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## **Quality of Biology Laboratory SMA Muhammadiyah 1 Simo Boyolali Academic Year 2023/2024**

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### **ABSTRACT**

**KEYWORDS:**

*Laboratory  
Biology Learning  
Infrastructure  
Laboratory  
Laboratory Quality  
Practicum*

The laboratory is one of the facilities available at school as a support for learning biology. The fulfillment of facilities and infrastructure in the biology laboratory will affect the success of learning. Biology learning does not only include theory but also direct practical activities. Therefore, to support the success of practicum-based learning, a biology laboratory must have adequate facilities and infrastructure by the minimum standards listed in Permendiknas Number 24 of 2007. This research aims to determine the quality of the biology laboratory at SMA Muhammadiyah 1 Simo Boyolali in the academic year 2023/2024. This research uses a qualitative descriptive method with data collection techniques in the form of observation and interviews. The results of this study indicate that the quality of the laboratory at SMA Muhammadiyah 1 Simo Boyolali has good criteria with a percentage of 78,31%, where these results are still lacking in meeting the minimum standards listed in Permendiknas Number 24 of 2007. This research concludes that the quality of the biology laboratory is classified as good even though it has not met the minimum standards by Permendiknas Number 24 of 2007.

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## **1. INTRODUCTION**

The laboratory is a place where students can gain skills in demonstration, experimentation, and science development. In addition, laboratories have a very important role in science learning at school because, with the activities in the laboratory, students are expected to foster interest in laboratory activities (Munarti and Sutjihati 2018). Laboratories are very important for the advancement of teaching and the development of an increasingly complex curriculum. Laboratories can also affect the development of schools, colleges, and Islamic boarding schools. Each unit of educational institution must have a laboratory room to improve the quality of education. Therefore, an educational institution must optimize the use of laboratories to achieve the teaching and curriculum objectives (Harahap et al. 2017). Laboratories in schools help students learn scientific attitudes and knowledge and test theories with facts (Balqis et al. 2018).

A laboratory is a place where students can learn and develop process skills in practical activities directly in the laboratory through experiments and simple research activities (Laeli and Maryani 2020). However, the ability of students to utilize laboratory space is still considered lacking. To anticipate this, the biology laboratory must always be in a ready-to-use state, the infrastructure and media in it must be in good condition, and various administrations must work well (Nulngafan and Khoiri 2020). Therefore, the laboratory is an important component of classroom learning, especially biology. Learners must be present in the laboratory to get a direct understanding of how the theory they have previously learned. After the theory is obtained,

students can take part in practical activities in the laboratory as a support for the biology learning process (Aritawarni et al. 2023).

Biology is a science that continues to develop and can be understood through scientific processes in particular activities. This means that learning biology is not only mastering a collection of data in the form of natural diversity and living things but also a discovery process (Purnama et al. 2017). The skills to know and understand various phenomena that occur in nature are important in learning biology. So practical activities or experiments are an inseparable part of biology. Therefore, in improving students' ability to explore the surrounding nature naturally, biology learning must be emphasized on direct experience, because biology learning becomes less optimal if there is no real experience from students through practical activities (Mastika et al. 2014).

Biology learning includes practical activities both inside and outside the laboratory. The practicum must also be equipped with biological facilities and infrastructure that meet the minimum laboratory standards set out in Permendiknas Number 24 of 2007 (Siregar et al. 2023). According to Permendiknas Number 24 of 2007 which explains that the biology laboratory room functions as a place for the implementation of biological assessment activities both in theory and in practice which requires special and adequate equipment. The biology laboratory room must be able to meet at least one class of study, besides that it must have good lighting when carrying out object observations. The types of infrastructure that must be contained in the biology laboratory room are; (1) Building / Laboratory Space (2) Furniture, (3) Educational Equipment (4) Tools and Materials, (5) Educational Media, (6) Consumables, and (7) Other Equipment.

To ensure that biology laboratories in schools remain available and their facilities and infrastructure can be used for a long time, laboratories must be assisted with proper care and maintenance. Given that the laboratory is one of the learning methods where students can apply the theory or knowledge they learn directly through practicum, demonstration, and skills (Rifa'i et al. 2021). Therefore, it is important for an educational institution that has a laboratory space, especially biology, to maintain the quality of the laboratory so that it can be used as a learning support.

SMA Muhammadiyah 1 Simo is one of the oldest private schools in the Boyolali Regency. The facilities and infrastructure in the school are good enough to support learning including the biology laboratory. However, the biology laboratory has facilities and infrastructure that do not meet the minimum laboratory standards set out in Permendiknas Number 24 of 2007 such as the lack of practicum materials, tools that are not maintained and neatly arranged, and the absence of a laboratory assistant. This is the same as the results of Munarti and Sutjihati's (2018) research on five high schools (SMA PGRI 4, SMAN 7, SMAN 4, SMA PGRI, and SMA Al-Nur), which found that the facilities and infrastructure in these schools when observed in total still cannot be said to meet the standards as stated in the Permendiknas Number 24 of 2007. Then another study found that the biology laboratories of the four secondary schools in Pontianak City had standard B because five criteria were met, namely at least one rumble was accommodated in one room, adequate facilities, well-maintained and clean conditions, but SMAN 05 did not meet the standard room area, but in laboratory utilization, SMAN 05 more often carried out practicum than other high schools, while two high schools were in category E because they did not meet the existing criteria (Adilah et al. 2021).

Based on the description above regarding the importance of the completeness of facilities and infrastructure contained in the laboratory, the researchers are interested in examining the

quality of the laboratory as a support for biology learning. This study aims to determine the quality of the biology laboratory of SMA Muhammadiyah 1 Simo in terms of laboratory facilities and infrastructure by the minimum standards set out in Permendiknas Number 24 of 2007.

## 2. MATERIALS AND METHODS

### 2.1. Types of Research

This research uses descriptive qualitative research where the method is a research method that describes the state of the object under study by the situation and conditions in the field and the data from this research is not in the form of numbers but in the form of value categorization (Sugiyono 2017).

### 2.2. Place and Time of Research

This research was conducted in the biology laboratory of SMA Muhammadiyah 1 Simo Boyolali at Jl. Madu No.152, Ngreni, Simo, Simo, Boyolali, Central Java 57377. This research was conducted from January to May 2024.

### 2.3. Population, Sample, and Sampling

The population in this study were all those involved in using the biology laboratory of SMA Muhammadiyah 1 Simo. Samples taken in this study were biology laboratories, laboratory heads, and biology teachers. This study used a sampling technique, namely purposive sampling because this technique is by the research, namely by selecting samples based on groups or areas through certain considerations and criteria and is believed to represent all that will be analyzed.

### 2.4. Data and Data Source

**Table 1.** Data and Data Sources

<b>Data</b>	<b>Source</b>	<b>Method</b>	<b>Instrument</b>
Laboratory room	Biology laboratory	Observation	Observation sheet
Completeness facilities and infrastructure according to Permendiknas Number 24 Tahun 2007	Biology laboratory	Observation	Observation sheet

### 2.5. Data Collection Techniques

#### 2.5.1. Observation

Observations were made directly to the research location to collect data in the field, Observation data is in the form of an observation sheet instrument that contains a checklist (v) to obtain data from observations regarding the quality of the laboratory including the laboratory room and the completeness of laboratory infrastructure facilities that refer to Permendiknas Number 24 of 2007.

#### 2.5.2. Interview

Interviews were used to complement laboratory data regarding the quality of facilities and infrastructure in supporting biology learning.

### 2.6. Research Procedure

This research was conducted through three stages, starting from the preparation stage to determine the sample, compile research instruments in the form of observation sheets of laboratory space and infrastructure, interview lists, and make a permit for research. The second stage is the implementation of research to collect the required data. The last stage is the analysis of research data.

### 2.7. Data Analysis Techniques

This research data analysis technique uses qualitative descriptive techniques with the formula:

$$\text{Score} = \frac{\text{Skor perolehan}}{\text{Skor maksimal}} \times 100\%$$

Then the value is categorized as follows:

- 81 – 100 % : Excellent
- 61 – 80 % : Good
- 41 – 60 % : Enough
- 21 – 40 % : Less
- 0 – 20 % : Very Lacking

(Agustina et al. 2019).

## 3. RESULTS AND DISCUSSION

Laboratories play an important role in curriculum development and more complex teaching. All biology laboratories must have facilities or tools that are by the standard infrastructure according to Permendiknas Number 24 of 2007. These tools can be used in classroom demonstrations, lab work, and observations in the school environment (Romadhoni and Saifuddin 2021). The quality of the laboratory itself is very important to support the practicum-based biology learning process. By optimizing the right facilities and infrastructure, students' understanding of concepts and learning outcomes will be more optimal. This will also affect the result of the learning objectives. In addition. The learning process using laboratories and practicum can improve and foster students' scientific attitudes (Sinangkling et al. 2022).

**Table 2. Observation Result Data**

Variables	Aspects	Percentage (%)	Description
Biology laboratory facilities and infrastructure	Laboratory Room	87.5	Excellent
	Furniture	50	Enough
	Education Equipment	88.52	Excellent
	Education Media	100	Excellent
	Consumables	53.85	Enough
	Other Equipment	90	Excellent
<b>Average</b>		<b>78.31%</b>	<b>Good</b>

Based on Table 2. it is known that the quality of the biology laboratory of SMA Muhammadiyah 1 Simo has a good quality category which obtained an average of 78.31%, which means that the laboratory has not fulfilled 100% of the minimum standards listed in Permendiknas Number 24 of 2007, but this laboratory is sufficient to support biology learning activities. Biology laboratories must have adequate facilities so that practice-based learning such as practicum activities can run optimally (Lubis and Rizkika 2017). From the observation data that has been done, the biology laboratory room of SMA Muhammadiyah 1 Simo has very good criteria with a percentage of 87.5%. The biology laboratory is separate from other laboratory rooms, namely physics and chemistry laboratories, but the biology laboratory room at SMA Muhammadiyah 1 Simo is used as a classroom. According to the results of interviews with the head of the laboratory and biology teachers, due to limited space and land, this laboratory is used as a classroom XI-2. Therefore, this makes it difficult for teachers to do conditioning if there are classes that have practicum schedules. So the solution taken is to do practicum in each of these classes that have a practicum schedule. This is in line with the research of Lestari et al. (2017) that one of the obstacles experienced by teachers in several schools is that biology laboratories are converted into classrooms because of an imbalance between the number of students and available classrooms.

Laboratory environmental conditions also need to be considered, among others, with an adequate air circulation and ventilation system, and a room temperature that is maintained constant and safe from interference (Maharani and Sasi 2019). The biology laboratory room of SMA Muhammadiyah 1 Simo is equipped with good lighting and circulation so that students can read books and observe experimental objects. The storage room for tools and materials is located separately from the experimental room and already has a minimum standard area of 18 m<sup>2</sup>, but the storage room has a less clean and untidy condition. The laboratory room also has clean water located outside the laboratory room.

The condition of the facilities in the form of furniture in the biology laboratory of SMA Muhammadiyah 1 Simo has a percentage of 50% with enough category. The category shows that the furniture facilities of the laboratory have not met the minimum standards of Permendiknas Number 24 of 2007. Of the 7 aspects observed, only chairs, material cabinets, and tool cabinets are by the standards. The learner's table is a table that is generally located in the classroom, which is only for 2 students because it adapts to the condition of the room used as a classroom. This biology laboratory room does not have a preparation table, demonstration table, or sink either in the laboratory room for experiments or in the preparation room. The result is that, if the biology laboratory does not have furniture facilities that meet the standards, it will hurt the effectiveness of practicum-based laboratory learning (Sinangkling et al. 2022).

Furthermore, for the aspect of laboratory facilities in the form of educational equipment, the observation data obtained an average percentage of 88.52% with an excellent category which can be interpreted that the aspect of educational equipment is good in achieving the minimum standards of Permendiknas Number 24 of 2007. This aspect of educational equipment is divided into 2 parts, namely teaching aids and experimental tools and materials. Teaching aids used in practicum are used to improve students' psychomotor abilities through tools that can be seen, held,

assembled, or changed in shape (Dewi et al. 2021). The teaching aids have 25 aspects that are observed, among these 25 aspects, 4 aspects do not comply with the standard, namely mitosis preparations, meiosis preparations, plant anatomy preparations, and animal anatomy preparations. The components of the teaching aids are not by the minimum standards contained in Permendiknas Number 24 of 2007, this is because the preparations of mitosis, meiosis, plant anatomy, and animal anatomy should be 6 pieces/lab, but this laboratory only have 3 pieces/lab, besides that the condition of the preparations is also poorly maintained.

Another part of educational equipment facilities is experimental tools and materials. According to Permendiknas Number 24 of 2007, there are 36 aspects observed in the category of experimental tools and materials. Of these 36 aspects, 13 tools and materials are lacking in meeting the minimum standards, including monocular microscopes, binocular stereo microscopes, preparation boxes, stopwatches, three legs, stative rod devices, universal clamps, bossheads, gauze, thermometers, respirometers, squares, and experimental instructions. The tools and materials that have been mentioned are still lacking in meeting the minimum standards listed in Permendiknas Number 24 of 2007 due to the number that does not meet the standards and the lack of maintenance carried out by laboratory staff. This is also because the biology laboratory at SMA Muhammadiyah 1 Simo does not have a laboratory assistant. The results of interviews with the head of the laboratory and biology teachers stated that laboratory equipment and materials also do not have codes and specifications for their use, but only names. In addition, all preparations and implementation in practicum learning are carried out by biology subject teachers themselves because they do not yet have a laboratory assistant. Munarti and Sutjihati (2018), state that the management of laboratory equipment and materials is very important because it involves work safety in the laboratory. It is better if the tools and materials that will be used during the practicum are prepared in advance by the laboratory assistant. The absence of laboratory assistants is a challenge for teachers, because before practicum teachers must prepare everything themselves, including cleaning and checking. Laboratory assistants are very important in optimizing practicum activities, starting from the preparation of tools and materials to the evaluation after practicum activities are carried out.

Learning media in education are tools, methodologies, and techniques used as intermediaries in communication between teachers and students. Used to improve communication and interaction between teachers and students during the learning process at school (Umar 2014). The condition of educational media has a percentage of 100% with an excellent category. It can be interpreted that the educational media in the biology laboratory has met the minimum standards listed in Permendiknas Number 24 of 2007 having 1 media in the form of a blackboard with a minimum size of 90 cm x 200 cm. The blackboard already has a position that allows all students to see it.

Table 2 shows the observation results of consumables that obtained a enough category with a percentage of 53.85%. This shows that the quality of consumables in the biology laboratory of SMA Muhammadiyah I Simo still does not meet the minimum standards by Permendiknas Number 24 of 2007. There are 13 aspects of consumables in the form of 12 chemicals and filter paper where these materials are materials that run out quickly and are not durable. Of the 13 materials, there are only 4 materials that meet the standards, namely glucose, universal indicators, KOH, and vaseline. In this aspect, 5 materials are not available in the laboratory including acetocarmine, eosin, iodine, MnSO<sub>4</sub>, and NaOH. Meanwhile, other materials such as acetocarmine, HCL, ethanol, and filter paper do not meet the standards because the amount does not meet the minimum standards of Permendiknas Number 24 of 2007. In addition, some materials are not maintained and are not suitable for use. The results of the interview also mentioned that the materials in the laboratory of SMA Muhammadiyah 1 Simo are still lacking, so practicum activities cannot run smoothly. Therefore, in practicum-based learning only utilize materials around and within reach.

The last aspect observed was other equipment, where this aspect obtained a percentage of 90% with an excellent category. This aspect of other equipment includes 5 components, namely contact boxes, fire extinguishers, first aid equipment, trash cans, and wall clocks. Of the 5 components,

only the contact box does not meet the standards, this is because the number does not meet the minimum standards of Permendiknas Number 24 of 2007, namely 1 piece on each student table, 2 pieces on the demo table, and 2 pieces in the preparation room. Generally, every laboratory in the school already has electricity that supports it, but considering the importance of a laboratory to meet the minimum standards listed in Permendiknas Number 24 of 2007, it is hoped that the SMA Muhammadiyah 1 Simo laboratory can improve the lack of the required number of ratios. When carrying out activities in the laboratory, it is prone to work accidents, therefore it is important to have first aid equipment in the laboratory to handle work accidents in the laboratory that can occur at any time. This is in line with the opinion of Hidayat (2021) that all laboratory rooms must have work safety equipment, especially first aid kits because they are very important for laboratory work procedures and can be a place of first aid when technical errors or accidents occur.

Interviews were conducted with the head of the laboratory and biology teachers. There were ten questions covering the state of the biology laboratory space, storage of practicum tools and materials, laboratory management, and constraints in managing and preparing the laboratory for practicum activities. From the interview results, it was found that the biology laboratory is separated from other laboratories such as physics and chemistry laboratories. However, besides being used for practicum activities, this laboratory is used as a classroom and sometimes for meeting rooms due to limited space and location. The tools and materials in this laboratory have not supported 100%, but approximately 80% have supported practicum activities by the material to be carried out for practicum activities. This is by the research results obtained, namely the facilities and infrastructure in this laboratory 78.31% have supported activities in the laboratory. Laboratory tools and materials are arranged according to their groups to make it easier when they are to be used, This is in line with the opinion of Romadhoni and Saifuddin (2021) that to reduce the risk of damage, laboratory materials require special treatment based on their properties and characteristics. But there are no codes and specifications for how to use them. The head of the laboratory and biology teacher said that the practicum was carried out at least once a month according to the material that had been delivered. An inventory of tools and materials is carried out at the beginning of the semester, which is approximately twice a year. If there is damage to laboratory equipment then the manager will make a table or list of tools that are damaged, but if the damage to the tool is caused by students, then students must replace the tool. In preparing the biology laboratory for practicum activities, biology teachers first check whether the tools and materials whether adequate to carry out practicum by the material, then conduct conditioning of students. In managing the laboratory, there are obstacle faced by the head of the laboratory and biology teachers including laboratory space which is used as a classroom so that teachers have dissiculty in conditioning the class, lack of practicum materials that are by the material so that they only use materials that are around the school environment. The results of this interview also obtained information that the biology laboratory at SMA Muhammadiyah 1 Simo does not yet have a laboratory assistant so all activities in the laboratory are carried out by each biology teacher.

#### **4. CONCLUSIONS**

Based on the research that has been done, it can be concluded that the quality of the biology laboratory of SMA Muhammadiyah 1 Simo Boyolali in the 2023/2024 academic year has a good category with an average percentage of all aspects observed, namely 78,31%. This shows that the laboratory is good at supporting practicum activities even though it has not met the 100% standard stated in Permendiknas Number 24 of 2007. However, aspects of laboratory space, educational equipment, educational media, and other equipment already have an excellent category in fulfilling the quality of the laboratory to support practicum-based learning activities.

## 5. ACKNOWLEDGMENTS

The researcher would like to thank the lecturers of Biology Education, Faculty of Teacher Training and Education, Universitas Muhammadiyah Surakarta who have helped in the process of working and publishing the article. The researcher also would like to thank the head of the laboratory and biology teacher of SMA Muhammadiyah 1 Simo, who have helped in the implementation of this research.

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