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Analysis of Physics Laboratory Standardization to Support Physics Learning at SMAN 2 Lumajang

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ABSTRACT

The physics laboratory standards are a collection of rules or criteria that physics laboratories must follow in order to meet quality standards and enable effective physics learning. The physics laboratory standards include a variety of topics, including laboratory buildings and infrastructure, laboratory staff competency, and laboratory management and administration. The study's goal is to determine the standardization of the physics laboratory in support of physics education at SMAN 2 Lumajang. The research approach employed was qualitative descriptive, utilizing a case study design. Data collection methods include observation, interviews, and documentation. According to the research findings, the physics laboratory at SMAN 2 Lumajang has yet to meet the standards for physics laboratory administration, but some areas already enable practical operations. The standardization of physics laboratory administration is critical for supporting physics education at SMAN 2 Lumajang. The laboratory must be used to its full potential, and laboratory equipment and supplies must be more readily available. The laboratory schedule must be well-planned, and the laboratory management system must be integrated.
Keywords: Physics Lab, Facilities & Infrastructure, Standardization.

INTRODUCTION

Since physics is one of the sciences that examines natural occurrences and phenomena, it can be regarded as the fundamental basis of technology, offering adequate readiness for the future [1]. Another field of study that necessitates firsthand observation through experimentation is physics [2]. [3] asserts that physics is an organized and methodical field of study that is derived from experiments and observation. This indicates that physics is both a theoretical and a practical science, requiring trials and experiments to validate previously taught notions.

[4] noting that in the field of education, it is vital to combine theory with practice. The presented theory will be re-examined through practice, and its accuracy will then be mutually verified by the theory and laboratory practice. One of the resources that supports physics education is the laboratory, which is used for research, scientific work development, practical work, and the study of previously learned material [5]. According to [6], the laboratory is also one of the requirements that all formal educational institutions, including high schools, must fulfill. This includes preparing human resources by teaching teachers how to run the

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laboratory and providing buildings, facilities, and infrastructure.

Because of its multiple applications, including demonstrating the coherence of theory and practice, the laboratory is an essential classroom facility. Without a laboratory, knowledge is only possible in theory and cannot be verified in practice. Natural or virtual laboratories, for instance, can be used in place of laboratories, which are simply structures with equipment. Therefore, a teacher can create a virtual laboratory when the existing facilities are inadequate and impede laboratory activity. [7] contends that the laboratory must be appropriately managed given its significance as a resource to enhance student competency.

[8] contend that a number of elements, including laboratory management, infrastructure, and the availability of tools and materials, as well as the attitudes of students during practical activities, affect how practical activities are implemented. In order to make sure that laboratory activities are more effective and efficient and beneficial for students, laboratory management consists of four primary activities: developing a schedule for laboratory use that can be divided equally among all classes, making the most of laboratory equipment to ensure that it is kept in good condition so that laboratory activities are not impeded, and educating students about laboratory safety to avoid mishaps. To improve safety and security in the school laboratory, educational initiatives for work safety and security are also required [10]

Apart from the significance of comprehending safety and security in the laboratory, it is also critical for educators to be aware of students' emotions, as this can aid in their comprehension during the learning process [11].A practitioner's comfort and sense of safety in the lab are also aspects of safety and security. This indicates that a clean room and surrounding environment, along with the laboratory's compliance with regulatory requirements, reinforce the feeling of security and comfort that exists within the space.

The Minister of National Education Regulation No. 24 of 2007 governs the general laboratory provisions. The building's layout, the laboratory's dimensions, the furniture—such as tables and chairs—and the instructional media resources are all governed by this ministerial order. To meet competency standards, laboratories must contain teaching materials or learning resources, such as knowledge, abilities, and student attitudes, in addition to equipment and facilities that facilitate the implementation of practical work in schools [12]. [12] asserts that the accomplishment of teaching and learning activities in the laboratory is the key to the successful execution of practical activities. Students' attainment of learning objectives may suffer if practical activities are impeded, which will impact the school's overall results. Therefore, even when the outcomes are still subpar, students must complete the process of implementing learning in the laboratory.

Information-gathering operations are evaluated in order to identify the best options for decision-making. It is necessary to assess the viability of laboratory infrastructure and facilities in relation to data, information, management, funding, and governance [13]. This implies that assessments can be carried out every few years to pinpoint the infrastructure and facility deficiencies of the laboratory.

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METHOD OF RESEARCH

Descriptive qualitative research using a case study approach is the methodology employed. The study was carried out at SMA Negeri 2 Lumajang. The head of laboratory management, who also teaches physics, the laboratory technician, the physics lab's infrastructure and facilities, and the administration of laboratory operations are the topics of this study. Techniques for gathering data include documentation, interviews, and observation. While interviews are used to collect information that cannot be immediately collected in the laboratory, such as calibration time, actions for broken equipment, equipment renewal time, and the challenges faced, observation is used to gain information on the infrastructure and facilities that are available. documentation as corroborating information acquired from interviews and observation. Tables based on the observation aspects and the facilities and infrastructure observation sheets are used to present the data. where the data is presented in compliance with Permendiknas No. 24 of 2007 regulations. To determine the percentage value of the availability of laboratory facilities and infrastructure that have been modified to Permendiknas norms, the results of the observation data will be added together. Data categorization according to Table 1.

Table 1. Infrastructure and Facility Signage Classification.

Presentase	Klasifikasi
85% < x ≤ 100%	Sangat baik
65% < x ≤ 85%	Baik
45% < x ≤ 65%	Cukup
25% < x ≤ 45%	Kurang
0% < x ≤ 45%	Sangat kurang

RESULTS AND DISCUSSION

An overview of SMAN 2 Lumajang's past. Prior to 1977, Lumajang Regency had just one high school building. The Lumajang Regency Government was somewhat relieved to have a new high school facility in 1977 since the Lumajang community needed more educational facilities to improve its quality. SMPP Negeri Lumajang was founded at Jalan HOS Cokroaminoto 159, Tompokersan Village, by using the village's fallow land as the location for the new educational facility. SMAN 2 Lumajang, SD Negeri Tompokersan 03, SMP Negeri 1 Lumajang, and SMK Negeri 1 Lumajang are all part of the SUT (Sekolah Unggulan Terpadu) complex. The principal of SMPP is in charge of both SMPP and SMA Negeri 1 Lumajang, two schools that are under their concurrent supervision. He is Dr. Santoso, a leader with the ability to advance education through the integration of two schools that benefit one another. Additionally, SMPP has made a substantial contribution to the State's admirable goals of raising the standard of the country.

Figure 1: The Physics Lab Room

The results of the study indicate that SMAN 2 Lumajang contains two physics labs. The space that each of these labs occupies is 90 square meters. The principal, Moh. Yatim Khudlori, M.Pd., the coordinator of the physics lab, Mr. Salim Nakhas, M.Pd., and the members, who are the physics instructors at SMAN 2 Lumajang, make up the laboratory's organizational structure. Additionally, Mr. Achmad Ansori, a laboratory technician, is in charge of overseeing the laboratory at SMAN 2 Lumajang through activity planning, material and equipment operation, and the upkeep and expansion of laboratory activities. SMAN 2

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Lumajang pupils make up the last group. In order to become a capable laboratory that generates reliable data results, the physics lab at SMAN 2 Lumajang is designed to be safe and clean, with all laboratory operations conducted in compliance with ISO and ISC standards.

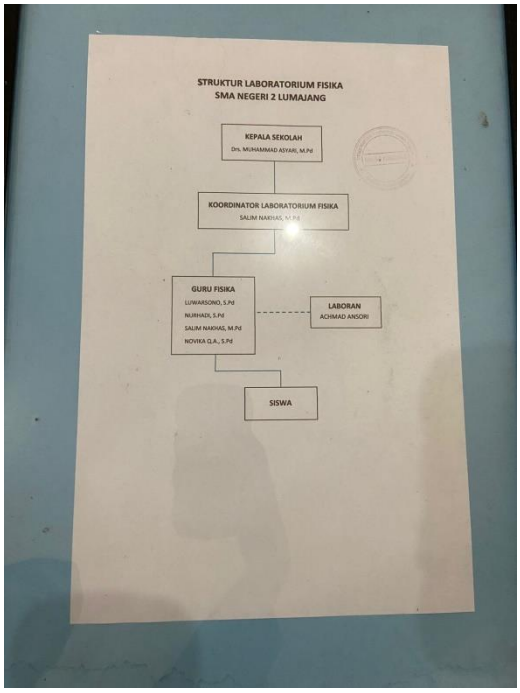

Figure 2: Physics Laboratory Management Structure

Constructing Physics Lab Space and Standards at SMAN 2 Lumajang

Regarding the requirements for infrastructure and facilities for elementary schools/madrasah ibtidaiyah (SD/MI), junior high schools/madrasah tsanawiyah (SMP/MTS), and senior high schools/madrasah aliyah (SMA/MA), as stated in Indonesian Minister of Education Regulation No. 24 of 2007:

a. Practical physics learning activities that call for specialized equipment are carried out in the physics laboratory.
b. At least one study group can be accommodated in the physics lab.
c. A chemical lab must have a minimum ratio of 2.4 m² per student. The minimal laboratory size for study groups with fewer than 20 students is 48 m2, which includes 18 m2 for preparation and storage. The physics lab must be at least five meters wide.
d. There are facilities in the physics lab that offer sufficient lighting for reading texts and looking at experimental materials.
e. Infrastructure and facilities are present in the physics lab.

Table 1: Laboratory Physics

Nama Barang	**Standar Lab Fisika Minimum**	**Lab Fisika SMAN 2 Lumajang**	**Presentase %**
Ruang Lab 36 siswa	86,4 m^2	90 m^2	100
Lebar lab	5m	10 m	100
Luas ruang penyimpanan	18m^2	30 m^2	100
Rerata			**100**

The physics laboratory at SMAN 2 Lumajang is distinct from the chemical and biology labs. In order to keep practical activities concentrated in one area and prevent equipment or other materials from being left behind during practical sessions, the physics lab at SMAN 2 Lumajang is situated neither too close nor too distant from the classrooms. The learning process is not disrupted by

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students doing experiments. Furthermore, SMAN 2 Lumajang's physics lab is fairly large, with enough space for 36 students for practical work or one class. SMAN 2 Lumajang's physics lab has a dedicated storage area for tools and supplies, which are arranged in glass cabinets and labeled with the names of the various items based on the subject matter being studied..

Additionally, the physics lab at SMAN 2 Lumajang has more than enough lighting thanks to a number of bulbs inside the lab in addition to windows that let in light. Air ventilation is also installed in the windows that connect the laboratory to the outside world. There is only one door in the physics lab at SMAN 2 Lumajang, and practitioners enter and exit through it. There are also a number of cleaning supplies, like dusters and brooms, within the lab. However, since physics experiments do not require liquid materials like chemistry experiments do, there is no water channel in this physics lab; instead, the water channel is outside the room. However, due to space constraints that prevent it from being constructed in accordance with the standards, the SMAN 2 Lumajang laboratory does not yet meet the requirements for physics laboratory facilities.

Guidelines for Setting Up Physics Lab Supplies and Equipment at SMAN 2 Lumajang

The physics lab's equipment and materials must be arranged or stored in a way that promotes both ease of maintenance and neat storage. Maintaining the number and quality of laboratory equipment is made easier by the use of specialized techniques for the orderly storage and maintenance of tools, which enable laboratory personnel to swiftly and readily retrieve instruments for work. The physics lab at SMAN 2 Lumajang has already complied with a number of requirements for the configuration of the equipment and supplies, including:

a. Unique glass-covered cabinet serves as a storage area for useful equipment, which is arranged by category. For instance, how electrical practical equipment is arranged.

Figure 3: Electrical Devices

b. Practical equipment is kept in a separate glass-covered cabinet that is arranged specifically for that purpose. For instance, the practical equipment's temperature and heating configuration.

Figure 4: Equipment for Temperature and Heat

c. The practical equipment is kept in a specific glass-covered cabinet that is arranged by group. For instance, how fluid practical equipment is arranged.

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Figure 5: Equipment for Fluids

Table 2: Facilities for Physics Labs

Jenis	**Presentase %**	**Kategori**
Perabot	70	Baik
Peralatan pendidikan	100	Baik
Alat percobaan	100	Sangat baik
Media pendidikan	100	Sangat baik
Perlengkapan lain	100	Sangat baik
Rerata	**94**	**Sangat baik**

As the practical equipment, such as measuring cylinders, electrical practical tools, temperature and heat practical tools, and many more, are kept in a special glass cabinet, the overall tool and material arrangement in the physics laboratory of SMAN 2 Lumajang satisfies the standards based on the observations that have been made. The equipment is kept clean, and the positioning is not haphazard but rather well-organized.

Equipment calibration at SMAN 2 Lumajang is typically carried out anytime a device malfunctions, but it should be done at least once a year in accordance with laboratory standards. The frequency of use of the equipment determines this. Nevertheless, a number of useful items have been destroyed and are kept in a separate warehouse so that they can be found when calibration officers visit.

CONCLUSION

The following conclusions were drawn from the data analysis and the findings of the physics lab research conducted at SMA Negeri 2 Lumajang. The physics laboratory at SMAN 2 Lumajang has a conventional layout and area that makes it easy to reach because it is neither too close nor too far from the classrooms. Both air ventilation and sufficient lighting are present. However, there is a drainage system outside this lab. The physics lab's overall tool and material storage satisfies storage requirements. furnished with numerous specialized cabinets, each serving a distinct role, to hold real physics instruments and materials. A list of damaged tools, a tool requisition journal, a goods receipt book, and tool borrowing books are already in place for the administration's completeness. The equipment loan book, the damaged equipment list book, the equipment request journal, and the goods receipt book are all complete for the administration's completeness. Although the physics lab is rather large and satisfies all laboratory requirements, it still only has one entry point, which is utilized for both entering and leaving the building. As a result, the physics lab at SMAN 2 Lumajang falls short of the requirements for physics labs as stated in Regulation No. 24 of 2007 of the Indonesian Minister of National Education concerning the standardization of infrastructure and facilities.

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