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Development of integral learning tools with the discovery learning model

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Abstract
The purpose of this study is to produce learning tools in integral subject matter with discovery learning models that meet valid, practical, and effective criteria. This research is categorized as a research development with the resulting product in the form of a Learning Implementation Plan (RPP), Student Worksheet (LKPD), and Evaluation of Learning Outcomes (EHB) of the Discovery Learning model on integral subject matter. The learning tool was developed using the Plomp model to the stage of assessment of the results of the field test, so that a final prototype is ready to be implemented and continued to be tested on a broader scope. The assessment of learning tools by the validator shows very valid criteria for the RPP, LKPD, and validation of the contents of the EHB. The practicality test of learning devices through the student response questionnaire and the teacher's questionnaire showed practical criteria. Evaluation of student learning outcomes shows mastery learning that can be categorized as effective.

Keywords: integral, discovery learning, development of learning devices

1. Introduction

The Indonesian government is actively making improvements in the education system in this country. The 2013 curriculum was repeatedly revised to overcome several obstacles that occurred. However, it cannot be denied that in some locations, the implementation of the 2013 curriculum has not been carried out optimally. Some of the obstacles that are often encountered are the lack of activeness of students in the learning process and the inability of teachers to use scientific approaches. On the other hand, Permendikbud number 103 of 2014 clearly demands learning activities to use a scientific approach and motivate students to participate actively.

Teaching and learning activities that do not take place optimally, of course, will provide additional difficulties for students in understanding the subject matter, especially in subject matter that is considered complicated for students. On the other hand, subject matter which is considered as complicated as integral is a mathematical concept that is widely used as the basis of other applied sciences so that it becomes one of the important roles in the development of the 21st century.

The tasks of the teacher as stipulated in Permendikbud number 15 of 2018, include planning, implementing, and evaluating learning outcomes. In order to achieve the learning objectives, the teacher must prepare learning well, including preparing the learning tools. According to Nazarudin (2007), a learning tool that is something or some preparations prepared by the teacher so that the implementation and evaluation of learning can be done systematically and obtain the results as expected, including: analysis of effective weeks, annual programs, semester programs, syllabi, learning implementation plans (RPP), student worksheets (LKPD), evaluation instruments, and minimum completeness performance (KKM) [1].

From the learning models that are in line with the demands of the 2013 curriculum, the discovery learning model is one that is proposed and considered suitable for integral subject matter. By using the discovery learning model, students are trained to be active in learning activities. The discovery strategy will arouse students' enthusiasm in learning because students can feel the labors of the investigation, especially if accompanied by the success of finding answers. The discovery activity itself will cause satisfaction. This inner satisfaction can encourage students to make other discoveries until their learning interest increases. Students who acquire knowledge using the discovery method will also be able to transfer knowledge to various aspects so that it is easier to use it in life (Kemendikbud, 2013) [2].

However, one of the obstacles in the discovery learning model is that it is not suitable to be applied in classes with large numbers of students (Afandi *et al*, 2013) [3]. Most mathematics teachers in high school are also not accustomed to using a scientific approach in the learning process. This is based on the idea that most of the objects studied in mathematics are abstract so it is rather difficult to be matched with problems in everyday life. As a result, in applying the discovery learning model, the teacher found several difficulties, such as those found in SMA Negeri 1 Langowan.

The results of observations and interviews with teachers and students at SMA Negeri 1 Langowan, showed a limitation in terms of learning tools. The lesson plan (RPP) used by the teacher has not been developed properly and its implementation is not in accordance with the existing design. In addition, learning activities use student worksheets (LKPD) which are only copies of the contents of student books published by the Ministry of Education and Culture. Evaluation of learning outcomes (EHB) compiled by the teacher was not tested for validity and reliability.

Based on this background, researchers deem it necessary to develop learning tools for integral subject matter in the form of RPP, LKPD, and EHB with discovery learning models.

2. Research Methods

This type of research is development research. The products produced in this study are learning tools in the form of RPP, LKPD, and EHB by using the discovery learning model in integral subject matter of class XI SMA. The research design used in developing learning tools is the Plomp design development model. This model consists of three development phases, namely the preliminary research phase, the prototype manufacturing phase, and the assessment phase. However, due to limited research time and availability of resources, the scope of the research assessment phase was limited to only one class.

3. Result and Discussion

A. Description of the Preliminer Research Phase

The preliminary research stage begins with interviews with mathematics teachers and some students use guidelines. Furthermore, researchers collect learning tools used by teachers. Based on the results of interviews with a number of XI MIPA students and mathematics teachers in SMA Negeri 1 Langowan, information was obtained that the implementation of the 2013 curriculum had not been carried out optimally. Although referring to the Student Book and Teacher's Book published by the Ministry of Education and Culture which uses a scientific approach, the implementation of learning in the classroom is again centered on the teacher. This is because teachers and students are not accustomed to using a scientific approach.

Mastery of most teachers of learning models with a scientific approach is inadequate. Although some teachers have attended training on the implementation of the 2013 curriculum, teachers still find difficulties when implementing it in class. This is due to the ineffective training and the rather confusing guide to learning steps in the Teacher's Book. Teachers, who are mostly still familiar with the scientific approach, need clearer guidance to be able to implement the 2013 curriculum in learning.

On the other hand, students who are supposed to play an active role in learning activities actually do not respond to the stimulus provided. Most students feel confused with the stimulus and study guides provided by the teacher so they prefer to wait until the teacher explains the subject matter and gives examples directly. Some students even complained about the unclear process of discovery that teachers often demanded in learning. After further exploration, this is due to the details of the activities in the Student Worksheet just copied from the Student Book without being adjusted to the needs of the students.

In terms of evaluating learning outcomes, teachers use evaluation instruments that are less appropriate to the demands of the indicators and have not been tested for validity and reliability. Some students admitted that they only carelessly answered the questions because the appearance of the questions was so dense that it was confusing to choose. As a result, many students complained about the results of the evaluation because it was not in accordance with their learning experience. Some students with abilities below average in fact get a value that can be said To be equivalent to students with high ability.

B. Description of Prototype Making Phase

The development of RPP, LKPD, and EHB is based on the demands of the 2013 curriculum and uses discovery learning models. Allocation of time used for integral subject matter is four meetings with 2 x 45 minutes for each meeting. Given the weaknesses of the discovery learning model in classrooms with large numbers of students, the LKPD was developed in the form of tasks that were done in groups. While EHB is compiled based on indicators of competency achievement.

The instruments designed include validity instruments, practicality instruments, and effectiveness instruments. Validation instruments produced were RPP validation sheets, LKPD validation sheets, EHB validation sheets, teacher response questionnaire validation sheets, and student response questionnaire validation sheets. The practicality instruments produced were the students' questionnaire responses and the teacher's questionnaire responses. The effectiveness instrument produced was Evaluation of Learning Outcomes (EHB).

The validation of the contents of the learning kit was carried out by 5 validators consisting of 3 lecturers in Mathematics Education Study Program, Postgraduate Program, Manado State University and 2 mathematics subject teachers at SMA Negeri 1 Langowan. Content validation focuses on the format, content, and language used in learning tools. The results of the validation in the form of corrections, criticisms, and suggestions are used as a basis for making revisions and improvements to the learning tools developed.

1. Validation of Learning Implementation Plan

Based on the results of the assessment on the RPP validation sheet, several revisions were made. After the revision process, the final assessment results obtained from the validator with the results of the validity analysis as presented in Table 1.

Table 1: Results of RPP Validity Analysis

Validator	Validation Average	Criteria
1	3.4	Very Valid
2	3.8	Very Valid
3	3.7	Very Valid
4	3.6	Very Valid
5	3.9	Very Valid
Average	3.68	Very Valid

2. Student Worksheet Validation

Based on the results of the assessment on the LKPD validation sheet, several revisions were subsequently made. After the revision process, the final assessment results obtained from the validator with the results of the validity analysis as presented in Table 2.

Table 2: Results of LKPD Validity Analysis

Validator	Validation Average	Criteria
1	3.56	Very Valid
2	3.78	Very Valid
3	3.67	Very Valid
4	3.78	Very Valid
5	3.78	Very Valid
Average	**3.71**	**Very Valid**

3. Content Validation Evaluation of Learning Outcomes

Based on the results of the evaluation on the EHB validation sheet, several revisions were made. After the revision process, the final assessment results obtained from the validator with the results of the validity analysis as presented in Table 3.

Table 3: Results of Analysis of EHB Contents Validity

Validator	Validation Average	Criteria
1	3.00	Valid
2	3.25	Very Valid
3	3.75	Very Valid
4	3.50	Very Valid
5	3.75	Very Valid
Average	3.45	Very Valid

4. Student Questionnaire Response Validation

Based on the results of the assessment on the student validation questionnaire responses sheet, then some revisions were made. After the revision process, the final assessment results obtained from the validator with the results of the validity analysis as presented in Table 4.

Table 4: Results of Analysis of Student Questionnaire Validity Responses

Validator	Validation Average	Criteria
1	3.57	Very Valid
2	3.71	Very Valid
3	3.86	Very Valid
4	3.86	Very Valid
5	4.00	Very Valid
Average	3.80	Very Valid

5. Teacher Response Questionnaire Validation

Based on the results of the evaluation on the teacher response questionnaire validation sheet, several revisions were then carried out. After the revision process, the final assessment results obtained from the validator with the results of the validity analysis as presented in Table 5.

Table 5: Results of Analysis of Teacher Response Questionnaire Validity

Validator	Validation Average	Criteria
1	3.57	Very Valid
2	3.71	Very Valid
3	3.71	Very Valid
4	3.71	Very Valid
5	3.86	Very Valid
Average	3.71	Very Valid

C. Description of the Assessment Phase

1. Learning Outcomes Evaluation Trial (EHB)

After the validity of the contents is guaranteed by experts, the EHB is then tested to calculate the validity of the criteria and their reliability. EHB was tested in the XI MIPA 3 class of SMA Negeri 1 Langowan which is the class with the highest average grade in the previous mathematics learning evaluation. The analysis shows the reliability coefficient of 0.85 which is included in the very high category. The results of the analysis of the validity of the developed EHB criteria are presented in Table 6.

Table 6: Results of Validity Analysis of EHB Criteria

Item Question	Correlation coefficient	Validity of Test Item Criteria
1	0.75	High
2	0.73	High
3	0.83	Very high
4	0.75	High
5	0.83	Very high
6	0.82	Very high

2. Trial of RPP and LKPD

The trial was conducted in class XI MIPA 2 of SMA Negeri 1 Langowan consisting of 35 students. This class has followed integral learning activities provided by mathematics teachers. But the results of the achievement of most students still have not reached the Minimum Mastery Performance (KKM). The results of the evaluation have not been followed up by the teacher making it possible for researchers to conduct trials. The data obtained during the trial in the form of pretest data, data on the ability of teachers to manage learning, posttest data, student questionnaire response data, and teacher response questionnaire data. The results of these data are then analyzed to be used as consideration for prototype revisions.

3. Practical Analysis of Learning Devices

The practicality of LKPD is obtained from the results of filling out the student response questionnaire. The questionnaire was filled by 35 students of Class XI MIPA 2 of SMA Negeri 1 Langowan who had used LKPD in integral learning. The results of the analysis show a score of 4.23 and are in very good criteria. The developed LKPD is declared practical if the minimum criteria for student response achieved are good categories. Therefore, the developed LKPD can be declared practical for use by students in learning integral subject matter with the discovery learning model.

The practicality of the RPP and EHB developed was obtained from the results of filling in the questionnaire responses from the teacher. The questionnaire was filled by two mathematics teachers at SMA Negeri 1 Langowan who had observed the learning activities undertaken by researchers. The results of the analysis show a score of 4.16 and are in the Good criteria. The RPP and EHB developed are deemed practical if the minimum criteria for student response achieved are good categories. Therefore, the RPP and EHB developed can be declared practical for use in learning integral material with the discovery learning model.

4. Analysis of the Effectiveness of Learning Devices

The effectiveness of learning tools is obtained from the Learning Outcomes Evaluation given to 35 students. The results of the analysis show that the percentage of the number of students who reach completeness is included in the criteria of “Good” with a percentage of 82.86% with an average value of 77.11. This shows that the learning tools developed are effective in their use in learning activities. Information on the results of the evaluation of learning outcomes is supported by the results of the analysis of the observation sheet of the implementation of learning. The implementation of learning is in the Good category with a score of 3.18 so that the RPP, LKPD, and EHB developed

Can be declared effective in terms of the implementation of learning.

4. Discussion

1. Learning Implementation Plan (RPP)

The Learning Implementation Plan that has been used by mathematics teachers in SMA Negeri 1 Langowan is only a copy of the contents of the Teacher's Book published by the Ministry of Education and Culture. The teacher does not analyze students' needs or develop lesson plans according to their needs and abilities. Some teachers even found it difficult to apply the learning steps contained in the description of the activities so that the learning process no longer matches the existing lesson plans.

From the comparison of the two Learning Implementation Plans, it can be seen that the description of the activities in the lesson plan that has been developed to be more easily understood and implemented. The division of time allocation has also been developed based on the results of the analysis of the needs of students. In terms of material preparation, the lesson plans that have been developed have been adapted to the abilities of students and the demands of Competency Achievement Indicators. Furthermore, the Learning Implementation Plan (RPP) developed in this study was tested for validity by 5 expert validators and was declared in the valid category. The results of the teacher's response questionnaire showed that the lesson plans developed were in the practical category. In terms of effectiveness, the lesson plans that have been developed have also been proven effective through the large percentage of completeness in evaluating student learning outcomes.

2. Student Worksheet (LKPD)

Mathematics teacher at SMA Negeri 1 Langowan only uses LKPD in the form of a copy of the contents of the Student Book published by the Ministry of Education and Culture. The teacher does not analyze students' needs or develop LKPD as needed. On the other hand, students at the previous education level who are not accustomed to using a scientific approach to learning find it difficult to learn the discovery learning model. The obstacles expressed by students at the time of the interview were that they immediately felt that integral subject matter was difficult when the teacher gave stimulation at the first meeting. Based on the Teacher's Book and Student's Book published by the Ministry of Education and Culture, the teacher provides stimulation by asking students to imagine a problem at the port. This is less interesting for students of SMA Negeri 1 Langowan who all live in mountainous areas. Furthermore, when having to relate the problem to the concept of derivatives, students have difficulty getting the common thread of understanding. Based on these constraints, in the development of LKPD, the stimulation phase at the first meeting is presented in assignments that are more easily responded to by students.

The most significant difference between the LKPD that was previously used by the teacher and the LKPD that was developed was the presentation of the questions the students were going to do. The activities in the developed LKPD have been adjusted to the results of the analysis of the needs of students, the demands of the discovery learning model, and indicators of competency achievement. Furthermore, the validity of the LKPD developed in this study was tested by 5 expert validators and was declared to be in the valid category. Practicality testing through the student response questionnaire also showed that the LKPD developed was in the practical category. While in terms of effectiveness, the developed LKPD has been proven effective through the large percentage of completeness in the Evaluation of Student Learning Outcomes.

3. Evaluation of Learning Outcomes (EHB)

Evaluation of Learning Outcomes used by mathematics teachers in SMA Negeri 1 Langowan for Integral subject matter in the form of multiple choice made without a grid of questions. The number of questions for certain indicators becomes excessive while other indicators are lacking. The difficulty aspect of the questions is also lacking in attention so that some questions do not fit the demands of competency achievement indicators.

The use of multiple choice questions allows students to guess answers carelessly so that it will be difficult for teachers to know the extent of mastery of the material by students. Therefore, the questions in the EHB that were developed were in the form of essays with a gradual assessment of cognitive aspects and in accordance with indicator demands. Furthermore, the EHB developed in this study was tested for content validity by 5 expert validators and tested the criteria for validity and reliability. The results of the questionnaire responses from the teacher also stated that the EHB developed was in the practical category.

4. Conclusion

Judging from the results of the assessment of learning tools conducted by expert lecturers and mathematics teachers, the learning tools developed already meet valid criteria. Judging from the results of the student questionnaire responses and teacher responses questionnaire it can be concluded that the learning tools developed already meet practical criteria. Judging from the Evaluation of Learning Outcomes and the observation sheet of the implementation of learning, it can be concluded that the learning tools developed have a good level of effectiveness. Overall it can be said that the integral learning tool by using the discovery learning model that has been developed for high school students in class XI has fulfilled valid, practical, and effective criteria.

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