Development of two variable linear equation system learning development with a problem-based learning model

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Abstract. This study aims to produce a two-variable linear equation system learning tool using the Problem Based Learning model for students of Santa Rosa De Lima Tondano Catholic Middle School. This research method is a descriptive method. At the research, development stage, the device development model used in this study was a modified 4-D model. The learning tools developed are the Learning Implementation Plan, Student Activity Sheets, and Evaluation of Learning Outcomes. Based on the results of the descriptive analysis, it was found that the development of the Problem Based Learning model of learning produced good learning tools because it met valid criteria based on expert opinion, the ability of teachers to carry out learning was also good, Students were active during the learning process, students gave positive responses to learning, and evaluation of results. Learning meets the criteria of valid, sensitive, and reliable. Based on the descriptive analysis, it can be concluded: (1) The development research carried out at Santa Rosa De Lima Tondano Catholic Junior High School with the research subjects being students of class VIII in the 2019/2020 school year has produced learning tools that are valid, practical, and effective after being tested and through the process. Content validation. The tools developed are the Learning Implementation Plan, Student Worksheets, Evaluation of Learning Outcomes with the Problem Based Learning model on the material of the two-variable linear equation system, (2) Validated learning devices produce data with valid criteria, (3) In terms of practicality, the tool, learning is in the very practical category according to student responses or responses, and (4) Effective learning tools in terms of the Teacher Readiness Level which are in the very good category and the percentage of classical completeness is in the very good classification.

1. Introduction
Learning devices can make it easy for students to learn. The learning tools referred to include the Learning Implementation Plan (RPP), Student Activity Sheets (LKPD), and Learning Outcomes Evaluation (EHB). SPLDV material is part of the Algebra material studied in class VIII even semester in the 2013 curriculum. SPLDV material has several activities in its learning, including: making PLDV forms, making problem models from PLDV, making problem models from SPLDV, and writing related problem solving with SPLDV in everyday life.

Learning that has something to do with the environment or student life, so that it can make students remember more about the learning. One model that can be used for the development of learning tools to improve student learning outcomes is to use the PBL model. Because the PBL model is considered very possible to be used in learning this SPLDV material.
This can be seen from one of the characteristics of the PBL model, namely learning that begins with a problem. Thus, students find it easier to understand concepts because learning departs from everyday experiences. In the SPLDV learning conducted at the St. Catholic Middle School. Rosa De Lima Tondano, the teacher only rewrote the formulas that were already in the student manual, gave examples of questions, and gave assignments. Students are not actively involved in solving problems related to SPLDV.

In observations made by researchers at St. Catholic Middle School. Rosa De Lima Tondano obtained information that teachers still have difficulty developing learning tools that are in accordance with the 2013 curriculum. The learning tools referred to are syllabus, lesson plans, and student worksheet.

The LKPD used only contains material summaries, examples of questions and exercises that do not invite students to find the concept of learning mathematics, do not increase students' curiosity and do not make students independent in solving the problems presented because students only read material summaries in LKPD, see sample questions as well as doing exercises. In the practice questions presented, not all questions contain contextual questions that do not improve students' thinking processes. What students learn and get is done with their own senses and minds so that students experience directly in the process of gaining knowledge. One of the learning models for the 2013 curriculum that is in accordance with the problems the researcher has observed is the model Problem Based Learning.

EHB is used to measure learning outcomes. According to Permendiknas [1], EHB is used as a material to improve the learning process in accordance with the Education Assessment Standards. In the preparation of the evaluation of learning outcomes compiled by the teacher, its validity and reliability are not tested.

The results of this study are expected that the learning tools created in the form of RPP and LKPD can help the learning process for students of class VIII SMP, namely the teacher is facilitated in delivering material and students are facilitated in capturing material in SPLDV material according to the competency standards and basic competencies in the 2013 Curriculum in the eyes.

2. Problem formulation
What is the process and the results of the development of learning tools for SPLDV material for grade VIII junior high school students with the PBL model that meets the criteria of validity, practicality and effectiveness?

3. Research methods
This research is a development research that is a research to develop a product. The product produced from this research is a learning tool consisting of lesson plans, student worksheet and EHB using the PBL model in the SPLDV material.

4. Research results

4.1. Description of the process and results of learning device development
As formulated in the objectives of this study in the previous chapter, that this study has the aim of producing mathematics learning tools using the learning model Problem Based Learning on two-variable linear equation system material in class VIII SMP Catholic Sta. Rosa De Lima Tondano. The resulting learning tools are (1) RPP, (2) LKPD, and (3) EHB. This learning tool was developed based on the ADDIE development model.

4.2. Description of the analysis phase (analysis)
The analysis stage is the first step of the ADDIE development model. At this stage, the researcher carried out the analysis of the needs of learning devices, curriculum analysis, and analysis of student characteristics.
4.3. Analysis of learning tool needs
Analysis of the needs of learning tools was carried out by means of researchers collecting important information related to problems that occurred in mathematics learning for grade VIII students of SMP Katolik Sta. Rosa De Lima Tondano. The results of this analysis were obtained through surveys and interviews with mathematics teachers at the school.

4.4. Task analysis task
Analysis aims to determine the tasks that students must master in the material of two-variable linear equation systems in accordance with the 2013 Curriculum, so the tasks that will be carried out by students during the learning process are: (a) Tasks on the sub-topic of linear equation systems Two variables in LKPD1: (1) Explain the definition of a two-variable linear equation, (2) Explain the definition of a two-variable linear equation system, (3) Make a mathematical model related to a two-variable system of linear equations, (4) Determine the solution set of a linear equation system two variables with the graph method; and (b) Assignments on the sub-subject of the One-Variable Linear Absolute Value Equation in LKPD 2: (1) Determine the set of solutions for a two-variable linear equation system using the substitution method, and (2) Determine the set of solutions for a two-variable linear equation system using the method elimination.

4.5. Analysis of student characteristics
From the results of the analysis of student characteristics, it was found that grade VIII students of SMP Katolik Sta. Rosa De Lima Tondano have various abilities. Based on some of these student characteristics, an effort is needed to overcome this problem, namely by developing a learning device with the aim of generating learning, motivation and student activeness in participating in any mathematics learning in class.

4.6. Stage design (design)
Phase design is the second step of the ADDIE development model. At the stage design, it is done is to make a learning device development plan that is adjusted to the analysis results obtained at the analysis stage. Furthermore, at this stage the researcher began to design lesson plans, LKPD, and EHB learning tools using the learning model Problem Based Learning.

4.7. Development stage (Development)
Stage of development is the third step of the ADDIE development model. This stage is the stage of realization of the learning device design. At this stage, the researcher began to make learning tools with the PBL model in accordance with what had been designed at the design stage. At this stage, mathematics learning tools were developed using the PBL model on the SPLDV material for class VIII junior high school students.

4.8. The development of RPP
Learning Implementation Plan is a tool used by the teacher as a guide in carrying out the learning process. Learning is carried out using the PBL model on the material of the two-variable linear equation system for class VIII junior high school students. The lesson plans developed referred to lesson plan components such as: school identity, subject identity, class or semester, subject matter, time allocation, learning objectives, core competencies, basic competencies, competency achievement indicators, subject matter, learning methods, steps learning, learning media, learning resources, and assessment of learning outcomes. In this study, two lesson plans were prepared, namely RPP 1 and RPP 2. Each lesson plan was designed for one meeting.
4.9. The development of student worksheets
LKPD developed in this study were made of 2 LKPD, namely Student Worksheet 1 and Student Worksheet 2. Each LKPD is designed for one meeting. Student Worksheet development is carried out in accordance with the predetermined initial design.

4.10. Development of learning outcomes evaluation
In this study, 2 Learning Outcomes Evaluations were made, namely Learning Outcomes Evaluation 1, and Learning Outcomes Evaluation 2. Learning Outcomes Evaluation Development was carried out according to the initial design set. Each Learning Outcome Evaluation is designed for one meeting.

4.11. Expert assessment or validator
Assessment by experts is carried out to determine the validity and feasibility of learning tools developed in the form of RPP, LKPD, and EHB that have been approved by the supervisor and then validated by the validator. Expert validation, namely the assessment of RPP, LKPD, and EHB uses RPP, LKPD, and EHB assessment instruments in the form of a questionnaire for expert lecturers.

4.12. Product trial results trials are
Included in the implementation activities carried out after the learning device is declared feasible to be tested with revision by experts. This data is used to determine the quality of the Learning Implementation Plan, Student Worksheets, and Evaluation of Learning Outcomes that are developed. The following will describe an explanation of the data obtained from the test results of the developed device.

4.13. Practicality data practicality
Data were obtained from the results of student responses, and the implementation of learning: (1) Student Assessment Data: Student assessment data were obtained from 10 students in class VIII SMP Katolik Sta. Rosa De Lima Tondano. This assessment is obtained after students carry out mathematics learning using the Student Activity Sheet and the Learning Outcomes Evaluation developed, and (2) Learning Implementation Data: During the implementation of learning, observations are made to determine the implementation of the learning steps in the development Learning Implementation Plan.

4.14. Effectiveness data effectiveness
Data obtained from the results of student learning tests conducted at the end of learning mathematics.

4.15. Product revision
Based on the stages that have been carried out, also obtained some suggestions regarding the learning tools being developed. The researcher evaluates the Learning Implementation Plan (RPP), Student Activity Sheets, and the Learning Outcomes Evaluation that is developed. This is done to improve the Learning Implementation Plan, Student Activity Sheets, and Evaluation of Learning Outcomes that researchers encounter during the trial.

4.16. Revision of the learning implementation plan
After conducting an expert assessment of the developed Learning Implementation Plan, there are several suggestions that need to be revised so that the Learning Implementation Plan developed is suitable for use in mathematics learning using the PBL model. The revision of the Learning Implementation Plan according to experts is as follows. (1) The time distribution for each learning activity is detailed, (2) Photos or videos are included in the observing activity, (3) The assessment instrument has been attached.

4.17. Revised LKPD and EHB
After conducting an expert assessment of the developed Student Activity Sheet and Learning Outcomes Evaluation, there are several suggestions that need to be revised, namely, in writing so that the Student
Activity Sheet and Learning Outcomes Evaluation developed are suitable for use in mathematics learning.

4.18. Final product review
Based on the research results described above, products were obtained in the form of a Learning Implementation Plan, Student Activity Sheets, and Evaluation of Learning Outcomes using a valid, practical, and effective PBL model. The steps for compiling and developing the Learning Implementation Plan and Student Activity Sheet are carried out with the ADDIE development model (Analysis, Design, Development, Implementation, Evaluation). Conducting an analysis that includes: (1) Needs analysis: analyzing the need to determine the basic problems faced in mathematics learning of the material of two variable linear equation systems, (2) Curriculum analysis: analyzing the subject matter of class VIII of SMP Katolik Sta. Rosa De Lima Tondano, (3) Analysis of student characteristics: analyzing the condition of students at Sta. Rosa De Lima Tondano based on the results of an interview with a mathematics teacher at Sta. Rosa De Lima Tondano.

The Design of Learning Implementation Plans (RPP), Student Activity Sheets (LKPD), and Learning Outcomes Evaluation (EHB) which includes: (a) Design of RPP, LKPD, and EHB: Two RPPs are made according to process standards, while LKPD is made based on the material / content aspects, process standards, construction requirements, and technical requirements, (b) The design of the assessment instrument is that the researcher prepares an assessment instrument for teaching materials as a tool to measure the feasibility of the RPP, LKPD, and EHB produced.

Development of Learning Implementation Plans (RPP), Student Activity Sheets (LKPD), and Learning Outcomes Evaluation (EHB) which include: (1) Development of research instruments in the form of validation sheets filled out by expert lecturers, practical assessment sheets filled out by teachers and students, learning observation sheets filled out by observers to measure product effectiveness, (2) Development of Learning Implementation Plans (RPP) according to design at the design stage, (3) Development of Student Worksheets (LKPD) and Evaluation of Learning Outcomes (EHB) according to the design in the design stage.

Implementation of Learning Implementation Plans (RPP) and Student Worksheets (LKPD): conducted in June. Evaluation of the Learning Implementation Plan (RPP), Student Activity Sheet (LKPD), and Learning Outcomes Evaluation (EHB): RPP, LKPD, and the EHB is evaluated for its validity, practicality, and effectiveness.

4.19. Implementation phase (Implementation)

4.19.1. Device trial. After the learning device is declared feasible by the expert, the learning device is implemented, which can be used in learning activities. The trial results will be used as a reference for revising the learning tools developed. Product trials were carried out at Sta. Rosa De Lima Tondano with research subjects, namely students of class VIII. In the implementation of learning, the use of devices in their learning activities can be grouped. The group was selected heterogeneously and consisted of 2 people. In addition to working on discussion activities, group activities, they also carry out student activities together and discuss if there are students in the group who are experiencing difficulties.

4.19.2. Product revision products. That have been tested are then revised again based on input or suggestions from student response questionnaires after using learning products that have been developed.

4.20. Evaluation phase (evaluation)
Evaluation is carried out by analyzing research data obtained by researchers, namely the analysis of the validity of the tools from expert lecturers and teachers. Data on student responses to learning activities to determine student responses or responses to the learning tools developed. Through the results of filling
out the student response questionnaires, it will be known whether the LKPD developed falls into the practical category. Analysis of the effectiveness of learning tools can be obtained from evaluating learning outcomes.

4.21. Data analysis and discussion
Data analysis and test results meant the students' responses to learning activities and learning outcomes tests. Analysis of the data on the test results of the two-variable linear equation system learning tools developed, including validity analysis, practical analysis, and analysis of the effectiveness of learning tools.

4.22. Analysis of the validity of the learning tool

4.22.1. Implementation plan. After the validation process was carried out by the validator, it can be seen that the five validates gave an average rating of 3 and above, meaning that the components in the lesson plan got a good and very good assessment and could be used with a slight revision of the lesson plan.

4.22.2. Student worksheet. After the validation process is carried out by the validates, it can be seen that the three validates give an assessment of 3 and above, meaning that the components in the LKPD get a good and very good assessment and can be used.

4.22.3. Evaluation of learning outcomes of the. Three validates gave a good assessment so that it met the valid criteria for content validity, was very understandable for language and question writing, and could be used without a little revision.

4.22.4. Analysis of student response questionnaires. Based on data from student response questionnaires that have been filled in by 10 students after participating in learning activities for the subject of the Pythagorean theorem with a Problem Based Learning model using the Approach Realistic Mathematics Learning, the following results are obtained. For example, are you interested in participating in the next learning activity that you are currently participating in? And the answer is all interested. The language used in the LKS & THB all answers well, and the appearance (writing, pictures, location of the pictures) contained in the LKS & THB also answers all well.

4.22.5. Analysis of the ability of teachers in managing learning. Based on the criteria for teacher's ability described in chapter III, the ability of teachers to manage learning in the first to second meetings reaches the "Good" category, which is located at intervals. Thus the ability of the teacher to manage learning has reached the good category, so this learning device does not undergo a revision based on the observation of the ability to manage learning.

4.22.6. Analysis of learning tool effectiveness learning. Completeness is 8 students or 80%. Based on the assessment criteria, it can be said that the device developed meets the effective category.

4.22.7. Analysis of learning outcomes evaluation data. Trials of learning outcomes test aim to obtain data about the validity of the test items which will determine whether the test being developed needs to be revised or not and it is stated that all the test items are said to be valid. Based on the calculation results (can be seen in appendix 18), the reliability coefficient is obtained. From the results obtained, the reliability of the Learning Outcomes Test instrument developed was included in the "high" category and could be said to be reliable. Based on the previous description, that the learning device that has been developed is valid based on expert validation, it is said to be practical based on the results of the teacher's ability to manage learning in the classroom and student responses to learning activities, and is effective based on classical learning outcomes. Thus, a two-variable linear equation system learning tool with the PBL learning model has been developed in grade VIII at SMP Katolik Sta. Rosa De Lima Tondano.
5. Conclusion

- Development research carried out at Santa Rosa De Lima Tondano Catholic Junior High School with the research subjects being students of class VIII in the 2019/2020 school year has produced valid, practical, and effective learning tools.
- After being tested and going through the content validation process. The tools developed are Learning Implementation Plans, Student Worksheets, Evaluation of Learning Outcomes using the PBL model on SPLDV material;
- Validated learning tools produce data with valid criteria;
- In terms of practicality, the learning device is in the very practical category according to student responses.
- Effective learning tools in terms of TKG are in the very good category and the percentage of classical completeness is in the very good classification.

References

[1] Permendikbud 2016 *Number 23 Year 2016 concerning Education Assessment Standards*