Analysis of Laboratory Utilization in Supporting Physics Learning: A Case Study at Metro Public High School 5

Riswanto, Wari Prastiti, Friska Octavia Rosa, Dian Utama Hartanto Setya Putra*, Febi Afifah, & Anggun Saputri
[1]Physics Education, Universitas Muhammadiyah Metro, Indonesia
*Corresponding Author: utamadian191@gmail.com

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Abstract - *This study aims to provide a more in-depth analysis of laboratory utilization at SMAN 5 Metro. The research employed a qualitative approach. The object of this study was SMAN 5 Metro, with class XI students and physics teachers as the research subjects. Data were collected through three techniques: observation, interviews, and questionnaires. The data analysis was conducted both during and after the data collection process. The analysis technique used was data triangulation, which involved comparing findings from the three data sources (observations, interviews, and questionnaires). Based on the results of the data analysis, it can be concluded that practicum activities at SMA Negeri 5 Metro are still conducted in the classroom, with teachers bringing practicum tools into the classroom to demonstrate and carry out experiments. In addition, practicum implementation has not been optimal due to improper laboratory utilization, the use of laboratory spaces that do not align with their intended functions, and the absence of laboratory assistants or technicians. These personnel are essential for managing laboratory administration, including maintaining inventory records of tools and materials, handling equipment loans, and organizing tools and materials according to their types and characteristics.*

Keywords*: Laboratory Use; Physics Learning*

INTRODUCTION

The Indonesian government has set eight criteria for education through Government Regulation of the Republic of Indonesia No. 19 of 2005, which includes content standards, learning processes, graduate competencies, qualifications of educators and education personnel, facilities and infrastructure, management, financing, and assessment. In accordance with the Regulation of the Minister of National Education No. 24/2007, laboratories are one of the facility and infrastructure requirements that must be met by every formal educational institution, including senior high schools (SMA). The laboratory aims to support learning through practicum activities.

According to Puspitasari et al. (2023), an important aspect in educational institutions is the laboratory that supports practical learning, especially in physics. Aini et al. (2019) also stated that the existence of a laboratory in physics learning is very important because the laboratory serves as a place to find facts, concepts, and scientific learning processes. In addition, Suseno (2019) also agrees that the laboratory is an extremely important facility in supporting the learning process at school. Sari and Roza (2020) added that "the laboratory not only plays a role as a support for learning activities, but also as an effort to improve the quality of teaching and learning activities so that students not only get theory in the classroom, but they can also prove the theory."

According to Anwar (2014), practicum carried out in the laboratory has several main objectives, one of which is to help form concepts and convey various natural phenomena in science to students. Another goal is to overcome students' misconceptions by providing concepts based

on real experiences. Emda (2017) also emphasized that the laboratory is an important part of the physics learning process because it is a place where a group of people can perform various tasks such as training, observation, research, and scientific testing. The laboratory approach combines theory and practice from various disciplines. According to Sarjono (2018), physics learning is also closely related to physics practicum because physics lessons are full of theories, concepts, laws, principles, and rules, all of which need to be proven through practicum. Physics practicum is closely related to physics laboratories in schools that contain various facilities supporting practicum activities. Physics lessons and laboratory activities cannot be separated, as both support each other.

The school physics laboratory is one of the most important learning resources to provide direct experience to students. Physics laboratories have a role in providing facilities that support the implementation of education and teaching, as well as providing facilities for conducting research in the field of physics. In addition, the physics laboratory also serves as a place to solve problems, explore facts, and hone scientific skills and thinking, instill and develop scientific attitudes, identify new problems, and so on (Aisyah and Yuliani, 2024). The utilization of physics laboratories as practicum locations in learning aims to enable students to improve their ability to understand and investigate natural phenomena scientifically. Laboratory activities also give students the opportunity to test and formulate hypotheses, design and assemble equipment, collect and analyze data, and compile reports. They can also convey the results of experiments orally and in writing (Kertiasa, 2006).

One of the public schools in Metro Lampung City that is supported with laboratory facilities and equipment is SMAN 5 Metro. However, this laboratory is not optimally used as a practicum site, so the great potential contained in it has not been fully utilized. The existence of the laboratory at SMAN 5 Metro should be a valuable asset in the learning process, especially in facilitating students' experiments and practicum. The sophisticated and complete equipment available should be a facility for students to dig deeper into scientific concepts and apply theories that have been learned in class. However, the reality in the field shows that this laboratory is often not utilized according to its function. According to Anggereni (2021), the functions of the laboratory itself are: 1) a place to develop skills and increase knowledge about physics concepts, 2) foster interest and motivate students in studying physics, 3) increase students' imagination and creativity so that they can spur inspiration in carrying out practicum activities in the laboratory, 4) as a means of solving problems so that clarity of the physics concepts being studied is achieved, and 5) foster students' confidence in studying physics.

An in-depth analysis of the factors that lead to the underutilization of laboratories at SMAN 5 Metro is important. These factors may involve aspects of the curriculum, human resources, school policy, or even awareness of the true potential of the facility. By identifying and understanding the root of these problems, it is hoped that a solution can be found that will have a positive impact on improving the quality of learning in the school. Through this article, the researcher will carry out an in-depth analysis of laboratory usage at SMAN 5 Metro. A better understanding of the constraints faced and possible solutions implemented can positively contribute to the development of education in this school. With the title "Analysis of Laboratory Utilization in

Supporting Physics Learning: A Case Study at SMA Negeri 5 Metro," this article is expected to be the first step toward optimal utilization of the available learning facilities.

RESEARCH METHODS

Research is a process in which researchers take logistical steps to obtain accurate and valid data and then make correct and appropriate conclusions (Sidiq and Miftachul, 2019: 1). This research uses a qualitative descriptive approach to describe in detail the state of the subject based on information in the field. This method was chosen because it has the ability to explain thoroughly and in depth the conditions, processes, and relationships or correlations between research subjects. In line with Wahyuningsih's statement (2013), a case study is research in which researchers explore a phenomenon or case in a particular activity or time and then collect detailed and in-depth information using various data collection procedures.

In this context, this study aims to investigate and describe laboratory utilization in supporting physics learning at SMA Negeri 5 Metro. The data collection methods used include observation, interviews, and questionnaires. Observations were conducted directly during classroom learning activities to analyze the problems that arise during physics learning. Furthermore, interviews were conducted with physics teachers to understand the problems and phenomena that occur during learning. Interview respondents were selected using a purposive sampling technique, where respondents were selected based on criteria relevant to the purpose of this study.

After obtaining data from observations and interviews, researchers distributed questionnaires to students of class X.1. This questionnaire was addressed to all students of class X.1 to find out their perceptions of the effectiveness of the laboratory in physics learning. In addition, researchers also obtained data from a literature review of previous research.

Data analysis was conducted using a qualitative descriptive approach with data triangulation techniques. Data triangulation was carried out to ensure data validity by comparing data from observations, interviews, and questionnaires. Winayarti (2019) explains that data triangulation is the use of more than two data sources in studying the same phenomenon in research to increase the validity of the results.

RESULTS AND DISCUSSION

The laboratory is a place where students learn to understand physics concepts in real terms through practicum. The role of laboratory personnel, such as laboratory technicians or laboratory assistants, is very important in supporting the improvement of the learning process in the laboratory (Purwanti and Ahmad, 2020).

According to the Regulation of the Minister of National Education of the Republic of Indonesia on School/Madrasah Laboratory Personnel Standards, school/madrasah laboratory personnel include laboratory heads, laboratory technicians, and laboratory assistants. The presence of laboratory assistants helps manage the laboratory and support practicum activities. Sarjono (2018) states that the presence of laboratory managers (laboratory assistants) in schools can reactivate existing laboratories. The duties of laboratory assistants include planning the procurement of tools and materials, compiling activity schedules and rules, preparing tools and materials, organizing the storage and distribution of equipment, registering the use of tools and materials, making catalog lists, inventorying and

administering the use of tools and materials, maintaining and repairing damaged equipment, recording data on students or research participants, and compiling reports on laboratory activities (Nikmah et al., 2017).

The existence of laboratory assistants is essential because their role is very important in assisting the duties of the laboratory head in laboratory management. Since laboratory assistants play a key role in organizing laboratory activities, incompetent laboratory assistants will certainly have an impact on the low quality of laboratory activities and increase the risk of accidents in the laboratory (Hendrawan et al., 2023). Therefore, the absence of laboratory assistants can have a significant impact on the continuity of practicum. Hidayat et al. (2023: 164) explain that the lack of laboratory management personnel can hamper the operation and maintenance of equipment and materials in the laboratory, making practicum less effective.

Factors that influence the implementation of physics practicum consist of supporting and inhibiting factors. Supporting factors include the readiness of educators and students, as well as the completeness of practicum tools and materials. Inhibiting factors include the use of laboratory space for other activities such as MGMP and student council meetings, limited time for educators to prepare teaching modules that support practicum, and the absence of laboratory assistants. The readiness of educators and students plays a crucial role in the smooth implementation of practicum. High student enthusiasm and curiosity support the success of practicum activities, while the ability of teachers to plan and implement practicum creatively determines the effectiveness of the activity. The completeness of laboratory equipment is also an important supporting factor, as it ensures that practicum activities can run without interruption.

The physics laboratory at SMA Negeri 5 Metro is relatively complete based on Permendiknas standards, including mechanics kits, optical kits, electricity and magnetism kits, telescopes, measuring instruments (for electricity, temperature, time, length, and mass), and wave experiment kits. Teaching modules designed by educators also play an important role in facilitating practicum activities. According to Nurdyansyah (2018), teaching modules or Learning Implementation Plans (RPP) are designed in accordance with the independent curriculum to achieve the competencies set by educators. In physics learning, teaching modules that support practicum activities are essential to help students better understand the material.

One of the main obstacles at SMA Negeri 5 Metro is the absence of a specialized physics laboratory assistant. According to the Regulation of the Minister of National Education No. 26/2008, laboratory assistants are responsible for preparing equipment according to practicum guidelines and assisting students during practicum activities. The absence of laboratory assistants forces educators to handle the preparation and arrangement of equipment themselves, which hampers the implementation of practicum.

The results of observations in class X.1 at SMA Negeri 5 Metro show that physics learning is mostly conducted in the classroom, while laboratory conditions are poorly maintained. Although physics practicum tools and materials are quite complete and stored in warehouses and laboratory cabinets, suboptimal laboratory management causes the laboratory to not function properly.

Overall, optimizing the use of laboratories at SMA Negeri 5 Metro requires

improved management and the addition of laboratory personnel to support practicum activities. Thus, the laboratory can be utilized more effectively to support physics learning and improve the quality of education in the school.

Figure 1. Demonstration of the use of length measuring instruments by a physics teacher at SMAN 5 Metro

Figure 2. The condition of the storage room of the physics laboratory at SMAN 5 Metro

Then, the results of interviews with one of the educators at SMAN 5 Metro indicate that there are separate laboratories for biology, chemistry, and physics. However, the implementation of practicum, especially in physics learning at SMA Negeri 5 Metro, has not been carried out optimally due to the limited use of tools and materials in learning, the use of laboratories that is not in accordance with their functions, and the absence of laboratory assistants or laboratory technicians.

Figure 3. The researcher conducting an interview with one of the physics teachers at SMA Negeri 5 Metro

This is supported by response data from students of class X.1, which shows that practicum activities are only conducted in the classroom, with educators bringing physics practicum tools into the classroom. As a result, students lack a new learning atmosphere, particularly laboratory-based experiences. The results of the questionnaire completed by students of SMAN 5 Metro are presented in the form of a graph. The following shows the percentage results of the questionnaire responses from students of class X at SMAN 5 Metro.

Students' responses to physics learning at SMAN 5 Metro show that 86.4% of students do not like physics lessons, while 13.6% of students like them. A total of 95.5% of students stated that the reason for disliking physics is that it is difficult, whereas 4.5% stated that they like physics because it is easy. Practical learning is considered to take place coherently by 81.8% of students, and they are fairly enthusiastic in participating even though it is conducted only in the classroom. However, 18.2% of students are less enthusiastic about physics lessons using practicum. The graph of questionnaire results indicates that the majority of students are less interested in physics due to its perceived difficulty. Nevertheless, most students show greater enthusiasm and interest when physics

learning is combined with practicum activities.

Figure 4. Graph of student response results of class X.1 at SMAN 5 Metro

The results of the research presented above show that the physics laboratory at SMAN 5 Metro has relatively complete tools and practicum materials, including storage cabinets, a special room for laboratory assistants, and handwashing facilities. In terms of human resources, the quality of physics teachers at SMAN 5 Metro is very good in both educational background and learning management. However, despite the availability of adequate tools and materials, practicum activities are still conducted in the classroom by bringing equipment as needed. This indicates that the utilization of the laboratory has not been optimal. One of the main factors contributing to this issue is the absence of a laboratory assistant who is responsible for laboratory management, such as managing equipment loans and inventory. In addition, the condition of the laboratory room is not well maintained, which affects its usability. Furthermore, the laboratory is sometimes used for other purposes, such as MGMP meetings and student council activities.

Based on the data analysis conducted, several solutions can be proposed to overcome the problem of laboratory utilization at SMA Negeri 5 Metro.

First, optimizing laboratory management can be achieved by recruiting or appointing a laboratory assistant or technician who is fully responsible for laboratory operations. The main duties include managing and maintaining equipment, organizing tools based on their codes, types, and functions, and maintaining laboratory administrative data. The appointed personnel should also receive training in laboratory management, safety procedures, and equipment maintenance.

Second, the laboratory must be utilized according to its intended function. This can be implemented by creating a fixed schedule for laboratory use for each class so that all students have equal opportunities to conduct practicum. Additionally, integrating more practicum activities into the physics curriculum will enable students to engage more frequently in hands-on experiments.

Third, improving the quality of teacher human resources is essential. Organizing training or workshops for physics teachers on effective practicum methods and techniques, including how to maximize the use of laboratory equipment, is recommended. Collaboration with higher education institutions or research centers to provide additional seminars or training can further enhance teacher competence.

Fourth, improving laboratory facilities and infrastructure is necessary. Conducting an inventory and procuring additional equipment that may still be lacking will allow practicum to be carried out with greater variety and depth. Establishing a

regular maintenance schedule for all laboratory equipment is also important to ensure readiness for use.

Fifth, laboratory administration and documentation need to be improved. Developing a well-organized administration system, including equipment loan records, inventory books, and documentation of practicum activities (both manual and digital), will greatly support laboratory management. Proper documentation is also essential for evaluation and continuous improvement of learning quality.

Sixth, increasing awareness and compliance with laboratory procedures is important. Regular socialization of laboratory safety procedures to both students and teachers, along with accident prevention measures, should be conducted. Additionally, providing clear and structured practicum guidelines for each experiment will help ensure that activities are carried out safely and correctly.

Through the implementation of these solutions, it is expected that the utilization of the physics laboratory at SMA Negeri 5 Metro can be optimized, thereby improving the quality of physics learning through effective and efficient practicum activities.

CONCLUSION

Based on the data analysis, the researcher concludes that the overall utilization of the physics laboratory has not been carried out optimally. This can be seen from the implementation of practicum at SMA Negeri 5 Metro, which is still conducted in the classroom, with teachers bringing practicum tools into the classroom to demonstrate or conduct experiments.

Although the availability of practicum tools is relatively complete and the quality of teacher human resources is very good in terms of education and learning management, laboratory management has not been properly organized to support learning. In addition, practicum activities have not been optimally implemented due to the use of laboratories that is not in accordance with their intended functions, as well as the absence of laboratory assistants or laboratory technicians. These personnel are essential for managing laboratory activities, such as organizing tools based on their codes, types, functions, and characteristics, as well as maintaining laboratory administrative records, including equipment loan books and inventory records of tools and materials.

Several solutions can be proposed to optimize laboratory utilization at SMA Negeri 5 Metro. These include the appointment of laboratory assistants, training for laboratory assistants and teachers, scheduling laboratory use, improving facilities and infrastructure, developing laboratory administration and documentation, as well as promoting safety procedures and providing detailed practicum guidelines.

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