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Improving Students' Science Process Skills through Discovery Learning Model on Biodiversity Material

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Abstract: Research aims to improve students' science process skills by using the Discovery Learning learning model on biodiversity material. This classroom action research was carried out at SMA Negeri 1 Gorontalo. The instruments used in this research were observation sheets and written tests to measure students' science process skills. The research results show that using the discovery learning model can improve students' science process skills. This is proven by the results of the 6 indicators of science process skills, namely observing, classifying/grouping, interpreting, asking questions, hypothesizing and applying the concepts measured, getting an average percentage in cycle I of 70.42% and in cycle II amounting to 81.37%. with an N-Gain score obtained of 0.59 or a value of $0.3 \leq g \leq 0.7$ (medium category). The achievement of student learning outcomes as measured by objective test questions also saw an increase in the average score in cycle I of 55% and in cycle II of 76%. Thus it can be concluded that the discovery learning learning model can be used in the learning process which can improve students' science process skills at SMA Negeri 1 Gorontalo and as information material, especially in the use of appropriate learning models in learning activities.

Keywords: Biodiversity; Discovery learning; Science process skills

Introduction

Science Process Skills is a scientific method in which the steps to discover something through experiments and experiments are practiced. Science process skills allow students to tie new information with old information (Eliyana, 2020). Science Process Skills are a core part of contextual-based learning activities that describe and describe systematic procedures in organizing learning and learning experiences and to achieve specific learning objectives and serve as guidelines for teaching planning for teachers in carrying out learning activities (Daud, 2018).

According to Muh et al. (2014), science process skills consist of a number of indicators, namely: making observation, interpreting, classifying, predicting, communicating, hypothesizing, planning experiments, applying concepts and asking questions.

Science process skills are very important for every student, because they can help students solve problems in the phenomena encountered during the learning process. In addition, by improving students' science process skills, it can help learning outcomes to be better. Based on initial observations of teachers teaching biology subjects in class teachers do not see the process skills of all students, for example the skills of asking questions or answering questions and the skills of drawing conclusions.

The grades obtained by students are the result of the grades of the assignments given. It is also known that teachers who carry out learning activities only develop a few skills, such as communication skills and observation skills. Not all students are able to apply these skills. Examples of activities carried out in communication skills include students being asked to have discussions after learning. The communication that occurs is a question and answer process, both student-to-student and student-to-teacher. Meanwhile, in observation skills, students are asked to observe the learning material in the guidebook and on the power point provided by the teacher so that, in this case, the science skills process needs to be developed further.

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Based on initial observations of teachers at SMA Negeri 1 Gorontalo, it is known that teachers who carry out learning activities only develop some science process skills, such as communication skills and observation skills. These skills are also not all students are able to apply them. The learning process implemented greatly influences the improvement of science process skills. The use of learning models is something that supports success in the learning process.

The learning model used in this study is the Discovery Learning learning model. Discovery learning is a type of learning that allows students to actively learn and discover their own knowledge, according to Hanifah et al. (2017).

According to Sani (2015), discovery learning is a cognitive learning strategy that requires teachers to be more creative when facing situations that allow students who are actively learning to obtain their own information. In line with the opinion of Hasan et al. (2019), teachers in the era of the industrial revolution 4.0 must improve their understanding in expressing themselves in the field of media literacy, understanding the information that will be shared with students and finding analysis to solve the problems of digital literacy academics. Hopefully, all parties must increase collaboration in the orientation of future education and change the performance of the education system that can develop the quality of students' mindset and strengthen the digitalization of application-based education.

According to Sinambela (2013) the steps for implementing Discovery Learning are stimulation (providing stimulation), problem statement (problem statement/identification), data collection (data collection), data processing (data processing), verification (proof) and generalization (drawing conclusions).

Information obtained through discussions with the biology teacher of SMA Negeri 1 Gorontalo that in the learning process the learning model used is more spurring the teacher to work than the students. In addition to using the right learning model, this research also requires the relevant material in improving the science process skills of students. Biology learning is learning that studies all problems related to living things and nature. Biodiversity material is one of the right materials in seeing the improvement of students' science process skills.

Biodiversity (or biological diversity) is a term used to describe the richness of various life forms on this earth ranging from single-celled organisms to higher organisms. Biodiversity includes habitat diversity, species diversity and genetic diversity (variation of traits within species) (Siboro, 2019).

Biodiversity can decline both due to natural factors and human activities. Natural disasters, such as forest fires, are one of the natural factors that cause damage to ecosystems that can threaten the reduction of biodiversity. In general, human activities have a major contribution to the reduction of Indonesia's biodiversity. Conservation area protection efforts are one of the things that can preserve biodiversity. The new paradigm of conservation area management aims to reduce dependence on management funds from outside parties and carry out conservation at its own expense. This can be done through the development of utilization of various potential areas and being able to direct business orientation carried out in utilization corridors that guarantee their sustainability (Susanti et al., 2014).

Some of Indonesia's biodiversity has been exploited, some of its potential has only just been discovered, and some of it is still unknown. Basically, biodiversity can restore itself, but this ability is not unlimited. Biodiversity is needed for life and is used as capital for development, so the existence of biodiversity is very dependent on human treatment. Direct use of biodiversity is not without risks. In this case, the interests of various sectors in government, society and the private sector do not always coincide. There are many elements that influence the future of Indonesia's biodiversity, as well as the challenges that must be faced in the overall national development process, especially the large population and demands for the provision of various basic needs (Anggraini, 2018).

Method

The research was conducted in the odd semester of the 2022/2023 academic year at SMA Negeri 1 Gorontalo in class X IPA-1. This research is a type of Classroom Action Researchs. This research design refers to the Stephen Kemmis and Robyn Mc. Taggart model which consists of 4 stages: planning, action, observation, and reflection (Prihantoro et al., 2019).

The subjects in this research were focused on class X-IPA 1 with a total of 35 students on odd semester Biodiversity material. Data collection techniques using observation techniques and objective question instruments. Observation is used to observe all activities that occur in the learning process, then included with taking pictures so that the observation is considered valid. In addition, researchers also recorded all activities that occurred during the learning process on the observation sheet that had been made previously.

The observation sheet was arranged in a rubric by giving scores ranging from 1, 2, 3, and 4. The observation sheet contains 6 indicators of science process skills that are assessed, namely observing, classifying/classifying, interpreting, asking questions, hypothesizing and applying concepts. In addition, student worksheet is also used to support observers to see the ability of

students' science process skills. The data obtained from the observation results and student worksheet were analyzed referring to the formula:

$$value = \frac{\text{Science process skills scores obtained}}{\sum \max scores} x\ 100\ \% \quad (1)$$

Table 1. Science Process Skills Assessment Criteria (Mutmainnah et al., 2019)

Percentage (%)	Criteria
86-100	So good
76-85	Good
56-75	Good enough
41-55	Less good
>40	Not good

To determine the level of increase in the significance of students' science process skills from one cycle to the next cycle, the gain test was used as follows:

$$value = \frac{S2-S1}{100-S2} \quad (2)$$

Notes:
S1 = Average score obtained in cycle I
S2 = Average score obtained in cycle II

Table 2. Science Process Skills Improvement Criteria (Mursali, 2016)

Percentage	Criteria
g > 0.7	High
0.3 ≤ g ≤ 0.7	Medium
g < 0.3	Low

In seeing learning achievement, students are given objective tests in each cycle. The test results can be shown by the average score of students in the class. This is calculated using the following equation:

$$\text{Value} = \frac{\text{Number of scores obtained}}{\text{Maximum number of scores}} x\ 100\% \quad (3)$$

After calculating the achievement of student learning outcomes, the data obtained is grouped based on indicators of science process skills. This aims to analyze and see the achievement of each indicator of science process skills, which will be calculated using the following formula:

$$\text{NP} = \frac{R}{SM} x\ 100\% \quad (4)$$

Description:
NP = Percentage value per indicator of KPS
R = Score obtained on each science process skills indicator
SM = Maximum score on each science process skills Indicator (Purwanto, 2010).

Result and Discussion

After the research was conducted by applying the Discovery Learning model on biodiversity material in class X SMA Negeri 1 Gorontalo, the data obtained from the observation of students' science process skills in cycle I and cycle II are written in Table 3.

Table 3. Observation Data of Science Process Skills

Observed indicators	Cycle I		Cycle II	
	Average score %	Criteria	Average score %	Criteria
Observe	83.57	Good	91.79	So good
Classification	75.00	Good enough	83.21	Good
Interpretation	45.71	Not good	56.79	Good enough
Asking questions	75.00	Less good	86.43	So good
Hypothesize	70.36	Less good	85.00	Good
Applying the concept	73.21	Less good	84.29	Good
Average	70.42		81.37	
gain test			0.59	Medium

Based on Table 3 above, it can be seen that learning with the Discovery Learning model can improve students' science process skills, this is intended from the results of the gain test with a value of 0.59 which has a moderate category.

The average percentage value of students' science process skills in cycle one was classified as a fairly good category while in cycle two it increased to a good category. From the two cycles, it is very clear that the value of each indicator of students' science process skills has increased. This is addressed in the figure below.

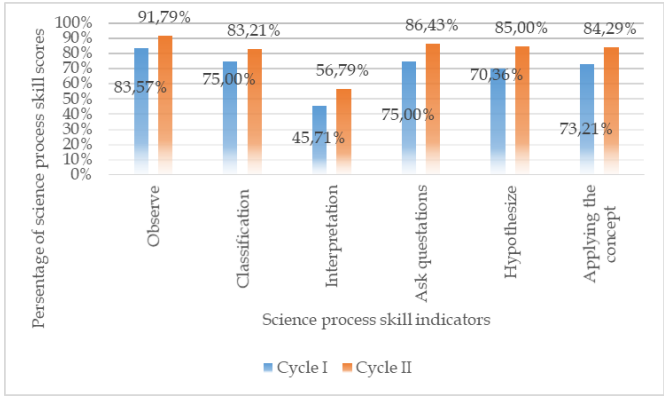

Figure 1. Graph of the percentage difference in science process skills values in each aspect

The figure above shows that the average percentage value in each aspect of students' science process skills has a different value. The highest average percentage value of cycle I and cycle II is in the indicator of observing 83.57% and 91.79%. The lowest average

percentage value of cycle I and cycle II is in the interpreting indicator of 45.71% and 56.79%.

Based on Table 1, there is a difference in the average value of science process skills in cycle I and cycle II. In cycle II, there was an increase in the average value of science process skills. The increase occurred because in Discovery Learning students are directly involved in the learning process which can help develop science process skills. This is in accordance with research conducted by Ilmi et al. (2012) which explains that the Discovery model is a learning model that can develop students' science process skills, where students are guided to find and investigate facts or concepts themselves, so that the skills and knowledge that students acquire are their own findings.

In the first indicator, namely the ability to observe, this ability in the learning process with the Discovery Learning model can be seen in the stimulation stage. Learners will carefully observe the images presented. From the results of the study it can be seen that the ability to observe students is already good. The results showed that in cycle one the indicator of observing was in the good category and increased in cycle two to a very good category. This is also supported by students being able to use their sense of vision well during the learning process. The ability to observe is the highest indicator of science process skills possessed by students. Observing activities can provide more meaningful learning, because students directly observe events in their environment (Fitriana et al., 2019).

In the second indicator, namely the ability to classify, in learning with the Discovery Learning model this classification ability can be seen at the problem identification stage. The ability of students is observed by the observer when students distinguish and record separately the results of observations obtained from the previous stage (providing stimuli) on the student worksheet. Based on the results of the study, it can be seen that the ability to classify students in cycle one with a fairly good category has increased in cycle two to a good category. The increase in the classification skills aspect is supported by the high increase that occurs in the observation skills aspect. The observation skill aspect is a basic skill that must be possessed to classify (Putra, 2013).

The third science process skill indicator is the ability to interpret, in learning with the Discovery Learning model this ability to interpret can be seen at the generalization stage (drawing conclusions). This ability to interpret is observed by the observer when students work on student worksheets that are asked to conclude the results of the discussions that have been carried out. Observers observed whether or not students were able to draw conclusions from the observations made at the previous stages of discovery learning. Based on the results of the study, the ability to interpret owned by students is very below average, it can be seen from the percentage value of cycle one with a poor category, then in the second cycle it has increased but only in the good enough category. This ability to interpret is the lowest indicator of science process skills possessed by students.

The fourth indicator is the ability to ask questions, in the learning process this ability can be observed by observers throughout the syntax of the Discovery Learning learning model. Based on the results of the study, the ability to ask questions by students seen in cycle one was in the good category which then increased in cycle two to a very good category. This is because asking questions is something that is easily done by students. It can be seen at the beginning of learning or during the first syntax of the discovery leaning model, namely providing stimulation, there are several students who immediately ask questions, as well as in subsequent syntaxes many students ask questions. Not only asking questions, there are some students who without hesitation volunteered to answer questions from other students. Discussion activities between students and teachers really support students' ability to ask questions. This is the same as the opinion of Kirch (2007) in his research which states that conversations or discussions between teachers and students can improve science process skills, including the skill of asking questions.

In the fifth indicator, namely hypothesizing, in the learning process with the discovery leaning model, this hypothesizing ability is seen when students work on student worksheet. In working on student worksheet, students will be asked to fill in the problem identification section, in that section students will formulate hypotheses based on the readings or pictures in the stimulation section. The observer will observe whether these students are able to formulate hypotheses properly and correctly in accordance with the material being taught. From the results of the study, it can be seen that the hypothesizing ability of students is still relatively low, which is shown in cycle one in the good enough category and increases in cycle two to the good category. This is because there are most students who do not understand what is meant by hypothesis, students do not understand the steps in preparing hypotheses. Basically, there are several behaviors that must be carried out when proposing a hypothesis, namely formulating a hypothesis based on the formulation, designing ways to test the hypothesis, and revising the hypothesis if the data does not support the hypothesis (Trianto, 2012).

The last indicator or the sixth indicator is applying concepts, in learning by using the Discovery Learning model the ability to apply concepts can be seen when answering student worksheets. The observer observes whether the students' answers match the concept or not.

Based on the results of the study, the ability to apply the concepts of students is still low. This can be seen from cycle one which has a fairly good category then increases in cycle two to a good category. In cycle one, the average answer of students in student worksheet is still not correct and not according to the concept. In line with the opinion of Purnamasari et al. (2021) who say that students have difficulty understanding the material, because teachers carry out learning conventionally, where students are not actively involved during the learning process.

The strategies used by teachers in the learning process greatly affect the success of teaching and learning activities. According to Hasan (2003), the development of teacher professionalism is a global concern, because teachers have the task and role of not only providing information on science and technology, but also forming attitudes and souls that are able to survive in an era of hypercompetition. The task of the teacher is to help students to be able to adapt to the various challenges of life and the pressures that develop in themselves. This empowerment of learners includes aspects of personality, especially intellectual, social, emotional, and skill aspects. This noble task becomes difficult because teachers must not only prepare the younger generation to enter the century of knowledge, but must prepare themselves to continue to exist, both as individuals and as professionals.

Furthermore, the written test results of students are obtained from the implementation of evaluations using science process skills-based tests in cycles I and II. There were 35 students who took part in the evaluation with a total of 15 multiple choice questions for each cycle which were arranged based on 5 indicators of science process skills, namely observing, classifying/grouping, interpreting/interpreting, hypothesizing and applying concepts. The test results obtained in cycles I and II are as follows:

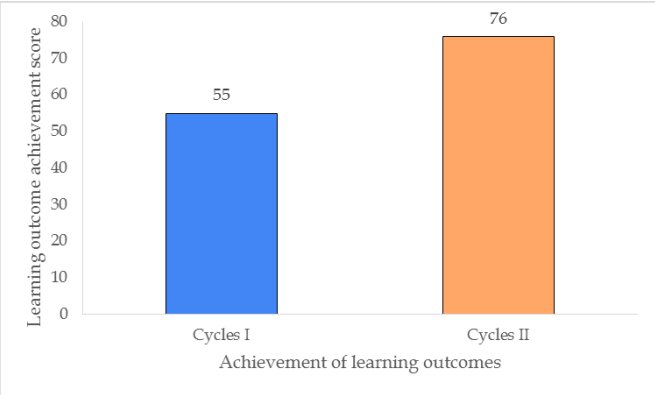

Figure 2. Graph of the achievement of student learning outcomes

Based on Figure 2, it can be seen that the achievement of student learning outcomes has increased. In cycle I, the value of the student learning achievement test was 55% which increased in cycle II with a value of 76%.

Furthermore, analyze the achievement of each indicator of students' science process skills. From the results that have been calculated, the average value of each indicator of science process skills in cycles I and II is as follows:

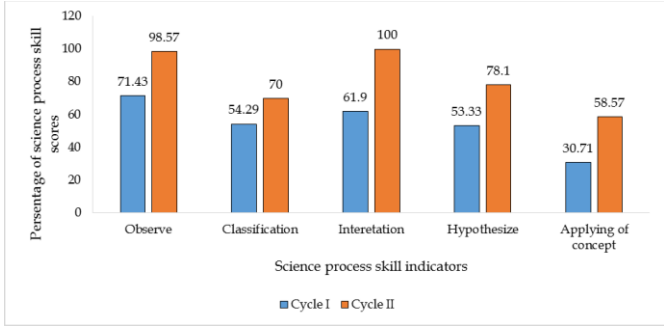

Figure 3. Graph of percentage of science process skills value from test results

Based on Figure 3, the percentage of the average value of science process skills indicators in cycle I was obtained for observing indicators with a value of 71.43, classifying indicators of 54.29, interpreting indicators with a value of 61.9, hypothesizing indicators with a value of 53.33, and applying concepts with a value of 30.71. Then in cycle II, the average percentage value of observing indicators was obtained with a value of 98.57, in the aspect of classifying with a value of 70.00, interpreting indicators with a value of 100, then in the hypothesizing indicator with a value of 78.1 and in the indicator of applying concepts with a value of 58.57.

The questions contained in the evaluation test are arranged based on 5 indicators of science process skills, namely indicators of observing, classifying interpreting, hypothesizing and applying concepts. The questions on the observation indicator in cycle I obtained a percentage value in the good category then increased in cycle II to a very good category. This is because the questions on the observing indicator are arranged by presenting clear images and are easy for students to understand and analyze. Observation activities are all the abilities to use all the senses that every person must have, to improve the scientific ability to select facts relevant to a particular task from the things being observed (Susiwi et al., 2015).

The question on the indicator of classifying in cycle I obtained a percentage value in the category of less which then increased in cycle II with a fairly good category. This classifying indicator is classified as a low indicator in students' written tests. Most of the students' answers are almost correct, most of them are wrong. This

can be caused by students not paying attention to the statements presented in the questions. Meanwhile, judging from the results of observations, students have been able to classify the results of observations and students record separately, but in this case students have not been able to develop it in answering questions on the test. It is explained in research Rifqiawati et al. (2017) that science process skills in grouping or classification indicators can be obtained when students are able to interpret experiences related to the surrounding environment.

Questions on the interpreting indicator are structured in the form of a statement whose answer is a conclusion. Learners are asked to choose which conclusion is correct according to the existing statement. Based on the results of the tests that have been carried out, the interpreting/interpreting indicator obtained a percentage of the value in cycle I with a fairly good category which then increased in cycle II to a very good category. This interpreting indicator is the highest science process skill indicator obtained by students in answering the test. This can be due to the ability to interpret students will work more when there are several answer choices that have been presented.

The next indicator of science process skills is hypothesizing. The questions on this hypothesizing indicator are arranged with questions that aim students to formulate hypotheses as the answer. Based on the tests that have been carried out, the hypothesizing indicator obtained a percentage in cycle I with a poor category which increased in cycle II to a good category.

The fifth indicator or the last indicator is the ability to apply concepts. The questions on this indicator are arranged by presenting the concept in a question. It is intended that students can understand more deeply the material previously learned. Based on the results of tests that have been carried out, the indicator of applying concepts is the lowest indicator owned by students. The percentage of values obtained in cycle I was in the poor category and in cycle II obtained a score in the good enough category. There are still many students who answer incorrectly in the question of applying concepts.

Conclusion

Based on the results of research, data analysis and discussion, it can be concluded that the application of the Discovery Learning model on biodiversity material at SMA 1 Gorontalo can improve students' science process skills. The results of the six indicators of science process skills, namely observing, classifying interpreting, asking questions, hypothesizing and applying concepts measured, obtained a percentage with an average in cycle I of 70.42% and in cycle II of 81.37%. The N-Gain score obtained was 0.59 or the value was 0, 3 0, 3 ≤ g ≤ 0.7 in the medium category. The achievement of student learning outcomes as measured by objective question tests also showed an increase in the average value in cycle 1 worth 55% and in cycle 2 worth 76%.

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Author Contributions

Conceptualization, H. A. M, S. N., and H. M. S.; methodology, S.N,; validation, L. M., and A. R,; data curation, S. N,; All authors have read and agreed to the published version of the manuscript.

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Conflicts of interest

The authors declare no conflict of interest.

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