

Identification of Laboratory Management Systems at Senior High Schools In Mataram City

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Abstract

The Laboratory for Biology serves an effective educational facility for learning of biology, where biology subject often requires lab activity. Proper management of the laboratory is a crucial aspect for the smooth execution of practical activities by both teachers and students. The objective of this research was to determine the biology laboratory management system at SMA Negeri 3 Mataram. This research is descriptive research using observation and interview methods. The data collected in two types, the primary data is observation questionnaire and the result of interview to the biology teachers of SMAN 3 Mataram. The development of the observation questionnaire for the standardization of biology laboratory refers to the National Education Minister's Regulation No. 24 of 2007, and the laboratory management standards refer to The Minister of Education and Culture's Regulation No.8 of 2018. There are ten aspects considered in the observation of the biology laboratory, including the evaluation of the laboratory space, the completeness of laboratory equipment and materials, and the cleanliness of the laboratory. Based on the research found that eight aspects were categorized as very good, and two aspect were categorized as as good. The completeness of laboratory tools and materials, as well as laboratory safety, need to be improved.

Keywords: *laboratory management system, biology laboratory, standardised laboratory.*

1. Introduction

The laboratory is a place where practical activities, experiments, measurements, scientific research (chemistry, physics, biology) or other scientific research are carried out. Science laboratory act as academic component in educational institutions, play an important role to support teaching and support the success of the skills learning process. Science laboratory with the lab activities provide a better explanation for students, biology teachers should prepare teaching materials followed by practical activities or experimental methods.

Science laboratories as an educational infrastructure, need to be maintained the effectiveness of it function. To maintain the effectiveness of its functions, a science laboratory must be managed and organized well with clear operational mechanism. Laboratory management is a technique or method for achieving objectives through the stages of planning, organizing, directing, and supervising all laboratory potentials to achieve optimal good targets (Ali, 2018).

Laboratory management is crucial for the effectiveness and efficiency of laboratory's operation (Elseria, 2016). A laboratory, as a place of learning, would be better

managed before it is used. Proper management facilitates the use of the science laboratory for both teachers and students. Planning, organizing, implementation, supervision, and evaluation are essential components for the successful management of a laboratory.

Laboratories are used in education to train intellectual skills through observation, recording natural phenomena, and developing students' motor skills (Silvester *et al.*, 2023). This activity teaches students to use the tools they have to seek and find the truth, on it nurtures the courage to persue scientific truth the natural and social environment. It also teaches them to be careful, patient, honest, think critically and skillfully.

According to The Minister of National Education No. 24 of 2007 concerning Facilities and Infrastructure Standards for Senior High School General Education, every senior high school is required to have at least one designated room for a biology laboratory. School laboratories play a crucial role in biology education, as certain learning materials necessitate observation and experimentation. If the school laboratory fails to meet these standards, practical activities will be hinderd, resulting unachieved learning objectives.

The biology laboratory serves both educational and research purposes, implementing and advancing biological theories and concepts. The practical activities conducted in this laboratory are intended to enhance students' comprehension of various forms of knowledge, including facts, concepts, principles, laws, and theories. Effective biology education relies on practical, hands-on learning experiences. Consequently, biology practical activities require adequate support in terms of facilities and infrastructure, such as laboratories and their associated equipment. This underscores the significance of biology laboratories within the school biology curriculum. Mulyasa (2006), biology laboratories constitute a vital resource for learning.

Considering the significance of laboratory laboratory as an educational resource, therefore very crucial to assess the facilities of laboratory at SMA 3 Mataram. The assessment should include the laboratory's layout and capacity of the laboratory equipment, tools and materials for practical activities, safety apparatus, and other laboratory resource at SMAN 3 Mataram.

2. Material and Method

The research methodology employed was descriptive research. The object of this research was SMAN 3 Mataram, with the participants involved in this research activity were biology teachers who in charge as the laboratory assistants. The data sources used were divided into two, primary data and secondary data. The primary data for this study were derived from questionnaires and observations of biology laboratory standardisation. The operation of the laboratory were conducted according to the Regulation of The Minister of National Education No. 24 of 2007 and standardisation of laboratory management according to the regulation of The Minister of Education and

Culture No. 8 of 2018. Secondary data were obtained from the interviews with biology teachers about the subject matter taught during biology practical activities.

The data analysis technique employed in this research is inductive data analysis. Inductive data analysis is a process whereby conclusions are drawn from specific facts, and then generalization is made. The steps involving in analysis data in this study are data collection, data reduction, data display and data retrieval.

The questionnaire data, expressed as assessment points, converted into percentage and subjected to analysis. The formula used to measure the percentage is as follows:

$$\text{expected score} = \frac{\text{total score}}{\text{maximum score}} \times 100\%$$

The formula was used to analyse the results of the questionnaire that has been distributed to teachers and biology laboratory assistants. The criteria for evaluating the aspects of biology laboratory management are as follows.

Table 1. Criteria for assessing aspects of biology laboratory management

Percentage	Category
86 % - 100%	Very good
76 % - 85 %	Good
66 % - 75 %	Good enough
55 % - 65 %	Not good enough
0 - 54 %	Very bad

3. Results and Discussion

3.1. Results

Based on the questionnaire used to collect research data, there were ten aspects of assessment compiled based on biology laboratory standardization referring to Regulation of The Minister of National Education No. 24 of 2007 and standardized laboratory management referring to regulation of The Minister of Education and Culture No. 8 of 2018. The ten aspects in detail as follows.

Location and Laboratory Space

The biology laboratory room at SMAN3 Mataram is 10 m x 15 m and divided into three rooms. The first of these is a storage room or warehouse measuring 4 m x 5 m, which is used as a storage area for tools and materials, The second is a preparation room measuring 4 m x 5 m, which is used for preparation of practical activities. The third is a practical activity room measuring 10 m x 11 m, which is used for practical activities or teaching and learning activities. In accordance with the finding of Kertiassa (2006), the optimal laboratory configuration for high school level comprises three distinct areas:

student practice rooms, preparation rooms and storage rooms. This was also stated by Rustaman et al. (2003), who asserted that the laboratory encompasses a primary area (practice room) and additional space (preparation room and storage room). Based on these observations, the biology laboratory room at SMAN 3 Mataram has found to aligned with the standard. Ismiyanti et al. (2021) stated that the layout of the laboratory is important because it is related to the comfort and safety of students engaged in practical activity activities.

A biology laboratory that meets the standards of The Minister of National Education No. 24 of 2007 is a laboratory that has a practical activity/student work space with a student movement ratio of $2.4 \text{ m}^2/\text{student}$. The average number of students in one study group of SMAN 3 Mataram who use the biology laboratory for practical activity is 36 students. Referring to The Minister of National Education No. 24 of 2007, with an area of 150 m^2 , the ratio obtained is $4.1 \text{ m}^2/\text{student}$. The laboratory of SMAN3 Mataram is quite spacious and able to accommodate a minimum of one study group for each practical activity. The size of the laboratory is quite large, so it is not an obstacle or barrier for students to carry out practical activity. The laboratory also has a clean water source, but the number of clean water taps is minimal. In addition, all laboratory rooms also have good and adequate lighting facilities. Good lighting will make it easier for students and teachers to carry out practical activity.

Completeness of Laboratory Tools and Materials

The completeness of laboratory tools and materials at SMAN3 Mataram was adequate but there were some tools and materials that are not found in the laboratory. From 39 lists of tools and materials listed in the questionnaire, there were 9 tools and materials that were not found in the laboratory of SMAN3 Mataram. Among them are wire mesh, meiosis preparations, mitosis preparations, pictures of plants from various divisions and phylum, pictures of human breathing, pictures of human blood circulation, pictures of human excretion, and pictures of human reproduction. Most of the laboratory tools and materials can be found in the preparation room and some others are found in the laboratory warehouse. Tools found in the biology laboratory of SMAN3 Mataram in accordance with the standards of The Minister of National Education No. 24 of 2007 including Petri dishes, beakers, object glasses, cover glasses, funnels, measuring pipettes, test tubes, three legs, Bunsen, veterinary surgical instruments, balance sheet, Erlenmeyer, human body skeleton model, human body odle, DNA images, RNA images, preparation boxes, digestion images, human circulatory system images, monocular microscopes, binocular microscopes, plant anatomy preparations, animal anatomy preparations, sterilizers. While the materials found are spiritus liquid, alcohol, KOH, NaHCO_3 , $\text{CuSO}_4 \cdot \text{H}_2\text{O}$, CuSO_4 1%, glucose and CaCO_3 . There are several tools and materials that can be found but do not meet the standards, including measuring cups, test tube clamps, stopwatches and e-tubes.

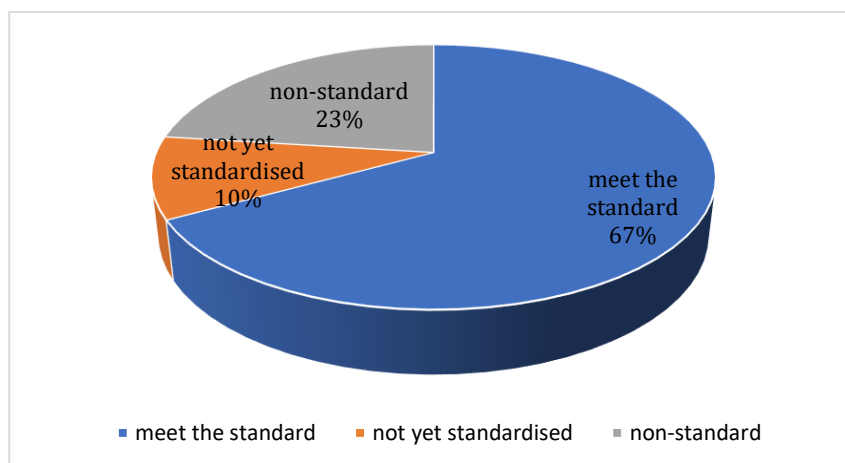


Figure 1. Comparison of the completeness of tools and materials that have met the standard.

Storage of Laboratory Equipment and Materials

The storage of laboratory equipment and materials in the biology laboratory of SMAN 3 Mataram is conducted appropriately. Equipments and materials are stored separately in separate cabinets. Upon removal of tools and materials from the storage cabinet, the glass cover of the cabinet must be closed again to maintain the sterilization of the existing tools and materials. The storage cabinets for tools and materials are sufficiently robust and secure for storage of laboratory equipments and materials. The storage cabinets are locked to prevent the loss of laboratory equipment and materials. The available storage cabinets were numerous and of a considerable size, allowing for the accommodation of a multitude of practical activity tools and materials. The separation of storage for tools is commandable, with the majority of tools being stored in the preparation room and damaged tools being stored in the laboratory warehouse. However, the cabinets are not labeled with the names of the tools stored, making it challenging to locate the necessary tools. The result of the research, revealed that one item on the questionnaire did not align with the conditions observed in the laboratory of SMAN 3 Mataram. In general, the storage of tools and materials was conducted appropriately. however, there are still some areas that require further attention.

Laboratory Equipment

Biology laboratory equipment at SMAN3 Mataram was complete, proven by the 23 points of the questionnaire have been fulfilled entirely. The equipment available in the biology laboratory of SMAN3 Mataram as follows: blackboard, electrical outlet, wall clock, strong and stable demonstration table, sink, clean water source, strong chair for student practical activity, teacher or laboratory chair, and strong and stable practical activity table.

Maintenance of Laboratory Equipment

The maintenance of biology laboratory equipment at SMAN 3 Mataram was done well. Materials and equipments were always reorganized after each practical activity. The feasibility of the equipment was monitored by the laboratory manager. Laboratory equipment was cleaned after each use so that it can be used for the next practical activity. There were periodic reports on equipment damage recorded by the laboratory manager. Some laboratory equipment will be repaired if it can still be repaired while still paying attention to the efficient use of laboratory equipment. Tools used in practical activity were always recorded before doing practical activity by students. Periodic checking or maintenance of laboratory equipment is always carried out by the manager or laboratory assistant.

Laboratory Organization and Administration

In order for the continuity of the laboratory's usefulness to be maintained, the laboratory needs to be managed properly. One part of this laboratory manager is the staff or personal laboratory. The laboratory staff or personnel were responsible for the effectiveness and efficiency of the laboratory including facilities, equipment and materials for practical activity.

SMAN3 Mataram has a laboratory organizational structure consisting of a laboratory head, laboratory technicians and laboratory personnel. The head of the laboratory is authorized and responsible for planning, implementing, developing, evaluating and following up all activities related to biology laboratory activities. Laboratory technicians are authorized and technically responsible for the preparation of practical activity, storage, maintenance and care of biology laboratory equipment and materials. Laboratory staff are administrative staff who are responsible for managing and carrying out laboratory functions, laboratory administration, and controlling laboratory usage.

In the administrative aspect, there is a laboratory management plan, a laboratory management plan made by the laboratory assistant, and a standard operating procedure (POS) for laboratory work. In addition, there is a schedule of laboratory activities and a report on laboratory activities. The duties of the technicians are detailed and formulated by the laboratory assistants. There is also a work schedule for technicians and laboratory assistants adjusted to the class hours at the school. The need for laboratory materials, equipment and spare parts is well planned. After conducting practical activities, there are periodic practical activity reports done by students. And once every six months (one semester), program evaluation activities are carried out to improve laboratory activities. During practical activities, there is an attendance book that needs to be filled in by teachers and practitioners while in the laboratory room. Furthermore, there is also a record of the use and damage of equipment in a book carried out by the laboratory assistant. All practical activities are periodically written in a report book.

Laboratory Utilization

Laboratory utilization at SMAN3 Mataram is carried out systematically equipped with a practical activity guidebook, and there are 6 practical activity courses that are carried out. Grade 11 conducted practical activity on animal and plant anatomy, human excretion and human digestion. Grade 12 conducted a practical activity on photosynthesis. The use of the laboratory is adjusted to the existing laboratory use schedule. The laboratory at SMAN 3 Mataram is not shared with other schools or institutions. The laboratory is used for research or discovery of innovations by students and teachers. There are several scientific papers resulting from studies or innovations. In addition, there are some catalogs available for research planning. To improve students' knowledge and understanding, practical activities are always carried out to support the material in biology subjects.

Provision and Preparation of Tools and Materials to be Used for Practical activity

In the biology laboratory of SMAN3 Mataram, there is a preparation table that is strong, stable, safe, and the size of the table is sufficient to prepare the tools and materials for practical activity. Before the practical activity is held, the laboratory manager or laboratory assistant identifies the tools and materials according to the needs of the practical activity to determine the availability of tools and materials in the laboratory. The provision of tools is done through checking the tools to find out which tools are still functioning properly or not. The laboratory assistant prepares instructions for using laboratory equipment to avoid damage to the tool when used and to get accurate results from using the tool correctly. Laboratory assistants prepare tools, materials, guides, and supporting equipment for practical activities to facilitate practical activities carried out by students. The laboratory assistant acts as a helper for the preparation of practical activity tools and materials, periodic checking, maintenance and storage. Thus, laboratory assistants are needed in the laboratory (Indriastuti, 2013).

Laboratory Safety

Laboratory work safety is the best condition in conducting practical activity which is equipped with equipment to conduct experiments or investigations. Laboratory work safety needs to be prioritized to prevent work accidents. To support work safety, a laboratory must be equipped with equipment that supports the safety of laboratory assistants and practitioners or students. Work safety in the biology laboratory of SMAN3 Mataram is quite good. The laboratory is equipped with fire extinguishers that can be operated when accidents occur during the practical activity process, such as fires and explosions. There is a first aid kit in the preparation room, but there is no wound medicine. There is no checking of the expiration date of the drugs in the first aid kit, as evidenced by one of the drugs that has expired. First aid equipment tends to be incomplete. In the implementation of practical activity, hazardous and toxic materials

always apply their own procedures and are always monitored in handling. Each individual is always required to maintain personal health and safety, as well as the work environment. Overall, the condition and safety of the laboratory building is in good condition.

Cleanliness of Laboratory Room and Furniture

The cleanliness of the biology laboratory room of SMAN3 Mataram needs to be considered in order to support practical activities carried out by teachers and students. The laboratory of SMAN3 Mataram has been equipped with trash bins, sinks, tables and chairs in a clean and tidy condition. Laboratory equipment is neatly organized in the preparation room. However, some equipment and materials in the warehouse are not clean and neat. Even so, the waste from the practical activity can be resolved properly. Cleaning checks before and after practical activity are always carried out to maintain the sterilization of equipment and materials in the laboratory.

The following are the results of the percentage assessment of each aspect in accordance with The Minister of National Education No. 24 of 2007 biology laboratory SMAN3 Mataram.

Table 2. Results of identification of biology laboratory management system at SMAN3 Mataram

Aspects of the assessment	Results	Category
Location and Laboratory Space	90%	Very good
Completeness of Laboratory Tools and Materials	77%	Good
Storage of Laboratory Equipment and Materials	91%	Very good
Laboratory Equipment	100%	Very good
Maintenance of Laboratory Equipment	100%	Very good
Laboratory Organization and Administration	100%	Very good
Laboratory Utilization	87,5%	Very good
Provision and Preparation of Tools and Materials to be Used for Practical activity	100%	Very good
Laboratory Safety	75%	Good
Cleanliness of Laboratory Room and Furniture	87,5%	Very good

3.2. Discussion

The finding of the research and analysis revealed that eight out of ten aspects of the assessment of the biology laboratory at SMAN 3 Mataram were in the very good category, two aspects of the assessment yielded results in the good category, as presented in Table 2. These results indicate that the management system of the biology laboratory at SMAN 3 Mataram has been in accordance with the standardization set out in Permendiknas No. 24 of 2007. This is supported by the completeness of the biology laboratory layout at SMAN 3 Mataram which has a good laboratory layout. Based on these

results, it can be said that the management of laboratory management is done well. A well managed laboratory is one that has effective organizational system, clear job descriptions, and good spatial planning in building planning. These elements are carried out effectively and efficiently with a disciplined work system (Suranto et al., 2020).

The availability of laboratory equipment and materials is an important factor in the implementation of practicum activities in schools. Candra and Hidayati's research (2020) indicated that the limited equipment for practical activities will impede the implementation and process skills, as well as work skills of students. The biology laboratory of SMAN 3 Mataram requires the following tools and materials: wire mesh, meiosis preparations, mitosis preparations, images of plants from various divisions and phyla, images of human respiration, images of human blood circulation, images of human excretion, and images of human reproduction. Additionally, the laboratory requires an increased number of measuring cups, test tube clamps, stopwatches, and ethanol. The procurement of tools and materials for practical activities must be based on needs (Ambarwati and Prodjosantoso, 2018). The laboratory plays an essential role in developing skills and fostering lifelong learning, as well as increasing student interest and enabling students to engage in continuous learning. Therefore, it is crucial to ensure the completeness of laboratory equipment including clothing, with gloves and footwear, to ensure the safety of students and the efficacy of laboratory activities (Atunuva and Artun, 2020).

Storage space is a fundamental component of any laboratory infrastructure. The findings indicated that the storage room in the biology laboratory of SMAN 3 Mataram was effectively managed and compartmentalized according to the designated storage areas for tools and materials. Suranto et al. (2020) asserted that the storage space for equipment, particularly those crafted from metal, must be separated from chemicals to prevent damage to tools or contamination of materials. The findings also demonstrate that biology teachers at SMAN 3 Mataram, in their capacity as laboratory managers, possess high competence in laboratory management. Singerin (2022) in his research mentioned that one of the signs of laboratory managers' competence is their ability to organize the storage of tools, materials and other spare equipment in school laboratories.

Adequate learning laboratories must be supported by effective laboratory equipment maintenance. It is recommended that equipment maintenance be carried out on a scheduled basis and equipped with a maintenance control card to facilitate monitoring of laboratory equipment (Suranto et al., 2020). The findings of the study indicated that the maintenance of laboratory equipment at SMAN 3 Mataram was conducted in an exemplary manner by the laboratory manager, who undertook regular inspections and promptly addressed any damaged equipment. Wang (2017) stated that one of the characteristics of good laboratory management is the presence of good maintenance management, including the repair of damaged laboratory equipment and the ability to devise solutions to any challenges that may arise

The utilization of the biology laboratory at SMAN 3 Mataram was 87.5% with the very good category. Indicators of laboratory use include the conduct of various practical activities such as animal and plant anatomy, excretory and digestive systems. This utilization is supported by other parameters such as room availability, excellent equipment availability, and excellent equipment maintenance. Indirasari et al. (2019) stated that there is a positive correlation between the availability of laboratory facilities and the motivation and achievement of learning objectives. Laboratory utilization in biology learning provide students with direct experience in science learning and increases their understanding of scientific phenomena (Etiubon and Ufonabasi, 2020).

Laboratory work safety is a crucial aspect that must be given due to consideration, as it is directly related to the performance of laboratory assistants, teachers, and students. The greater the availability of work safety and security facilities, the lower the likelihood of work related accidents. First aid kits and fire extinguishers are essential tools that must be readily accessible in the laboratory (Rahmantiyoko, 2019). However, the drugs found in the biology laboratory of SMAN3 Mataram were not checked for expiration, and there were no burns or external injuries. It is evident that laboratory safety is a shared responsibility of both managers and users. It is imperative that everyone involved in laboratory activities possess a sufficient level of awareness regarding laboratory safety management. Teachers and students in particular, are among the users of laboratory facilities who require a comprehensive understanding of laboratory safety management (Adilah et al., 2021) In addition to the aforementioned considerations, the management of laboratory safety also encompasses the availability of pertinent work safety regulations, including those pertaining to the handling of materials and equipment, which serve to protect students engagement in laboratory activities (Akinbobola and Olufunminiyi, 2015).

Conclusion

Laboratories are very important in schools to carry out practical activities. The ideal laboratory criteria standards are listed in The Minister of National Education No. 24 of 2007 and The Minister of Education and Culture No. 8 Of 2018. Based on the results of the assessment of the ten aspects of the assessment, eight of them are in the very good category and two of them are in the good category. Two aspects that need to be improved are the completeness of tools and materials and work safety in the laboratory. Based on the identification of all aspects, it can be said that the system is very good.

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