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Development of learning tools for linear absolute value equations in one variable with think pair square model

Silvia Debora Emor[1], Santje Salajang[2], Anneke Pesik[3]
[1] Students of Master Program, Mathematics Education Study Program, Postgraduate Program, Manado State University, Indonesia
[2, 3] Mathematics Education Study Program, Postgraduate Program, Manado State University, Indonesia

Abstract
This study aims to produce a learning tool for linear absolute value equations on one variable by using Think Pair Square cooperative learning models that meet valid, practical, and effective criteria. This research is categorized as development research. This study uses the ADDIE model developed by Dick and Carey. There are five stages, namely: 1) Analysis, 2) Design, 3) Development, 4) Implementation, and 5) Evaluation. The resulting learning tools are learning implementation plans (RPP), student worksheets (LKS), and learning achievement tests (THB). The results of the study stated that the products developed met valid, practical, and effective criteria. Learning devices are feasible to use with an average score of assessment of learning devices by a validator of 3.4 with valid criteria. The practicality of the learning device was obtained from the student response questionnaire which showed a score of 4.08 which was included in the practical criteria. The effectiveness of the learning device is obtained from the student learning outcomes test that shows 90% student mastery learning with an average value of 84 so that it can be concluded that the learning device is effectively used in learning.

Keywords: think pair square, the absolute linear value equation in one variable

1. Introduction

Education is one of the important aspects in nation building. The progress of a nation is influenced by the quality of education. The era of globalization has an impact on various aspects of life including quality demands in the administration of education. One important aspect in improving the quality of education is the learning process at school which involves teachers and students. The success of the learning process is marked by the condition of students who can learn optimally and the achievement of teaching objectives that have been set.

Mathematics is one of the subjects taught at all levels of education. From each of these levels, many students still have difficulty in learning mathematics, so it is natural that mathematics is still a subject that many students dislike. The same thing was also explained by Himmatul *et al* (2017) that fear of learning mathematics causes students to be lazy in learning mathematics [1].

Difficulties in learning mathematics can be seen from the results of learning mathematics in high school education (SMA), where the results of the National Examination (UN) mathematics subjects from year to year have not been encouraging, even in 2018 has decreased (Puspendik 2018) [2]. In addition, based on interviews with high school mathematics teachers it was found that most students had difficulty in understanding the subject matter of linear absolute value equations for one variable studied in class X, where the average student learning outcomes had not yet reached the KKM (Minimum completeness criteria) according determined by the school that is 75. This is in line with research by Zulvah (2007) which says the results of diagnostic tests on the subject matter of equations and the inequality of linear absolute values on one variable obtained that there are still students who make mistakes in solving problems related to the material [3]. The low learning outcomes of mathematics can be caused by several factors, one of which is the ability of teachers to implement learning strategies that are less precise.

In the teaching and learning process in class the teacher has the task to design and organize learning. The teacher must be creative and innovative in planning and implementing the learning process so that the teaching and learning process is interesting and fun. According to Minister of Education and Culture Regulation No. 22 of 2016 concerning Basic and Secondary Education Process Standards, which regulates learning planning. Learning planning one of them is developing learning tools. Examples of learning tools are learning implementation plans (RPP), Student worksheets (LKPD), and Evaluation of learning outcomes (EHB).

Permendinas (2016) requires every educator in the education unit to compile a complete and systematic lesson plan, according to the learning model used. The results of observations and interviews with high school mathematics teachers, it was found that generally learning conducted in the classroom is dominated by the teacher, namely the information center comes from the teacher [4]. The lesson plans that are compiled and used by mathematics teachers are less creative and not in accordance with the latest development tools. The teacher makes a study group, explains the subject matter, provide examples and exercises to be made by students. This makes students less participating in learning activities, students are not independent and depend on the teacher in learning mathematics. Teaching and learning process becomes less interesting and students have difficulty understanding the material being taught.

In learning in schools, LKPD made by teachers is less creative and has not facilitated students to be able to

construct their own knowledge. LKPD contains practice questions based on textbooks without instructions that can help understanding mathematics material. Basori, (2017) in his research stated that the developed LKPD must attract the attention of students and can direct students in learning mathematics [5]. Even in the research it is said students expect explanations in LKPD as detailed as possible so as to facilitate the workmanship.

To measure learning outcomes used is the evaluation of learning outcomes (EHB). According to Permendinas (2016) Evaluation of learning outcomes is used as material to improve the learning process in accordance with Education Assessment Standards [4]. In the preparation of the evaluation of learning outcomes compiled by teachers are not tested for validity and reliability.

The preparation of learning tools involves the selection of learning models. One learning model that can increase student activity is Think Pair Square (TPSq) type of cooperative learning model (Latifah. 2013) [6]. The advantage of using the TPSq learning model according to Darsono (2018) is to encourage students to be actively involved in learning activities to construct their own knowledge and work together and provide opportunities for students to show their participation to their friends. Students will discuss more so that more ideas will be issued by students and it will be easier to reconstruct their knowledge.

Based on the background of the problems outlined above, the researcher is interested in developing learning tools in the subject matter of linear absolute value equations for one variable in the form of RPP, LKPD, and EHB with a TPSq type cooperative model in class X MIPA students of SMA Negeri 1 Langowan.

2. Research Methods

This research is included in development research, which is a study to develop a product. The product produced from this research is in the form of learning tools consisting of RPP, LKPD, and EHB by using the TPSq type cooperative learning model on the subject matter of linear absolute value equations for one variable.

Research sites

This research was conducted in the 2018/2019 school year at SMA Negeri 1 Langowan.

Conceptual Description of Development of Learning Devices

The development model used is the ADDIE development model developed by Dick and Carry in 1996 (Endang, 2013). The ADDIE model uses five stages of development, namely the analysis, design, development, implementation and evaluation stages. Can be described as follows.

1. Analysis Phase

a. Needs Assessment

The needs analysis aims to establish the basic problems faced in learning mathematics in high school. Needs analysis is done through observation and interviews with high school mathematics teachers. It was concluded that the problem faced in this study was the ability of teachers to make learning tools. This is because the teacher is less innovative in making lesson plans and the creative learning media of the LKPD has not been used. The solution to this problem is by developing RPP and LKPD that are used so that students will more easily understand the material.

b. Task Analysis

Task analysis aims to find out the tasks that students must master to achieve Basic Competence (KD) on the material of the absolute value linear equations of one variable in accordance with the 2013 Curriculum.

c. Analysis of Student Characteristics

This analysis is conducted to see students' attitudes towards learning mathematics. This is done so that the development carried out in accordance with the character of students. Characteristic analysis is done by observation when students are doing the learning process and interviews with teachers and students in high school. The results of the analysis are used as a reference for developing learning tools.

2. Design Phase

a. Test Preparation

The preparation of the test is the preparation of items in accordance with the basic competencies and indicators set at the defining stage. Test preparation is based on needs analysis and task analysis. The test in question is the Evaluation of Learning Outcomes of the material equation of the absolute value of linear one variable. In designing the evaluation of student learning outcomes made a grid of questions and scoring references used is the Benchmark Reference Assessment (PAP).

b. Media Selection

This stage is to determine the media that can be used to present learning material. The process in selecting media is adjusted to the results of the needs analysis and task analysis and student characteristics.

c. Format Selection

The choice of format in the development of this tool includes the selection of formats for designing content, choosing learning strategies, and learning resources.

d. Initial Design

The initial design in question is the design of all activities that will be carried out before the trial. Preparation of the initial design of learning tools, namely RPP and LKPD. The design of the resulting learning device is called Draft A.

3. Development Phase

a. Expert Validation/Rating

Validation/assessment is carried out on the learning tools developed at the design stage (Draft A), so as to produce Draft B. Experts referred to in this study include mathematics education lecturers and mathematics teachers. The validator was given to the research instrument in the form of a validation sheet and Draft A to be validated. This validation sheet is used to obtain data on opinions, suggestions, and comments from experts regarding Draft A. The validation sheet is used to assess the RPP and LKPD. Data from the experts' assessment results for each instrument were analyzed by considering validator suggestions and comments. The results of the analysis are used as guidelines to revise Draft A, so that Draft B.

b. Simulation

The revised learning kit was then trialled in the field, namely to students. Partner teachers observe the implementation of the simulation in order to get a picture of how to carry out learning with the TPSq learning model in accordance with the RPP. The input obtained from the simulation results is used to revise Draft B, so that Draft C is produced which will be used for testing.

4. Implementation Phase Product trials

The learning kit uses the revised TPSq learning model which is then tested in the field, namely to students. A trial was conducted to obtain direct input from teachers, students and observers on the learning tools and research instruments that had been prepared. The trial results are used as a basis for refinement of Draft C to become the final Draft.

5. Evaluation Phase

Evaluation is carried out using a test of learning outcomes. This evaluation is to measure the competency of the material to be achieved. The evaluation results are used to provide feedback to the product users. Revisions are made according to the evaluation results or needs that cannot be met by the new product.

Data Analysis Technique

Analysis of Draft A to Draft B

Analysis from the initial design, namely draft A is validated by experts, suggestions from experts are used as a basis for improving learning tools to get draft B, validation of experts includes: (1) the contents of the learning kit, which is looking at the compatibility between the material and the learning objectives, (2) language, that is whether to use good and correct Indonesian, and whether the language used is unambiguous.

Analysis of Draft B to Draft C

The results of the validation from the experts, namely draft B, were trialled in the field, this trial aims to see the clarity, readability, and the suitability of the planned time in the learning plan and its implementation. The results of the trial are analyzed and used as a basis for improvement with draft B to get the learning tool for draft C.

Research Instruments

The instruments used to collect data in this study are as follows:

1. Learning Tools Assessment Sheet

The learning device assessment aims to measure the validity of the learning device and to consider product revision.

2. Student Response Questionnaire

The questionnaire was used to gather information about responses by students to the worksheet which was developed by putting a check mark (√) in the column provided for each question asked. The questionnaire was given to students at the end of the learning activity. Student response questionnaire aims to measure the practicality of LKPD.

3. Evaluation of Learning Outcomes

Evaluation of learning outcomes is used to determine the effectiveness of learning devices in terms of student learning outcomes of the material presented. Evaluation of learning outcomes is carried out to determine the final ability of students after learning the subject matter of linear absolute value equations on one variable by using learning tools.

Data Analysis Technique

Data analysis techniques are used to obtain quality social arithmetic learning tools and products that meet the criteria of validity, practicality, and effectiveness.

Validity Analysis

The instrument used to analyze validity is the format of the learning appraisal of the equation of the absolute value of a linear variable. Several stages of analyzing the validation of the RPP and LKPD

a. Tabulate data from the validator.
b. Add up the scores for each validator for each aspect using the following formula.

$$\bar{V} = \frac{\sum_{i=1}^{n} x_i}{n},$$ (Sudijono, 2011) [8]

Information:

$\bar{V}$ = validator validation average
Xi = aspect score
n = number of aspects

1. Look for the average aspects of all validators.
2. The assessment criteria use a score of 1-4, where score 1 shows the lowest score and 4 shows the highest score. Based on the determination of the range obtained by a range of 75%. The validity criteria for average value analysis are presented in the table below:

Table 1: Validation Criteria of RPP and LKPD

Score Interval	Category
$0 \leq x < 1$	Not Valid
$1 \leq x < 2$	Less valid
$2 \leq x < 3$	Valid
$3 \leq x < 4$	Very valid

(Sudijono, 2011)

Practical Analysis

The practical aspects of LKPD that were developed were seen from the results of the analysis of student questionnaire responses. The student response questionnaire took the form of a check-list using a Likert scale consisting of five categories: strongly agree (SS), agree (S), disagree (KS), disagree (TS), and strongly disagree (STS) with detailed guidelines scores (Widyoko, 2009) as follows.

Table 2: Guidelines for Questioning Questionnaire Student Response

Category	Score
Strongly Agree (SS)	5
Agree (S)	4
Disagree (KS)	3
Disagree (TS)	2
Strongly Disagree (STS)	1

The steps to determine the practicality of the module are as follows.

a. Score data obtained from student response questionnaires were calculated on average using means

$$\bar{x} = \frac{\sum x_i}{n}$$

Information:

$\bar{x}$ = average score

$$\sum x_i = \text{number of answer scores}$$

n = number of statements

b. Furthermore, the average score obtained is then converted to five scale qualitative data (Widyoko, 2009) [9]

Table 3: Criteria for Student Questionnaire Outcomes

Interval	Category
$\bar{x} > 4.2$	Very Good
$3.4 < \bar{x} \leq 4.2$	Good
$2.6 < \bar{x} \leq 3.4$	Enough Good
$2.6 < \bar{x} \leq 1.8$	Less Good
$\bar{x} \leq 1.8$	Not Good

The developed LKPD was declared practical if the minimum criteria for student responses achieved were good categories.

Effectiveness Analysis

The instrument used to analyze the effectiveness of the use of learning tools is the evaluation of learning outcomes. The maximum value in evaluating learning outcomes is 100 with KKM 70. Analysis of effectiveness is carried out with the following steps:

a. Tabulating student test results
b. Calculating the completeness presentation of student learning outcomes tests Percentage of completeness = (number of students completed)/ (number of students) × 100%
c. Matching the percentage of completeness of learning outcomes with intervals of completeness test of learning outcomes.

Table 4: Completion Criteria Interval

Interval	Criteria
90% < x ≤ 100%	Very good
80% < x ≤ 90%	Good
65% < x ≤ 80%	Enough
55% < x ≤ 65%	Less
x ≤ 55%	Very less

(Widoyoko, 2009) [9]

3. Result and Discussion

1. Validity

a. Validity of RPP

The lesson plans that have been developed are validated by experts. This validation is done to determine the validity of the lesson plan before the simulation and trial. The RPP is validated by two expert lecturers, two mathematics teachers and peer students.

Based on the assessment of the validator, the analysis showed a score of 3.4 which is in the category of very valid. Thus, the developed lesson plans can meet very valid criteria in aspects of the format of the lesson plan, the contents of the lesson plan, language and writing, and the benefits of the lesson sheet.

b. Validation of LKPD

LKPD that has been developed is validated by experts. This validation was conducted to determine the validity of the LKPD prior to the simulation and trial. LKPD was validated by two expert lecturers, two mathematics teachers and peer students. Based on the assessment of the validator, the analysis showed a score of 3.4 which is in the category of very valid. Thus, the developed LKPD can meet very valid criteria in aspects of the LKPD format, the contents of the RPP, language, and writing.

2. Practicality

The practicality of LKPD developed was obtained from the results of filling in the questionnaire responses of students given to 32 students of Class X MIPA 3 of SMA Negeri 1 Langowan, after using LKPD in learning the equation of linear absolute value on one variable. Assessment is done by filling in the questionnaire responses of students. Student responses questionnaire consisted of 15 statements.

The analysis showed a score of 4.08 in the practical category. Thus, the LKPD that is developed is practically used by students in the subject matter of linear absolute value equations on one variable.

3. Effectiveness

The effectiveness of the learning tools developed was obtained from the evaluation of learning outcomes given to 32 students. The following is an analysis of the evaluation of learning outcomes.

Table 5: Evaluation Analysis of Student Learning Outcomes

Number of Students	Number of Students Completed	Percentage of completeness	Number of Students Not Completed	Percentage of Inaction
32	29	90%	3	10%

Based on the above, the percentage of students who achieve completeness is included in both criteria with a percentage of 90%. This shows that the learning tools developed are effective in their use in learning activities.

Analysis of Learning Outcomes Evaluation Data

The EHB trial aims to find out the validity and reliability of the questions which will determine whether the evaluation questions developed need to be revised or not. The results of the analysis are as follows.

1. Validity

Based on the product moment correlation formula, the validity of each item is obtained as follows

Table 6: Results of Analysis of Validity of Problem Items

Number of question	1	2	3	4	5
r_{xy}	0.89	0.89	0.92	0.88	0.85

Based on the table above, the validation of each item is in the "very high" category. Thus in general the validation of each test item is considered appropriate for use without revision.

2. Reliability

Based on the calculation results, the reliability coefficient α = 0.90 is obtained. From the results obtained, the reliability of the learning outcomes evaluation instrument developed

Has very high reliability, and the instrument can be said to be reliable.

4. Discussion

Based on the research description, the results are obtained, the learning tools developed are "valid" based on expert validation, "practical" based on the analysis of the results of the questionnaire responses of students, and "effective" based on analysis of evaluation of learning outcomes.

Thus, mathematics learning tools have been produced using Think Pair Square learning models on the subject matter of linear absolute value equations for one variable in class X of SMA Negeri 1 Langowan. The learning tools produced include RPP, LKPD, and EHB.

5. Conclusion

Based on the research process of developing learning tools with ADDIE design models with the stages of analysis, design, development, implementation, and evaluation the following results are obtained:

1. Based on the analysis of the results of the assessment of learning tools conducted by lecturers and mathematics teachers, it can be concluded that the developed learning tools meet valid criteria.
2. Based on the analysis of the results of the questionnaire responses of students, it can be concluded that the developed learning tools meet practical criteria.
3. Based on the evaluation of learning outcomes evaluation, it can be concluded that the developed learning tools have a good level of effectiveness.

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