International Journal of Academic Research and Development
ISSN: 2455-4197; Impact Factor: RJIF 5.22
Received: 19-09-2019; Accepted: 20-10-2019
www.academicjournal.in
Volume 4; Issue 6; November 2019; Page No. 91-96

Development of discovery learning tools with a scientific approach to Barisan and series subjects

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Abstract
The purpose of this research is to find out how to develop learning tools using the Discovery Learning model with a scientific approach to the subject line and series and to produce learning tools using the Discovery Learning model with a scientific approach to the subject line and series that are valid, practical, and effective. The sample in this study was taken from students of Class XI MIPA of SMA Negeri 1 Amurang. The number of students studied was 38 students. In this research the RPP, LKPD, and EHB models of Discovery Learning developed with a scientific approach to the subject line and series. The development model used in this study is a modification of the 4D model which is only limited to three stages namely define, design, and develop. The results of the study stated that the products developed met valid, practical, and effective criteria. Learning devices with an average score of 3.56 with valid criteria. The practicality results of the learning kit were obtained from the average results of the ability of the teacher in managing learning, which was 3.46 which was categorized as good, located in intervals of $3 \leq P < 4$ and the questionnaire responses of students who were above 80% positive responses from students. The effectiveness of learning tools is obtained from the analysis of student activities that are categorized as well as evaluating student learning outcomes that indicate the value of mastery learning from students over 70.

Keywords: discovery learning, scientific, development, sequence and series

1. Introduction
Education has a very strategic important role in improving the quality of human resources and efforts to realize the ideals of the Indonesian people to realize public welfare and educate the nation's life. Education prioritizes active participation between teachers and students based on the talents, interests and potential of students and not one-way activities. Learning must be done both ways and emphasize the active interaction between the teacher and students, students with teaching materials, students with the media, and students with students during the learning activities.
The Government established the 2013 Curriculum as a development of the KTSP Curriculum. One element of change in the 2013 curriculum is that learning activities are carried out using a scientific approach. Scientific approach is an approach that is centered on students so that students actively construct concepts, laws or principles through the stages of observing, formulating problems, proposing or formulating hypotheses, collecting data with various techniques, analyzing data, drawing conclusions and communicating concepts, law or principle found.
The learning process and outcomes in the 2013 curriculum refer to competencies in the spiritual (K1), social (K2), cognitive (K3) and skills (K4) domains. The scientific learning process includes activities (1) observing; (2) asking questions; (3) gathering information; (4) associate; and (5) communicating.
One learning model that is applied to a scientific approach is Discovery Learning. The Discovery Learning model is characterized by learning that occurs when students are not presented with lessons in their final form, but are expected to organize themselves. As Joolingen (1999) argues that "Discovery learning is a type of learning where learners construct their own knowledge by experimenting with a domain, and inferring rules from the results of these experiments" [1]. With the Discovery Learning model it is hoped that students can think more intuitively and formulate their own hypotheses.
To achieve the basic competencies of each competency standard in the curriculum, teachers can use a variety of methods and create a learning process that takes place by involving students fully and in accordance with the conditions of students and the character of the material being taught. The use and development of learning tools used by teachers is one important factor in achieving this.
Learning tools that are easily developed by teachers are printed forms, one of which is a learning tool in the form of a Learning Implementation Plan (RPP), Student Activity Sheet (LKPD) and Learning Outcomes Evaluation (EHB). From the survey conducted by researchers, there are still teachers who have difficulty in developing scientific learning activities to implement teacher books and student books that already exist. Teachers are still fixated on the content of teacher books and student books and have not yet developed various models in teaching.
Learning devices are the guidelines for an educator in carrying out learning activities in class. The function of the learning tool is as an evaluation material for educators to find out the extent of achievement of the competency standards that have been delivered.
In this study learning tools will be developed in the form of RPP, LKPD, and EHB which are scientific approaches to the Discovery Learning model which are expected to help teachers and students in carrying out learning activities. This research is emphasized on learning subject line and series in class XI MIPA with the development of Discovery Learning models.

2. Research Methods

Based on the research objectives, this research is included in the research development, which will be developed is a learning tool that includes Learning Implementation Plan (RPP), Student Worksheet (LKPD) and Evaluation of learning outcomes (EHB) using the Discovery Learning learning model with a scientific approach on the subject line and series in class XI.

Research sites

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

Conceptual Description of Development of Learning Devices

The development model used is a modification of the Thiagarajan (1974) model known as the Four-D Models (4D Model), namely define, design, develop, and disseminate. Researchers modify the development model with the simplification of the model which is limited to the stages of development with consideration of limited time and cost. The stages are described as follows[2].

3. Define Phase

a. Initial to Final Analysis

This analysis aims to determine the basic problems needed in developing learning tools and evaluating learning outcomes. Before conducting trials, researchers conducted interviews with mathematics teachers related to mathematics learning in schools. Information was obtained that the learning tools at the school were still inadequate or did not use varied approaches or learning methods seen from the process of learning mathematics in class. The teacher only uses one learning method, the lecture method so the learning process is only centered on the teacher.

b. Student Analysis

Students of class XI of SMA Negeri 1 Amurang 2018/2019 school year average age 15-16 years, at this age students already have logical thinking skills, but only with objects that are concrete (Piaget in Hardiyanti, 2018)[3] . Therefore, it is very appropriate if mathematics learning is carried out with a discovery learning model with a scientific approach to train students to learn more independently and be actively involved in the learning process.

c. Material Analysis

To systematically identify and arrange relevant subject matter which will be developed and taught with discovery learning models on the subject line and sequence.

d. Task Analysis

Based on the analysis of the material on the subject line and sequence, obtained tasks that refer to indicators of competency achievement in K-13. The basic competence on the subject line and series is to generalize the pattern of numbers and numbers in the Arithmetic and Geometry sequence.

e. Specifications Learning Objectives

The learning objectives are adjusted to the basic competencies listed in the 2017 revised 2017 Curriculum. The specifications of the learning objectives are carried out by spelling out the indicators of achievement of learning outcomes into more specific indicators based on concept or material analysis and task analysis.

3. 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. Preparation of tests based on task analysis and analysis of material that has been described in the specifications of learning objectives. The test in question is the evaluation of learning outcomes of subject lines and sequences.

b. Media Selection

Media needed in the implementation of learning with discovery learning models on the subject line and series include Student Activity Sheets, Learning Implementation Plans and Learning Outcomes Evaluation as well as several learning aids such as LCDs, whiteboards, markers, etc.

c. Format Selection

The format of the learning plan (RPP) is based on the principles, characteristics and steps of learning with the discovery learning model with a scientific approach that is adjusted to the learning plan in the 2013 revised 2017 curriculum. While the learning content refers to the results of the analysis of the subject, the results of the task analysis, and competency achievement indicator specifications. The activities consist of introduction, core activities, and closing. Textbooks for students and LKPD are made so that students are expected to be interested and motivated to learn.

d. Initial Design

At this stage the learning device design is made. The tools compiled are the lesson plan (RPP), the student activity sheet (LKPD) and the learning outcome evaluation (EHB). The planned learning plan is oriented towards the 2013 revised 2017 curriculum using a scientific approach and discovery learning model consisting of core competencies, basic competencies, competency achievement indicators, learning objectives, learning materials, learning methods, learning media, learning resources, steps learning, and assessment.

4. Development Phase (Develop)

a. Expert judgment

The assessment of the experts covered all learning tools developed at the design stage, namely the RPP, LKPD, and EHB. The results of the validation from the experts in the form of suggestions are used as a reference to revise and refine the learning tools to get draft B. In general, validation covers the contents of the learning tools and language.

b. Learning Device Simulation

Learning tools using the Discovery Learning model with a revised Scientific Approach are then trialled in the field, namely to students. A trial was conducted to obtain direct input in the form of responses, reactions, comments from teachers, students, and observers in the field to the learning tools that have been prepared.

c. Field trials

The learning tool uses a discovery learning model with a revised Scientific Approach which is then tested in the field,

namely to students. The trial of this learning tool aims to find out the clarity of reading, and the compatibility between the planned time in the lesson plan and its implementation. The results of this trial are used to improve learning devices. The things observed in this trial are the activities of students, the management of learning by teachers, students' responses to learning. In addition, this trial also aims to determine the quality of evaluation of learning outcomes which include validity, reliability, and sensitivity.

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 improvement of learning tools to get draft B, validation of experts covers: (1) The contents of the learning kit, namely seeing the compatibility between the material and learning objectives, (2) Language, i.e. whether using Indonesian is good and right, 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 instrument used in this study used instruments that had been developed by previous researchers and were considered standard. The research instruments are as follows:

5. Validation of Learning Devices

The learning device assessment aims to measure the validity of the learning device and consideration for product revisions. The learning device assessment sheet consists of the RPP validation sheet, the LKS validation sheet, and the THB validation sheet. The validation sheet is given to the validator together with the equipment to be validated to obtain input or data about the validator's assessment of the learning kit.

6. Observation Sheet

Observation sheets are used to obtain information related to teaching and learning activities during the trial, namely:

a. Observation sheet ability from the teacher to manage learning

This instrument is used to obtain data about the ability of teachers to manage learning by using learning-oriented learning tools with discovery learning models with a scientific approach.

b. Observation sheet for student activities

This instrument is used to obtain data about student activities during learning.

c. Student response questionnaire

To get student response data on field trial activities an instrument in the form of student response questionnaire was used. Student responses to aspects of learning when the test is stated by putting a check mark (v) on the available choices. The response questionnaire was given to students at the end of the learning activity. Student response questionnaire aims to measure practicality.

d. 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 ability of students after learning the material sequence and series using learning tools. The form of the test is a description and is classified as a benchmark-based test (PAP). In order for the quality of the tests to be prepared, an item analysis is needed. Analysis of the test items include validity, reliability and sensitivity tests.

Data analysis technique

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

7. Validity Analysis

The instrument used to analyze validity is the format of assessment of sequence and sequence learning devices. 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)[4]

Information

$\bar{V}$ = Validator validation average
x_i = aspect score
n = number of aspects.

a. Look for the average aspects of all validators.
b. 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 (Sudijono, 2011) [4]

Score interval	Category
$0 \leq x < 1$	Invalid
$1 \leq x < 2$	Less valid
$2 \leq x < 3$	Valid
$3 \leq x < 4$	Very valid

8. Practical Analysis

To get response data from students to field trial activities an instrument in the form of questionnaire responses was used by students. Responses of the students to aspects of learning when the test is stated by putting a check mark (√) on the available choices, namely:

a. Happy or unhappy responses, new or not new, by students about:
1. Subject matter

2. LKPD
3. Atmosphere of Learning in Class
4. The way the teacher teaches

b. Options agree or not to the question whether students are interested in following the next mathematics learning with learning like this?

c. Yes or no choice for question:

a. Do students understand the language used in LKPD?

b. Are students interested in the appearance (writing, large letters, pictures, image location, color) in the LKPD?

Student response data obtained from the results of a questionnaire given to students after learning ends while the responses of students to learning activities are analyzed descriptively as a percentage. The response from students said to be good if every aspect is in the category of happy, new, interested, able to understand, and interested in more than or equal to 75%.

9. 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 2: Completion Criteria Interval

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

10. Result and Discussion

Validity

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 and two mathematics teachers. Based on the assessment of the validator, the average total analysis result of the RPP assessment is 3.56 which means it is very valid.

a. 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 and two mathematics teachers. Based on the evaluation of the validator, the average total analysis result of the RPP assessment is 3.64, which means it is very valid.

Practicality

a. Questionnaire responses of students

Based on data from the questionnaire responses of students who have been filled by 38 students after participating in learning activities for material and series using discovery learning model with a scientific approach, it can be said that the responses of students to all aspects are above 80%. Then every aspect is responded positively by students.

Table 3: Analysis of Student Questionnaire Responses

Description	Happy		New	
	Frequency	Percentage (%)	Frequency	Percentage (%)
What do you think about :				
Subject matter	35	92.11	36	94.74
LKDP	35	92.11	36	94.74
Learning Atmosphere	34	89.47	35	92.11
Ways Teachers Teach	32	84.21	34	89.47
	Average	89.47	Average	92.76
Description	Agree			
	Frequency		Percentage (%)	
1. Your opinion if the next subject uses learning like this	36		94.74	
2. Your opinion if all subjects use learning like this	33		86.84	
	Average		90.79	
Description	Yes			
	Frequency		Percentage (%)	
1. Do you understand the language used in LKPD?	38		100	
2. Are you interested in the appearance (writing, letters, pictures, colors) on LKPD?	36		94.74	
	Average		97.37	

b. The ability of the teacher to manage learning

Based on the ability criteria of the teacher managing learning, the average total result of the analysis of the ability assessment of the teacher managing learning is 3.46 and reaches the "good" category, which is located in intervals of $3 \leq P < 4$.

3. Effectiveness

a. Student Activity

From the results of observations of the activities of students during learning activities, it can be seen that the activities of students during learning are within the criteria of effectiveness limits, and it can be said that the activities of the students during this learning are good.

b. Mastery Learning Outcomes of Students

Table 4: Mastery Analysis of Student Learning Outcomes

Number of Students	Number of students who have completed	Completion Percentage (%)	Number of learners who do not complete	Percentage of Inaction (%)
38	38	100	0	0

Based on the table above, it can be seen that the percentage of the number of students who reach completeness is included in the very good criteria with a percentage of 100%. This shows that learning tools developed after effective use in learning activities.

Analysis of Learning Outcomes Evaluation Data

The EHB trial aims to obtain data on the validity of the items, the reliability of the questions, and the sensitivity of the items which will determine whether the evaluation questions developed need to be revised or not. The results of the analysis of the three indicators are as follows:

Validity

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

Table 5: Results of Analysis of Validity of Problem Items

No. Question	r_{xy}	Validity Level	No. Question	r_{xy}	Validity Level
1	0.617	Valid	6	0.623	Valid
2	0.614	Valid	7	0.652	Valid
3	0.735	Valid	8	0.615	Valid
4	0.624	Valid	9	0.617	Valid
5	0.614	Valid	10	0.600	Valid

Based on the table above, the level of validity of each test item is in the "high" category. Then all test items can be said to be valid.

Reliability

Based on the calculation results, the reliability coefficient α = 0.823 was obtained. From the results obtained, the reliability of the Learning Outcomes Evaluation instrument developed is included in the "high" category, and the instrument can be said to be reliable.

Sensitivity

The results of the calculation of the item sensitivity values are as follows:

Table 6: Results of Sensitivity Analysis Results of Problem Items

Question Number	1	2	3	4	5
Sensitivity Index	0.742	0.666	0.755	0.779	0.742
Question Number	6	7	8	9	10
Sensitivity Index	0.742	0.666	0.755	0.779	0.742

Based on the criteria of the test items it is said to be good if the sensitivity of the test items is between 0 and 1, and an item said to be sensitive to learning if sensitivity is greater or equal to 0.30 ($S \geq 0.30$). This means that from all items of evaluation of learning outcomes, questions developed are considered sensitive to learning. Thus, from the table all items can be said to be sensitive.

Based on the previous description, the learning tools developed are "valid" based on expert validation, "practical" based on the results of the ability of the teacher to manage learning that are categorized well and the response of students to positive learning seen from the results of the questionnaire responses of students, and "effective" based on analysis of student activities is categorized as good and learning outcomes are classically complete.

Thus, mathematics learning tools have been produced using discovery learning models with a scientific approach to the subject line and series in class XI of SMA Negeri 1 Amurang. The learning tools produced include RPP, LKPD, and EHB.

Conclusion

1. The discovery learning model mathematics learning tool with a scientific approach to the subject line and series was developed using a 4-D development model that was modified so that it became 3 stages namely define, design, and develop resulting in a valid learning device for the subject line and series refer to the discovery learning model and the scientific approach. The resulting learning tools include learning implementation plans, student activity sheets, and evaluation of learning outcomes.
2. Practical learning tools to teach subject lines and sequences using discovery learning models with a scientific approach, this is shown from the results of observations of the ability of teachers to manage learning and responses of students to positive learning.
3. Mathematics learning using discovery learning models with a scientific approach to the material row and series in class XI high school can be said to be effective this shows by analyzing the activities of students categorized as good and classical learning outcomes completely.
4. Classical learning completeness at EHB shows the percentage of students who complete 100%, students complete individually.
5. Student responses are also in positive learning.

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