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Development of Discovery Learning Based Modules in Ecosystem Material for Class X Senior High School/Madrasah Aliyah Students

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Abstract: This study aims to develop *discovery learning* based modules and to determine the level of feasibility, practicality and effectiveness of the developed modules. This study uses the *Research and Development* (R&D) research method with the ADDIE model consisting of five stages, namely *(Analysis, Design, Development, Implementation, Evaluation).* The research subjects were class X MIPA at SMA Negeri 4 Binjai with a total of 25 students. The research instruments were teacher needs analysis, validation sheets to obtain product feasibility data, educator response questionnaires and student questionnaires to obtain product practicality data and learning achievement tests to obtain data on the effectiveness of the products being developed. Based on the results of the study in terms of feasibility, material experts scored 94.28% in the "Very Eligible" category, media experts scored 92.94% in the "Very Eligible" category. Meanwhile, in terms of practicality, from the results of the Biology Teacher's responses, an average proportion of 94.66% was included "Very Practical". In the results of the assessment of students have an average proportion of 89.11% with the criteria "Very Interesting". And in terms of effectiveness, the *pretest* results averaged 53.6 while the *posttest* results averaged 80.4. So that the N-gain value is 0.53 with a range of 0.30< n < 0.70 for the "Medium" mixture. So it was concluded, the *Discovery Learning* based module that had been developed was stated to be feasible, effective, and practical to use, and could increase activeness in solving problems.

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Introduction

In education the most important components are educators and students. It is hoped that the interactions that occur between educators and students can improve the learning process that can be obtained by students (Hutapea, 2019: 77). Pendidikan has an important role in the development of a nation by creating quality human resources. The educational process is influenced by several factors, including student input, educational facilities and infrastructure, teaching materials, and human resources (educators) that can support the creation of a conducive learning atmosphere (Fajri, 2019: 65). Education with attention can devote, pay attention to and always follow the development of children in the development of faith and morals as well as spiritual and social preparation. As Ulwan (2007) said that education with attention is always paying full attention to and following the development of the child's faith and moral aspects, supervising and paying attention to social mental readiness.

Quality in the learning process will have an impact on student learning outcomes. The learning process required by students is an ideal learning process. The ideal learning process is a learning process that is able to encourage the creativity of students as a whole, makes students

July 2023 Vol. 8 No. 3
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P-ISSN: 2503-0602
pp. 722-729

more active and independent, achieves learning goals effectively and takes place in pleasant conditions (Nurhasikin, 2019: 164). Efforts that can be made to achieve an active and independent learning process is to pay attention to the learning process carried out in the classroom. One of the supporting factors in the learning process using teaching materials, one of which is the module. This module is written teaching material that allows students to learn independently (Gazaly, Sapitri & Lamote, 2021:1).

Modules are teaching materials packaged so that students can learn actively and independently without teacher guidance. With the module, the teacher will focus on the ability of students, because students have responsibility for their actions to learn independently then there is control over student learning regarding the use of modules (Nawawi, et al. 2017: 44). The benefits of the module for the teacher alone can limit the material being taught. The function of the module itself is as a guide that will direct all activities in the learning process and is a guiding substance that will direct all activities in the learning process to be more interesting (Sirate, 2017: 320). The application of the use of the module is expected to cause students to be more active in the learning process. The advantages of using modules in the learning process can increase students' interest in learning and as a measure of learning outcomes, where teachers and students know the success of the module (Islami & Armiati, 2020: 500).

Based on the results of observations that have been made of class X students at SMA Negeri 4 Binjai, it is stated that there are still many students who experience difficulties in understanding biology material, especially ecosystems. Students feel that the learning delivered by the teacher is less meaningful because the students' abilities in the learning process are not developed by the teacher. This problem can be seen when the teacher does not provide opportunities for students to develop their ideas by simply giving notes and explaining the material continuously. The students also found it difficult to understand the existing teaching materials. Teaching materials are available only in the form of textbooks provided by schools so that students still need other learning resources (Kalsum, Mustami & Ismail, 2018: 99).

The ability of students in the learning process still needs to be developed. In order for students' knowledge to increase, the teacher should choose a learning model that brings the level of students' ability to solve problems in class (Bahir, 2020: 14). To support students so that they can be trained in their abilities in a class problem, they can use the Discovery *Learning* learning model. This *Discovery learning* model can train students to learn independently, train students' reasoning abilities, and involve students actively in learning activities to find themselves and solve problems without the help of others. With the implementation of this *Discovery Learning* model, students can improve their abilities individually besides that so that the learning conditions of students who were initially passive become more active and creative (Salmi, 2019: 2).

In his study, Biology examines all living things, not only plants and animals that live on this earth. Biology is part of science and has characteristics in common with other sciences. Science is also known as natural science because it is a science that studies natural phenomena. As part of science, biology studies natural phenomena in the form of symptoms in living things and all the problems of life. Biology is also a science that studies the mutual relations between organisms and their environment, this material is very closely related to ecosystems (Effendi, Salsabila, & Malik, 2018: 76).

Based on research on the development of modules based on *Discovery Learning,* much has been done, namely in research conducted by Ariana (2020) regarding the development of modules on tissue and plant materials. There is also research conducted by Handoko (2016)

Jurnal Teknologi Pendidikan:
Jurnal Penelitian dan Pengembangan Pembelajaran
https://e-journal.undikma.ac.id/index.php/jtp/index

July 2023 Vol. 8 No. 3
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pp. 722-729

regarding module development in biotechnology material. Subsequent research was also carried out by Dwicahyani (2020) regarding the development of modules to increase student motivation and learning outcomes in the subject of the human respiratory system. However, there are still few who research on the development of modules based on Discovery Learning on ecosystem material, so it is necessary to conduct research on "Development of *Discovery Learning* Based Modules on Ecosystem Materials for Class X SMA/MA Students" in order to solve a problem being faced in the learning process.

Research methods

In this study, the Research and Development (R&D) method was used, which is a series of processes or steps in developing a new product or perfecting an existing product so that it can be accounted for. In this study using the development method with the ADDIE model. The ADDIE model is one of the learning system design models that shows a basic stage in the learning system that is easy to do. The ADDIE model consists of 5 stages namely: *Analysis (Analisis), Design (Rancangan), Development (Pengembangan), Implementation (Implementation),* dan *Evaluation (Evaluation)* (Branch, 2009).

In collecting data on product trials, there are several stages, namely: (1) Trial design. At this stage, activities are carried out starting from collecting data, compiling teaching materials in the form of modules, and assessing product feasibility by validating several experts. The feasibility test is carried out by submitting the product and a questionnaire to the validator to assess the feasibility level of the product. (2) The test subjects, the test subjects in this study were students of Class X SMA Negeri 4 Binjai with a total of 25 students. (3) Types of data. The types of data obtained from the validation results on the development of *Discovery Learning*-based modules are quantitative and qualitative.

As for the data collection instruments in this study, namely: validation sheets for material experts and media experts used for assessment to determine whether a product that has been designed is feasible or not. Furthermore, the response questionnaire sheets for teachers and students are used to find out the practicality of a product. The test results to determine the effectiveness of the *Discovery Learning*-based module. Setelah mendapat nilai dari tes yang telah dilakukan, After getting the scores from the tests that have been carried out, the researcher analyzes the scores obtained. The analysis used is the Gain Normality Test (N-gain).

1. **Due Diligence**

   Data from the assessment of the feasibility of product development modules based on *Discovery Learning* descriptively. Feasibility analysis is carried out by:

$$Kelayakan = \frac{\text{Total Skor}}{\text{Total Skor Maksimal}} \text{ x } 100\%$$

To determine the eligibility of the product can be adjusted to the criteria below.

Table 1. Eligibility Criteria

Score	Category
81-100%	Very good
61-80%	Good
41-60%	Pretty good
21-40%	Not good

Jurnal Teknologi Pendidikan:
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July 2023 Vol. 8 No. 3
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pp. 722-729

2. Practicality Test

Practicality analysis was carried out through validator response questionnaires to the products being developed. Practicality analysis can be done with the formula:

$$Praktis\ (p) = \frac{\text{total skor yang diperoleh}}{\text{total skor maksimal}} \text{x } 100\%$$

To find out the practicality of the product can be seen in the table below.

Table 2. Practicality Criteria

Score	Category
71-100%	Very practical
51-75%	Practical
26-50%	Less practical
00-25%	Not practical

3. Effectiveness Test

Effectiveness analysis is obtained based on the results of the *pretest* and *posttest* that have been carried out by students. This test is used to determine the effectiveness of the treatment given. The following is the formula used to calculate the normality of the gain (Guntara, 2020: 2).

$$\text{N Gain} = \frac{\text{Spost} - \text{Spre}}{\text{Smaks} - \text{Spre}}$$

Information :
N-Gain : Stating the normality test value of the gain
Sport : Declare the pretest score
Spre : Stating the posttest score
Smax : Declare the maximum score

Table 3. Effectiveness Criteria

Score	Category
0,70 ≤ n ≤ 1.00	Tall
0,30 ≤ n ≤ 0,70	Currently
1,0 0,30	Low

Mean Value Analysis

In this section, the mean value of the *pretest* and *posttest* scores is also analyzed. The following presents a formula for determining the mean value.

$$\text{Pretest Mean Score} = \frac{\text{Jumlah seluruh nilai pretest}}{\text{Jumlah peserta prettest}}$$

$$\text{Posttest Mean Score} = \frac{\text{Jumlah seluruh nilai pretest}}{\text{Jumlah peserta prettest}}$$

Research Results and Discussion

A. Research and Development Results

The result of this research is the creation of a *Discovery Learning*-based module on ecosystem material for class X students of SMA Negeri 4 Binjai. This research and development is carried

July 2023 Vol. 8 No. 3
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P-ISSN: 2503-0602
pp. 722-729

out using the ADDIE model which includes 5 stages, namely, *Analysis, Design, Define, Implementation, and Evaluation.*

1. Analysis Phase *(Analysis)*

Needs analysis was carried out through interviews with biology teachers in class X. According to the results of interviews with biology teachers in class X SMA Negeri 4 Binjai, the biology learning process did not use modules as teaching materials. So far, teachers have only used textbooks as teaching materials in the learning process in student classes which are still teacher-centered. Furthermore, there is a curriculum analysis carried out to find out the subject matter of the ecosystem being studied.

The evaluation results from the analysis stage show that the needs analysis and curriculum analysis in class X SMA Negeri 4 Binjai require renewal in the learning process. For this reason, it is necessary to design an attractive module in accordance with the learning criteria set at the school.

2. Design Stage *(Design)*

Based on the analysis stage, the material used to compile the module is ecosystem material for class X. Ecosystem material consists of understanding ecosystems, ecosystem constituent components, interactions between components, ecological pyramids, schemes of interaction patterns between components, biogeochemical cycles in ecosystems. The form of the module used is related to the *Discovery Learning* method using A4 size paper (21 cm x 29.7 cm), times new roman writing type with size 12 and 1.5 spacing with portrait orientation, on the inside or content, while on the cover and sub titles chapters use shrikhand typeface with size 48 and 1.15 spacing. The preparation of the module begins with the creation of the cover design and content design for the module.

3. Development Stage *(Development)*

Making modules that are developed into teaching materials that aim to broaden the scope of students' knowledge and make it easier for students to understand ecosystem material. there are several validations carried out to get the results of the designed module.

a. Material and Media Expert Validation

Based on validation from Material Experts for the feasibility of *Discovery Learning*-based modules on ecosystem material. The results of the validation that can be obtained from the assessment of material experts include aspects of content feasibility and presentation feasibility. In the validation process by material experts, a score of 94.28% was obtained in the "Very Valid" category. As for validation from Media Experts for the feasibility of *Discovery Learning*-based modules on ecosystem material. The validation results obtained from the assessment of material experts cover several aspects. In the validation process by media experts, a score of 92.94% was obtained in the "Very Valid" category.

b. Biology Teacher Response

The results of the teacher's response questionnaire conducted by the class X biology teacher in the *Discovery Learning*-based module in the assessment process obtained a total score of 75 with an average of 94.66% and was categorized as "Very Practical".

c. Student Response

The assessment was carried out by students from SMA Negeri 4 Binjai with a total of 25 students. The results of students' responses to the module obtained an average score of 89.11% with the interpretation criterion achieved "Very Practical".

Jurnal Teknologi Pendidikan:
Jurnal Penelitian dan Pengembangan Pembelajaran
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July 2023 Vol. 8 No. 3
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pp. 722-729

4. Implementation Stage *(Implementation)*

At the implementation stage, the effectiveness test was carried out. The product effectiveness test was carried out to determine the extent to which students' learning outcomes increased after participating in learning with the Module. Before the module is applied in learning, a pretest is given first. Furthermore, after the module is applied, students do a *posttest.* The results of the *pretest* and *posttest* can be seen in the image below.

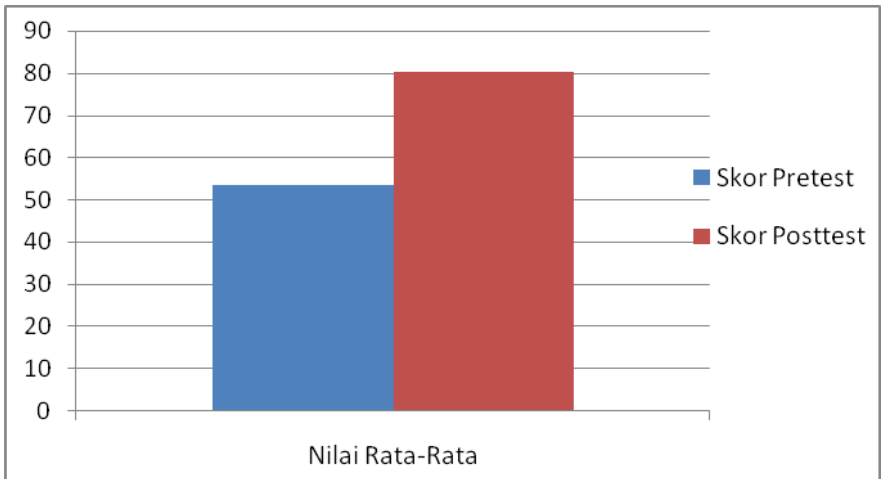

Figure 1. *Pretest* and *Posttest* Average Score Results

Based on table 4.1 above, the number of students who took part in the *pretest* and *posttest* were 25 students. The values obtained from the *pretest* amounted to 1,340 with an average of 53.6. While the value of the *posttest* amounted to 2,010 with an average of 80.4. This shows that learning outcomes in the cognitive domain increase after the use of *Discovery Learning*-based Modules in learning. In the N-gain category, the *pretest* and *posttest* values obtained a large N-gain value of 0.53.

5. Evaluation Stage *(Evaluation)*

At this stage the researcher understands that the application of the module can make students more involved in learning, interact with friends, discuss among group members, make students not bored, and can attract students' interest when learning takes place.

B. Discussion

In this development to produce products, researchers use the ADDIE model *(Analysis, Design, Development, Implementation, Evaluation).* In the first stage, *namely Analysis,* the researcher analyzed all aspects of module preparation including needs analysis and curriculum analysis. In the second stage, namely *Design,* the researcher designed the module design based on the analysis carried out in the previous stage. The designed design includes the outer part, namely the skin (cover) of the module and the inside, namely the contents of the module. In the third stage, namely *Development,* researchers carry out the development or implementation of the design. At this stage the researcher begins to make products covering the inside and outside of the module. At this stage the products that have been developed are validated by experts, then make revisions according to suggestions and input obtained from experts so that the modules used are valid and feasible to be tested. Then at this stage a response was also made to educators and students towards the development of a *Discovery Learning*-based Module. In the fourth stage, namely *Implementation,* testing the effectiveness by giving

July 2023 Vol. 8 No. 3
E-ISSN: 2656-1417
P-ISSN: 2503-0602
pp. 722-729

questions in the form of a *pretest* before the module is implemented and in the form of a *posttest* after the module is implemented involving 25 students in class X SMA Negeri 4 Binjai. The final stage is the fifth stage, namely *Evaluation.*

Before the developed module is tested on students, the module is first assessed by experts (validators). Based on the results of the material expert's validation in terms of the content aspect, the score was 92.72, the benefit aspect of the material content was 100, and the overall presentation with an average of 94.28% was rated "Very feasible". Based on the results of the media expert's validation in terms of the characteristic aspects of the module, it received an assessment score of 96, the visual element aspect of the module received an assessment score of 95, the module benefits aspect received an assessment of 80 and the quality element aspect of the module 93.33 Overall presentation was rated "Very feasible" with an average of 92 .94%. Based on the explanation above, the *Discovery Learning*-based Module is considered very feasible by the validator. After being validated by the validator, this *Discovery Learning*-based module will then be tested with practicality.

Next, based on the results of the teacher's response assessment conducted by the class X biology teacher as a whole it was categorized as "Very practical" with a score of 75 with an average value of 94.66%. The results of the assessment of 25 students as a whole are categorized as "Very practical" with an average value of 89.11%. From the results it can be seen that *Discovery Learning*-based modules can help students understand the concept of the material presented, solve problems from the learning process discussed, increase enthusiasm for learning and not get bored quickly and can add to the learning experience.

The level of effectiveness in this study was obtained from calculations using *pretest* and *posttest* values. As for the results of the pretest that has been carried out, namely the average value obtained is 53.6, which means it is below the KKM. The next step is the *posttest* activity. This *posttest* is carried out after completing learning activities using modules based on *Discovery Learning* on ecosystem material. The application of learning with modules allows students to learn independently and improve their own knowledge. In addition, the appearance of an attractive and modern module makes learning new and interesting, does not make students get bored quickly in the learning process. The score obtained from the *posttest* activity is an average value of 80.4, which means that the value is above the KKM.

From the result data obtained the N-Gain value of 0.53 has the "Medium" category. This shows that learning outcomes in the cognitive domain increase after the use of *Discovery Learning*-based Modules in learning.

Conclusion

Based on the results of the research and development that has been carried out in the development of *Discovery Learning*-based Modules on ecosystem materials carried out using the ADDIE research method, it can be concluded that: 1) The results of the Percentage of Material Experts received an average score of 94.28% in the "Very Eligible" category, Media Experts of 92.94% in the "Very Eligible" category. So that *Discovery Learning* based modules on ecosystem material are very suitable for use in the learning process. 2) The results of the Biology Teacher's responses obtained an average percentage of 94.66% and the results of student responses with a total of 25 students obtained an average percentage of 89.11%. So that the *Discovery Learning*-based Module on "Very practical" ecosystem material is used in the learning process. 3) Student learning outcomes obtained an average *pretest* of 53.6 and an average *posttest* result of 80.4. Increasing cognitive learning outcomes is included in the medium category with an average N-gain test value of 0.53 in the "moderate" category.

July 2023 Vol. 8 No. 3
E-ISSN: 2656-1417
P-ISSN: 2503-0602
pp. 722-729

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