obtained the B score were 10 people (38.46%) and those who got the C score were 4 people (15.3%).) and 1 person gets a D value. So it is concluded that the learning process using learning media applies the PBL model to achieve the learning objectives related to the students' mathematical communication skills, where learning completeness of students more than 75% **has reached the minimum completeness set (75%) .**

Through pretest and posttest data can be determined the category of gain (gain) mathematical communication skills for each student which is determined based on the difference between the pretest score and posttest score to further determine the N-gain value as a result of the gain comparison with maximum gain. N-gain calculation on mathematical communication skills can be seen in the attachment that supports the N-gain average of 0.85 (High category) and simply represented in the following table 4.11:

TABLE XI. FREQUENCY OF INCREASING VALUE OF MATHEMATICAL COMMUNICATION CAPABILITIES

N-Gain interval	Category	Frequency	Percentage
g < 0.3	Low	8	30,7
0.3 ≤ g < 0.7	medium	11	42,3
g > 0.7	High	7	26,9
Total		26	100

Through the table above, it is known that there has been a significant increase (N-gain) from the pretest score of the posttest scores of students. The table above shows that students who experienced an increase in the low category were 8 students (30.7%), there were as many as 11 students (42.3%) who experienced an increase in the moderate category and there were 7 students (26.9%) who experienced a high category increase.

V. CONCLUSIONS

A. *Conclusions*

Based on the results of the analysis and discussion in this study, several conclusions were raised (product quality of problem-based learning devices) as follows:

1) Validitas produk

- RPP includes the feasibility aspects of the format, discussion, and content with a total score of 4.4 in the **"Valid"** category.
- Student books include aspects of feasibility in format, language, illustration and content with a total score of 4.38 and are in the **"Valid"** category.
- LKPD with a score of 4.38 is in the **"Valid"** category.
- The mathematical communication skills test is in the "Valid" category.

2) There was an increase in students' mathematical communication skills, in the first trial the average score of students at pretest was 40.2 with a standard deviation of 12.35 and completeness 11.5% and the average score of students at posttest was 69.19 with a standard deviation of 7.52 and percentage of completeness 73.1%. The increase occurred in the medium category (N-gain average = 0.461).

3) There was an increase in students' mathematical communication skills, in the second trial the average score of students at pretest was 66.8 with a standard deviation of 9.03 and completeness 57.69% and the average score of students at posttest was 84.73 with a standard deviation of 8.8 and completeness percentage 96.15%. The increase occurred in the high category (mean N-gain = 0.51)

B. *Suggestions*

Based on the results of the research and the conclusions above, several things can be suggested as follows:

- The learning tools produced still need to be tested in other schools with various conditions so that learning devices that are truly valid, practical and effective are obtained (as a continuation of the deployment stage in the 4-D model).
- Development of learning tools such as this should also be made to improve mathematical communication skills on other topics.
- For teachers or other parties who want to develop problem-based learning tools in other mathematics subject matter or in other subjects, they can design / develop the device by paying attention to the components of the learning model and the characteristics of the subject matter to be developed.

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