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Practicum-Based Inquiry Learning to Improve Learning Outcome of Students at Senior High School

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Abstract

This study aims to determine the improvement of learning outcomes before and after being taught by practicum-based inquiry learning. Moreover, to analyze students' science process skills through practicum-based inquiry learning at SMA Negeri 1 Sukamakmur, Aceh Besar, Indonesia. The research was started with the preparation of learning outcomes test instruments and scientific process skills observation sheets. Furthermore, the two instruments were validated by two expert validations. The data analyzed are quantitative and qualitative. Quantitative data is in the form of learning outcomes data, while qualitative data from this study are from observations of science process skills. Learning outcomes data using statistical tests used to process learning outcomes data is the average difference test, namely the t-test. In contrast, the Science Process Skills data uses the percentage formula. This research is pre-experimental research with a one-group pretest and post-test design. Data analysis of learning outcomes was carried out using paired t-test, while science process skills used the percentage formula. The results showed that the average pretest score of students in understanding the material was still low, while the average post-test score was much better. The pretest value is 47.83, while the post-test value is 76.28. In addition, normalization and homogeneity of data are also necessary. Based on the calculations, the normal results were obtained at the X-hit 3.85 and the post-test value of the normal data with the X-hit value 4.77. After the data is normally distributed, it is necessary to test the homogeneity of the data. If you look at the data homogeneity, it is found that the experimental and control classes are homogeneous with an F-hit of 1.25, which tells that the class has the same or homogeneous variance. The value of t_{hit} = 4.03 > t_{table} = 2.1. Thus it can be concluded that the cognitive learning outcomes of students taught using practicum-based inquiry learning are higher than conventional methods. This research shows that practicum-based inquiry learning does improve not only cognitive learning outcomes but also effective ones.

Kata Kunci:
Pembelajaran Inkuiri;
Berbasis praktikum;
Hasil Belajar

Abstrak

Tujuan penelitian ini adalah untuk mengetahui peningkatan hasil belajar sebelum dan sesudah diajarkan dengan pembelajaran Inquiri berbasis praktikum, dan menganalisis tingkat kemampuan keterampilan proses sains siswa melalui pembelajaran Inquiri berbasis praktikum di SMA Negeri 1 Sukamakmur, Aceh Besar, Indonesia. Penelitian akan diawali dengan penyusunan instrumen tes hasil belajar dan lembar observasi keterampilan

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proses sains. Selanjutnya kedua instrumen tersebut divalidasi oleh beberapa validator. Data yang dianalisis adalah data kuantitatif dan kualitatif. Data kuantitatif berupa data hasil belajar, sedangkan data kualitatif dari penelitian ini yaitu data hasil observasi keterampilan proses sains. Data hasil belajar melakukan uji statistik yang digunakan untuk mengolah data hasil belajar adalah uji perbedaan rata-rata yaitu uji t sedangkan Data Keterampilan Proses Sains menggunakan rumus persentase. Penelitian ini merupakan penelitian pre-eksperimen dengan desain adalah *One group pretest and postest design*. Analisis data hasil belajar dilakukan dengan menggunakan uji t berpasangan, sedangakan keterampilan proses sains menggunakan rumus persentase. Hasil penelitian menunjukkan Nilai rata-rata pretes siswa dalam memahami materi masih rendah sedangkan nilai rata-rata postes jauh lebih baik. Nilai pretes yaitu 47,83 sedangkan nilai postes yaitu 76,28. Selain itu juga perlu dilakukan normalisasi dan juga homogenitas data. Berdasarkan perhitungan maka didapatkan hasil normal pada X^2_{hit} 3,85 dan nilai postes data normal dengan nilai X^2_{hit} 4,77. Setelah data berdistribusi normal maka perlu diuji homogenitas data, jika dilihat homogenitas data didapatkan bahwa kelas experimen dan juga kontrol homogen dengan F_{hit} yaitu 1,25 sehingga dapat disimpulkan kelas memiliki varians yang sama atau homogen. Nilai $t_{hit} = 4,03 > t_{tabel} = 2,1$ dengan demikian dapat disimpulkan bahwa hasil belajar kognitf siswa yang diajarkan menggunakan pembelajaran inkuiri berbasis praktikum lebih tinggi daripada metode konvensional. Penelitian ini menunjukkan bahwa pembelajaran inkuiri berbasis praktikum tidak hanya meningkatkan hasil belajar kognitif saja, melainkan afektif pula.

INTRODUCTION

Biology learning is one way to increase knowledge, skills, attitudes, and values as well as responsibility for the environment, society, nation, and country who are loyal and devoted. Biology is related to how to systematically know and understand nature so that learning biology is not only for mastering a collection of material, knowledge in the form of facts, concepts, principles but also a process of discovery so that students are required to think critically and creatively (Ali Sadikin, Ferdiaz Saudagar, 2018). Biology learning also contributes to building human resources with character, with the characteristics of knowledge and the nature of learning, which always emphasizes the process. In addition, product and its application are very strategic to develop the skills and behavior of students because, in principle, biology is one of the subjects in schools that has various visions and missions that must be realized (Anif, 2016). Among the things to be recognized in biology are trying to educate students with superior knowledge and skills, have a work ethic, train to research by scientific processes or methods. In addition, the student can learn by applying their best ability, have a disciplined, honest and responsible attitude. In addition, sensitive, responsive and active in solving the problems in their environment also other achievements in learning biology (Tivani et al., 2016).

The characteristics of science and the nature of Biology learning, which always emphasizes the process, product, and application, make biology one of the lessons that significantly contribute to building human resources (HR) with character (Lepiyanto, 2010). However, in reality, many students still consider Biology an uninteresting subject that results in low student learning outcomes (Jayawardana et al., 2020). The results of initial observations at SMA Negeri 1 Sukamakmur found that about 37.2% of students scored below the KKM in Biology. In addition, the results of initial interviews with teachers also obtained information that practicum activities are still rarely carried out at the school so that students' understanding is only limited to concepts, not profoundly appreciated. This is one of the causes of low student learning outcomes, so we need an appropriate form of the learning process in teaching a concept to improve student learning outcomes (Reflianto et al., 2019). One of the lessons that are thought to be appropriate to be applied is practicum-based inquiry learning. Learning with an inquiry approach that requires students to find and solve their problems is believed to increase students' problem-solving abilities so that student learning outcomes also increase. In addition, in implementing the practicum-based

inquiry learning process, science process skills are also needed to help students understand the material based on practical steps such as classifying, observing, communicating, asking questions, and interpreting (Nurul Afdhilla Asy'syakurni, Arif Widiyatmoko, 2015).

Based on research by Elster (2011), the inquiry is a scientific activity involving various activities that include observing, asking questions, evaluating books and other sources of information that looks at what has been understood, then planning an investigation, reviewing what is already there known. Based on probing evidence, using tools to collect, analyze, and interpret data, propose answers, explain and predict, and think logically and consider alternative explanations through finding answers to questions.

Meanwhile, to pay attention to the novelty of the research, the researcher describes the relevant research in this study. As researched by (Sulistina et al., 2010) with the title "Use of Open Inquiry and Guided Inquiry Learning Methods in Improving Chemistry Learning Outcomes of Students of SMA Laboratorium Malang Class X, their research results are from the results of cognitive, psychomotor, and cognitive assessment tests. Affective values are 72.16, 79.69, and 80.58, respectively. The open investigation also improves student achievement; their average cognitive, psychomotor, and affective scores were 63.39, 80.25, and 81.43, respectively. In contrast to the previous two methods, the conventional method is obtained less; the students' average cognitive, psychomotor, and affective learning outcomes were 54.14, 70.42, and 78.65, respectively. Furthermore, research from (Tri Sundari & Heliawati, 2017) with the title "Practice-based guided inquiry learning on the topic of reaction rates." The results show a significant difference between the concept mastery of students participating in practice-based guided inquiry learning (average 80.7) and conceptual mastery of students participating in traditional learning (average 74.8). Students' scientific attitudes also showed a significant difference between students participating in practice-based guided inquiry learning (mean 3.2) and students' scientific attitudes following traditional learning (mean 2.2). Thus, it can be concluded that guided inquiry in practice-based learning can improve students' mastery of scientific concepts and attitudes. Furthermore, research from (Walil & Fuadi, 2020) with the title "Practice-Based Inquiry Learning on the Concept of Biodiversity to Improve Student Learning Outcomes and Responses at SMA Negeri 11 Banda Aceh City". 2.01. The results showed that student learning outcomes increased with practicum-based inquiry learning on the concept of biodiversity, with an average N-Gain value of 52.3. In general, for students' responses, practicum-based learning is desirable because it can observe biological objects studied directly and increase student learning motivation. All students enthusiastically followed the practicum until it finished.

Based on some of the studies described above, the author's research is complementary to previous studies. However, this study has a different focus of discussion, namely, examining practicum-based inquiry learning to improve student learning outcomes.

It must be admitted that the inquiry learning model is one of the learning models that refers to the 2013 curriculum. According to Straits and Wilke, the inquiry learning model is a learning model that plays an essential role in building a constructivist learning paradigm that emphasizes the active learning of students (Jufri, 2010). In the learning process, all activities carried out by students are directed to seek and find their answers to a question, which is expected to improve science process skills (Sanjaya, 2012).

Science process skills are skills used by scientists in conducting scientific investigations (Kemendikbud, 2013). Process skills need to be developed in science learning because they can bridge science learning goals by providing direct experience through scientific investigation. Based on the problems that have been raised, the researchers are interested in making a study with the title "Practice-Based Inquiry Learning to Improve Student Learning Outcomes at SMA Negeri 1 Sukamakmur Aceh Besar".

METHODS

This research is conducted at SMA Negeri 1 Sukamakmur, Aceh Besar. The reason for choosing this place as a research location is that SMA Negeri 1 Sukamakmur is one of the schools open to innovations, making it easier for researchers to conduct research. The population in this study was all students of class X science at SMA Negeri 1 Sukamakmur, while the research sample was students of science class X with 32 students. The sample selection in this study used a purposive sampling technique because of the mollusk and arthropods material practicum

This study uses a quantitative and qualitative approach. This research is an experimental study because researchers want to know the effect of giving a treatment, namely learning with an inquiry approach to the research sample. The experiment used is a pre-experimental type with a one-group pretest and post-test design [12].

Experiment class A : O X O

Where : A: Class random sample selection
O: *pretes*t and *postest*
X: Learning with an Inquiry Approach

The data in this study were obtained from learning outcomes test instruments and science process skills observation sheets. The learning outcome test uses a multiple-choice test with five answer choices that measure students' cognitive abilities. Each correct answer is given a score of 1, while the incorrect answer is given 0. The test questions are given before and after learning. The ability of science process skills was measured using an observation sheet. The observations made are direct so that the appearance of the Science Process Skills (KPS) of students with the five senses can be seen directly. The instrument used to filter the data is adjusted to the indicators of science process skills based on predetermined criteria.

The data analyzed are quantitative and qualitative. Quantitative data is in the form of learning outcomes data, while qualitative data from this study are from observations of learning skills. Statistical tests used to process learning outcomes are the average difference test, namely the t-test, while the Science Process Skills data uses the percentage formula. The percentage formula is:

$$P = \frac{F}{N} \times 100\% \qquad \text{(Sugiono, 2014)}$$

Information :

P = Percentage
F = frekwensi
N = Number of samples
100% = konstanta

Table. 1 Evaluation Science Process Skills

Category	Science Process Skills Criteria
Very not good	25 % - 43,75 %
Not good	43,76 % - 62,50 %
Good	62,51 % - 81,25 %
Very good	81,26 % - 100 %

(Sugiono, 2014)

FINDINGS AND DISCUSSIONS

Practicum-Based Inquiry Learning

The ability observed in practicum-based inquiry learning is the ability to master the concepts or student learning outcomes and science process skills. Student learning outcomes are taken in two stages: the student's initial knowledge stage (pretest) and final knowledge (post-test). The biology learning skills of students observed were the process of practicum activities on the concept of Mollusca and Arthropoda.

Learning Outcomes

From the learning process on the concept of Mollusca and Arthropoda, we obtained the average value of the pretest and the average value of the protest. The results show that the average value of the pretest of students in understanding the material is still low, while the average value of the post-test is much better. The pretest value is 47.83, while the post-test value is 76.28. In addition, normalization and homogeneity of data is also necessary. Normality of the data is done to determine whether the data obtained is normally distributed or not. Based on the calculations, the normal results were obtained at the X-hit 3.85 and the post-test value of the normal data with the X-hit value 4.77. After proving that the data is normally distributed, it is necessary to test the homogeneity of the data. If you look at the uniformity of the data, it is found that the experimental and control classes are homogeneous with an F-hit of 1.25. Thus it can be concluded that the class has the same variance or is homogeneous.

Based on data analysis results, it can be concluded that the cognitive learning outcomes of students who are taught using practicum-based inquiry learning are higher than conventional methods. This research shows that practicum-based inquiry learning improves cognitive learning outcomes and a practical approach in education.

Practical-based inquiry learning can train students to practice being scientific in learning. According to Sumantri and Permana (2001), the inquiry method allows a scientific attitude and raises students' curiosity. By finding their own, students feel delighted, which later leads to mental satisfaction as an intrinsic value of students fulfilled.

In practicum-based learning, the teacher acts as a facilitator, not as a giver of information. It is the students who actively build concepts and align them with their initial knowledge. Productive questions are asked by the teacher as long as students carry out practical activities, helping students to think and build concepts. Ambarsari (2012) stated that an inquiry approach is an approach that can create more effective learning than conventional approaches. In the inquiry approach, students do more activities in learning than in the traditional method and can improve basic science process skills. Inquiry activities provide a brilliant opportunity to build knowledge through discovery.

The final ability of students who are taught using inquiry learning on the concept of Mollusca and Arthropoda can be seen from the comparison of the average pretest score and the post-test average value (Figure 1)

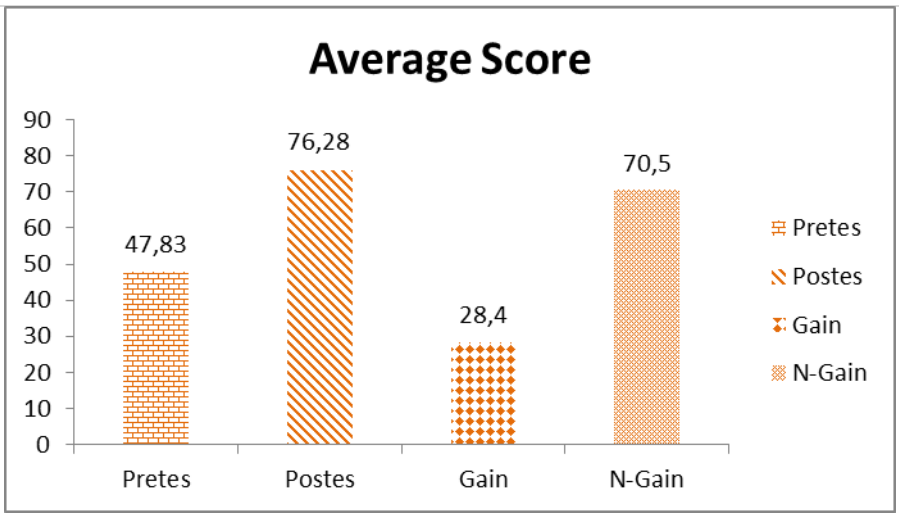

Figure 1. The average score of test results

The class data tested showed that the average value was obtained as follows. The average value of the pretest reached 47.83, and for the post-test, it reached 76.28. The gain value is 28.4, and the N-gain is 70.5.

The score of concept comprehension of experimental class students is better than the control class. The analysis of learning outcomes can prove that inquiry-based practicum can improve students' conceptual understanding of Mollusca and Anthropoid topics because the quest for knowledge involves students building concepts into their minds. Inquiry learning activities in this study involve actively capturing material patterns' regularity and then interpreting the material in other forms (Nirmalasasi, 2011).

The value of understanding the concept of experimental class students is better than the control class. The analysis of learning outcomes can prove that inquiry-based practicum can improve students' conceptual understanding of Mollusca and Anthropoid material because the search for knowledge involves students building concepts into their minds. Inquiry learning activities in this study involve students actively capturing material patterns' regularity and then interpreting the material in other forms (Nirmalasasi, 2011).

Based on the research results, the ability of students taught with practicum-based inquiry learning improves student learning outcomes on the concept of biodiversity. The increase in learning outcomes was seen from the post-test results given by the researchers after the learning process. Although students have to read with this model, students are more focused on understanding theory and discussion.

Learning using practicum-based successfully creates conditions in such a way that overall, students are active in learning. The implementation of practicum in learning biology concepts of mollusks and anthropods at SMA Negeri 1 Suka Makmur can help students: (1) make practicum more interesting, (2) practice finding a problem-solving, (3) encourage accurate observation and exploration to improve attitudes student discipline, (4) build and maintain curiosity about the practicum carried out, (5) increase and develop students' self-confidence so that they can communicate and work well.

The analysis results show that students' inquiry abilities can be seen that students who have good inquiry abilities have better learning outcomes. However, some have good inquiry abilities but have poor learning outcomes. It is the same with previous research (Walil & Fuadi, 2020), which increased learning outcomes. This can happen because student learning activities require students to discuss in the data analysis stage, while individual activities form hypotheses and draw conclusions. So that in general, students have scores that are almost the same at the data analysis stage and different at the stage of formulating hypotheses and drawing conclusions.

Science Process Skills

In the implementation in the field, the researcher was assisted by several observers to see the emergence of science process skills in each group. Assessment of science process skills was also carried out using observation sheets. The indicators observed were observing, classifying, predicting, asking questions, and interpreting.

Table 2 Average Appearance of Science Process Skills based on Observation Sheet

No	Type KPS	Meeting		Total	Average
		I	II		
1	Observation	67,2	90,5	157,7	78,85
2	Clarification	60,8	80,2	141	70,5
3	Communication	60	81,1	141,1	70,55
4	Questioning	62,2	76,1	138,3	69,15
5	Interpreting	60	80	140	70

Table 2 shows that the emergence of science process skills with the highest percentage appearing is observation/observing process skills with an average of 90.5 and is included in the excellent category. Science process skills with the most negligible percentage of interpreting and communication with an average of 60 are included in the poor category. The highest increase in science process skills at the first and second meetings is the observing indicator in the high class because students are maximal in making observations during the experiment using many senses. In addition, by using an inquiry practicum, students are more thorough in observing all the symptoms to obtain observational data to be analyzed to conclude (Kurnia, 2011).

a. Observation/Observation Process Skills

The most common biology learning process skills, namely KPS, observed a significant increase in the 1st meeting with an average of 67.2, while the second meeting obtained an average of 90.5. This shows that practical-based inquiry can be used in developing observation process skills. Observation process skills appear a lot because this skill is a fundamental ability of students that is often done in everyday life. Through observation activities, students learn about the world around them. Students observe objects and natural phenomena with sight, hearing, touch, smell, and taste. The observation activities carried out in this study were not so complicated with the number of objects that were not too many so that their appearance was significant, in the sense that all students carried out observation activities. In this case, it is reinforced by (Agung W Subiantoro, 2008) that the observation process skills appear a lot due to students' basic skills that are often done in everyday life.

b. Classification Process Skills

Based on the research data in Table 2, the classification process skills are included in the good category with an average of 65.25. In the field activities, some students can distinguish the types of species, genes and some students are still mistaken between the different types of species and genus. However, when given a question about the meaning of species and genus, students can answer it. Apart from the fact that some students are still wrong in the grouping, it is possible because the aspects of the objects observed are not too diverse.

c. Communication Skills

The communication process skills in Table 2 show that with the implementation of practical-based inquiry, most students have not conveyed ideas or opinions orally during the discussion. Several possibilities make students unable to be actively involved during the conference, one of which is because students are not accustomed to expressing ideas or ideas during learning. Usually, the teacher only chooses a few students to do this. During the discussion,

only students accustomed to being chosen by the teacher can easily express their observations and opinions. Therefore, communication skills that appear more are written communication skills because students do it more often than verbally communicate (Agung W Subiantoro, 2008).

d. Questioning Skills

The skills to ask and answer observed questions showed that the overall students' asking skills were good. According to the results of Oktiyani Rusdi's research (2007) on one of the state high school students in Bandung, learning through the practicum method can develop students' skills by mentioning examples and drawing conclusions from the results of investigating.

e. Interpreting Skills

Science process skills with the most petite, average interpreting skills are 60 at meeting 1. Interpreting skills are the least because students have not interpreted what their friends and teachers have said. However, some students are still not sure what they want to convey.

For more details in the explanation of science process skills, see Figure 2.

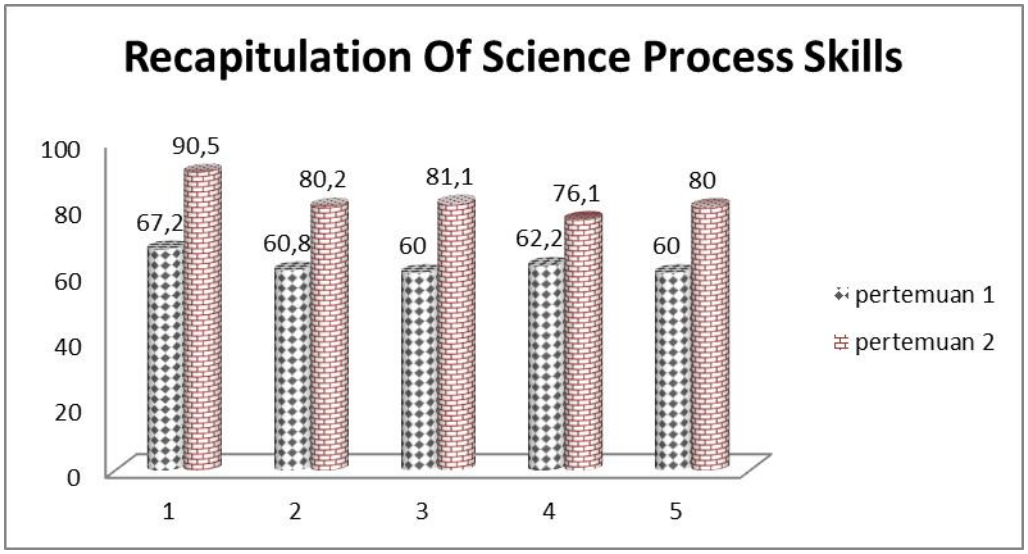

Figure 2. Graph of Science Process Capability

Based on Figure 2, there is an increase in the ability of the scientific process on the concept of Mollusca and anthropod. The highest indicator is observing in the excellent category. This inquiry-based practicum can increase students' curiosity about using tools and result in students being more prepared to carry out practicals to show the relevance of each indicator of science process skills (Haryani, 2007).

CONCLUSION

Based on the results of research on practicum-based inquiry learning on the concepts of Molluscs and anthropods to improve student learning outcomes and science process skills, it can be concluded that the learning process on the concept of Mollusca and Arthropoda obtained the average value of the pretest and the average value of the protest. The average value of students' pretest in understanding the material is still low, while the average value of the post-test is much better. The pretest value is 47.83, while the post-test value is 76.28. Based on the calculations, the normal results were obtained at the X-hit 3.85 and the post-test value of the normal data with the X-hit value 4.77. Then the experimental class and homogeneous control with F-hit is 1.25. Based on the results of data analysis, it can be concluded that the cognitive learning outcomes of students who are taught using practicum-based inquiry learning are higher than conventional methods. This research shows that practicum-based inquiry learning does improve not only cognitive learning

outcomes but also its effectiveness. Practical-based inquiry learning can train students to practice being scientific in learning. Practical-based learning is also that the teacher acts as a facilitator.

The ability of students' science process skills on the Mollusca and Arthropoda concepts through practicum-based inquiry learning shows that the emergence of science process skills with the highest percentage appearing is an observation/observing process skills with an average of 90.5 included in the excellent category. The most emerging biology learning process skills, namely KPS, observed a significant increase in the first meeting with an average of 67.2. In contrast, the second meeting obtained an average of 90.5, and classification process skills were included in the good category with an average of 65.25. The skills to ask and answer questions were observed, which showed that the overall category of students' asking skills was good. Science process skills with the least average interpreting skills are 60 at the first meeting. The communication process skills show that with the implementation of practical-based inquiry, most students have not been able to convey ideas or opinions orally during the discussion. Interpreting skills are at the least because students have not interpreted what was meant by their friends and teachers.

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