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Analysis of the quality of biological laboratories of state senior high schools ini Majalengka regency in the academic year 2023/2024

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ABSTRACT

This study This study aims to determine the quality of Public Senior High School biology laboratories in Majalengka Regency in the 2023/2024 academic year, especially in the aspect of room and laboratory managers. This research uses a qualitative method with a discrepancy evaluation model. The research was conducted in 4 Public Senior High School biology laboratories in Majalengka Regency. The research subjects in this study were the head of the laboratory, the head of facilities and infrastructure, biology subject teachers and representatives of students in grades XI and XII science class. The data collection techniques used by researchers were systematic observation, semi-structured interviews, and documentation. The research indicators in this study are the standardization of biology laboratory rooms and biology laboratory management. The results showed that the quality of the biology laboratory from the aspect of the room fell into a good category with an average percentage of 77.5%, while the management of the biology laboratory has not been done optimally and maximal.

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INTRODUCTION

The biology laboratory is one of the facilities and infrastructure that must be equipped at the senior high school education level as stated in Permendiknas No. 24 of 2007. The biology laboratory is used specifically to support biology learning through practicum activities carried out in it. Practical activities can be optimal if supported by adequate facilities and infrastructure, especially the laboratory room as a place for practicum. In addition, the biology laboratory infrastructure needs to be managed in such a way as to maintain all activities carried out. However, in reality, there are still some obstacles that can be found in the field related to the quality of the laboratory, including the laboratory being converted from its main function as a place for practicum (Lestari & Agustina, 2019), the absence of laboratory assistants and laboratory technicians who assist in the implementation of practicum activities (Agustina et al., 2017), Biology laboratory is still combined with the science laboratory (Harahap et al., 2022), there are problems with funding during the quality fulfilment process (Rahmania et al., 2020), and others.

Teachers cannot replace the existence of laboratory staff. In accordance with research conducted by Gökmen et al. (2021) that teachers only recognise some laboratory equipment and materials this is because teachers have incomplete or inaccurate information related to laboratory equipment; some teachers even stated that they did not consider themselves competent in recognising and using laboratory equipment. Every laboratory should have a

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management device so that it can be maintained and run properly. According to Permendiknas No. 26 of 2008, school laboratory personnel, at least consisting of laboratory heads, technicians, and laboratory assistants, have met the standards that apply nationally. Therefore, every school should have laboratory staff, including Public Senior High School in Majalengka District.

Majalengka is one of the regencies in West Java province which is included in the Cirebon Region III. Based on data published by Diskominfo Kabupaten Majalengka (2023) mentioned that Majalengka Regency has an area of about 1204.24 Km2. Majalengka Regency has 16 Public Senior High Schools, but there are two schools that do not have a biology laboratory because the biology laboratory is combined with the Physics and/or Chemistry laboratory. Of the 14 schools, not all of the research was conducted because they were being renovated or converted into other rooms.

In the absence of a biology laboratory room that is usually used for practicum activities, it will affect the student learning process. According to Ilma et al. (2021), the laboratory has an important role in helping students understand, training students' scientific attitudes, and training students' skills in using tools and materials. In addition, according to Permendikbudristek No. 7 of 2022, carrying out the design and implementation of investigations and/or solving problems related to living things and their environment is included in one of the scopes of high school material in learning biology. Therefore, a biology laboratory is important for students to deepen their knowledge and skills in the field of science through practical activities.

This study aimed to analyse the quality of biology laboratories of senior high schools in Majalengka Regency in terms of space and management. Therefore, this study is expected to provide a clear picture of the condition of biology laboratories of senior high schools in the Majalengka Regency. The results of this study are expected to help schools and policymakers improve the facilities and management of biology laboratories. With adequate laboratory facilities and optimal and maximum management, students will have a greater opportunity to improve their understanding of biological concepts. In addition, this study is also expected to contribute to the development of policies regarding biology laboratories so that schools can provide biology laboratory facilities that can be utilised as much as possible by students.

RESEARCH METHOD

This research uses a qualitative approach with a discrepancy evaluation model. This research method is used to determine whether a programme or activity is implemented by the standards or not. The characteristics of the gap evaluation model are described by Steinmetz (2000), which states that when we find out about the real characteristics of an object to be evaluated, then we need to know the size of the performance with the standard that should be, the comparison will produce discrepancy information. At the Standard stage, researchers examined the standards regarding the suitability of laboratory rooms and laboratory management. The standard refers to Permendiknas No. 24 of 2007, Permendiknas No. 19 of 2007, Permendiknas No. 26 of 2008, Permendikbud No. 145 of 2014, Permendikbudristek No. 22 of 2023 and supported by several relevant references. At the performance stage, researchers describe the suitability of laboratory space and management of high school biology laboratories. At the discrepancy stage, researchers describe the gap between the data obtained and the standards that have been set.

The study population included all biology laboratories of senior high schools in Majalengka Regency, with samples taken based on the purposive sampling method. The subjects in this study included the vice principal of facilities and infrastructure, school laboratory staff, biology teachers, and science class students. Data collection instruments included observation sheets and interview guidelines. The data collected included information about the size of the laboratory room, the number of study groups, the layout of infrastructure facilities in the

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laboratory room, laboratory administration, and the application of occupational safety and health. The data collection techniques used by researchers were systematic observation, semi-structured interviews, and documentation.

The percentage of the score obtained is calculated using the formula as follows (Agustina et al., 2019):

$$p = \frac{n}{Nmax} \times 100\% \quad (1)$$

Description

p = percentage achievement

n = score obtained

$Nmax$ = maximum score

Then the percentage of achievement results (p) is interpreted based on the following criteria:

Table 1. Criteria Based on Percentage

% Score	Rating Criteria
0-20	Very not good
21-40	Not good
41-60	Enough
61-80	Good
81-100	Very good

Source : Agustina et al. (2019)

FINDINGS AND DISCUSSION

Findings

Biology Laboratory Room

Based on Permendikbudristek No. 22 of 2023, Laboratory space is a room that functions as a place for practical learning that requires special equipment. The laboratory room reflects the quality of a laboratory from the outside. So, the biology laboratory needs to adjust to the standards that have been determined. The standard of biology laboratory space is listed in Permendikbudristek No. 22 of 2023, which is equal to 1.5 of the classroom area with a minimum classroom area ratio of 2 m2/student, according to the opinion of Susanti et al. (2021) regarding the laboratory room area which states that the laboratory area needs to be adjusted to the number of users and has a minimum ceiling height of around 3 meters.

All the biology laboratory rooms of Public Senior High School 3 can accommodate at least one study group. The biology laboratory of Public Senior High School 1 has an area of 96 m2, the biology laboratory of Public Senior High School 2 has an area of 120 m2, the biology laboratory of Public Senior High School 3 has an area of 110 m2, and the biology laboratory of Public Senior High School 4 has an area of 108 m2. All of the ceiling heights met the minimum standard, with a ceiling height of about 4 meters. The layout of the biology laboratory of Public Senior High School 3, which is made based on the description and appearance of the laboratory space assisted by the visio application, is as follows:

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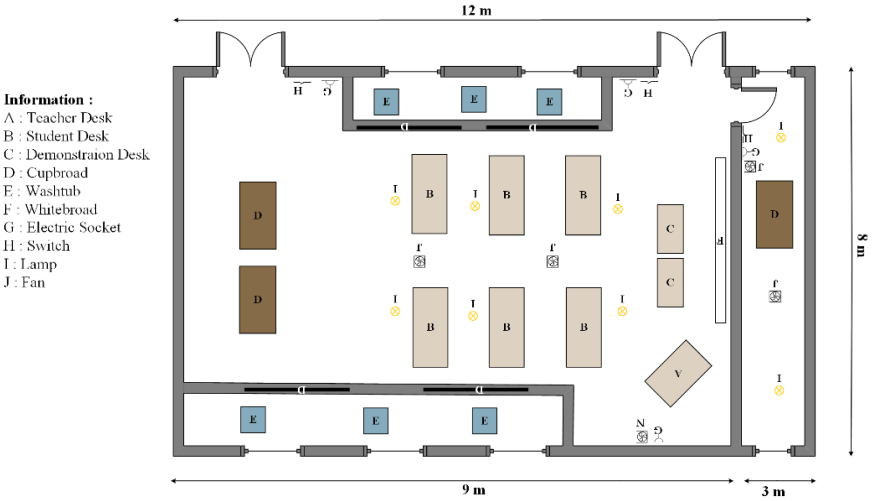

Figure 1a. Layout of Biology Laboratory Room Public Senior High School 1

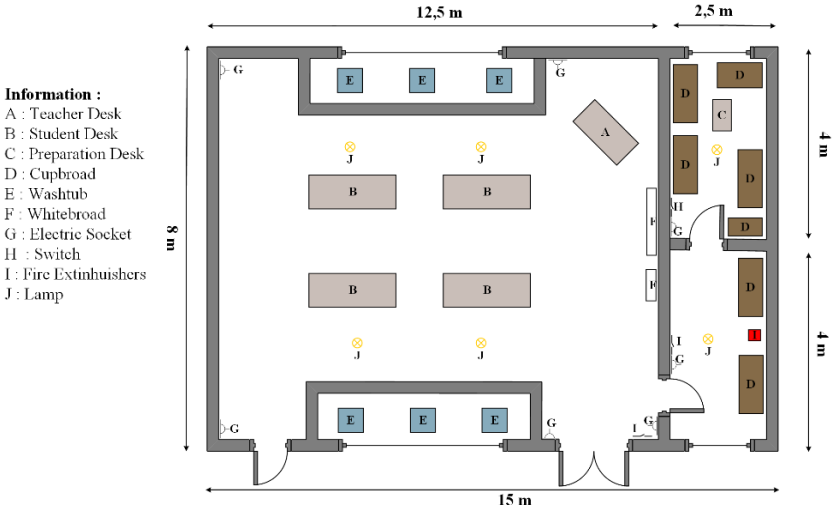

Figure 1b. Layout of Biology Laboratory Room Public Senior High School 2

Figure 1c. Layout of Biology Laboratory Room Public Senior High School 3

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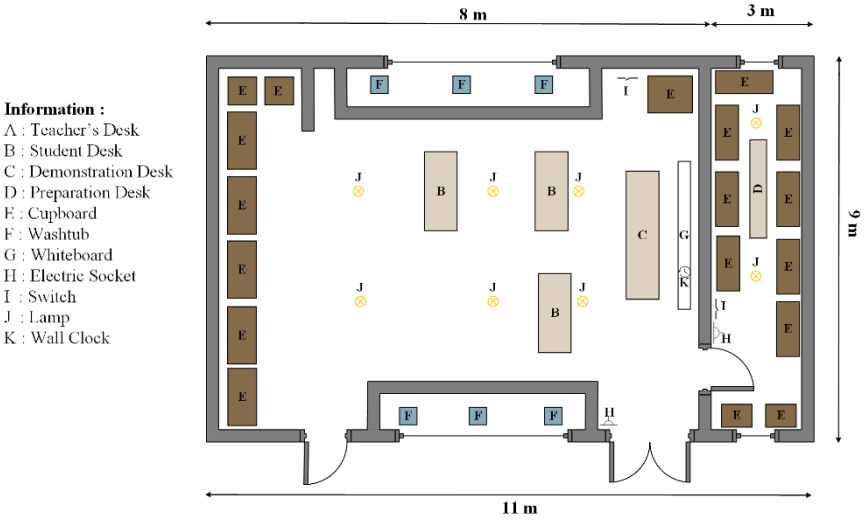

Figure 1d. Layout of Biology Laboratory Room Public Senior High School 3

To make it easier for readers to understand the results of the study, the researchers summarised the results of the study regarding the biology laboratory room in the Table 2.

Table 2. Research Results Regarding the Biology Laboratory Room

No	Indicator	Public Senior High School 1	Public Senior High School 2	Public Senior High School 3	Public Senior High School 4
1	The room meets the minimum area ratio (1.5 of the classroom area)	✓	✓	✓	✓
2	The laboratory room can accommodate a minimum of one study group	✓	✓	✓	-
3	Laboratory rooms have a ceiling height of ≥3 meters	✓	✓	✓	✓
4	The laboratory room has a space to prepare tools and materials that will be used for practicum.	-	✓	✓	-
5	The laboratory room has space to store tools and materials	✓	✓	✓	✓
6	Laboratory room has adequate air ventilation	✓	-	✓	-
7	Laboratory room has sufficient lighting	✓	✓	-	✓
8	The laboratory room has an emergency exit.	✓	✓	-	✓
9	Laboratory rooms are located ≥3 meters from other rooms	✓	✓	-	-
10	Laboratory door opens out	✓	✓	✓	✓
	Rate	9	9	7	6
	Score	90%	90%	70%	60%
	Criteria	Very good	Very good	good	enough
	Average		**77,5%**		
	Criteria		**Good**		

Biology Laboratory Management

According to Lestari Agustina (2019), the dimensions of laboratory management include laboratory organisation, laboratory administration, and work safety in the laboratory.

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Laboratory Organization

According to Susanti et al. (2021) laboratory managers consist of the principal, vice principal for infrastructure, vice principal for curriculum, laboratory head, laboratory assistants and technicians who are incorporated into the school laboratory organisational structure. The following is a picture of the organisational structure of the biology laboratory of Public Senior High School in Majalengka Regency.

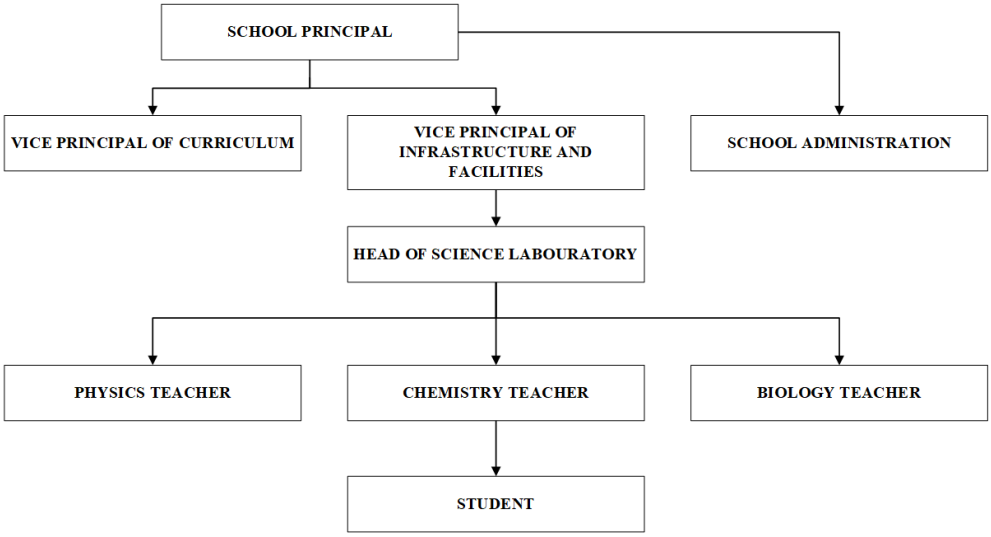

Figure 2a. Organization Structure of Biology Laboratory of Public Senior High School 1

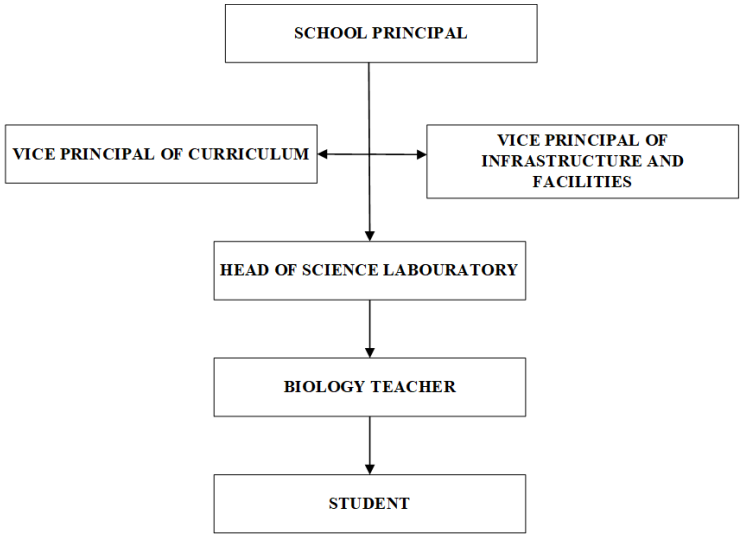

Figure 2b. Organization Structure of Biology Laboratory of Public Senior High School 2

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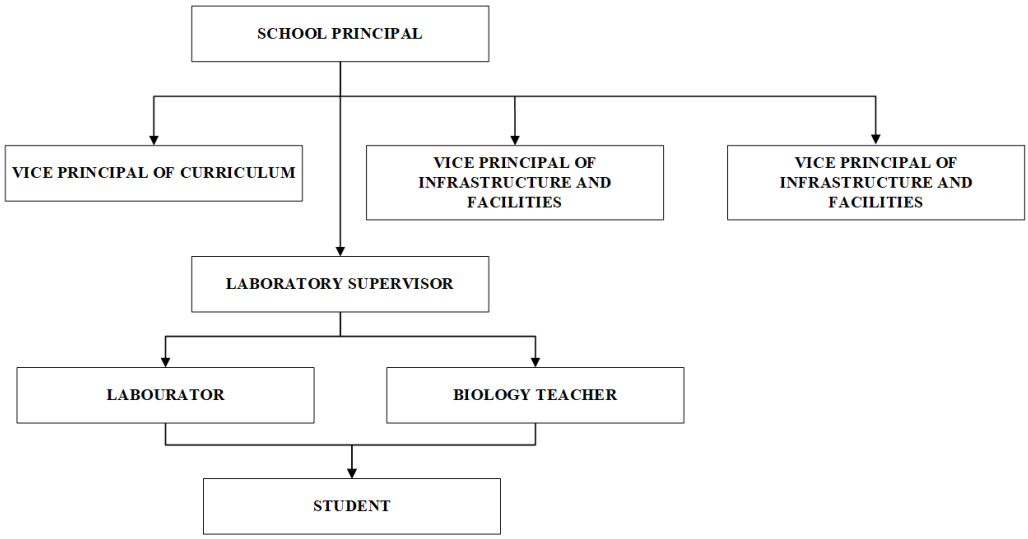

Figure 2c. Organization Structure of Biology Laboratory of Public Senior High School 3

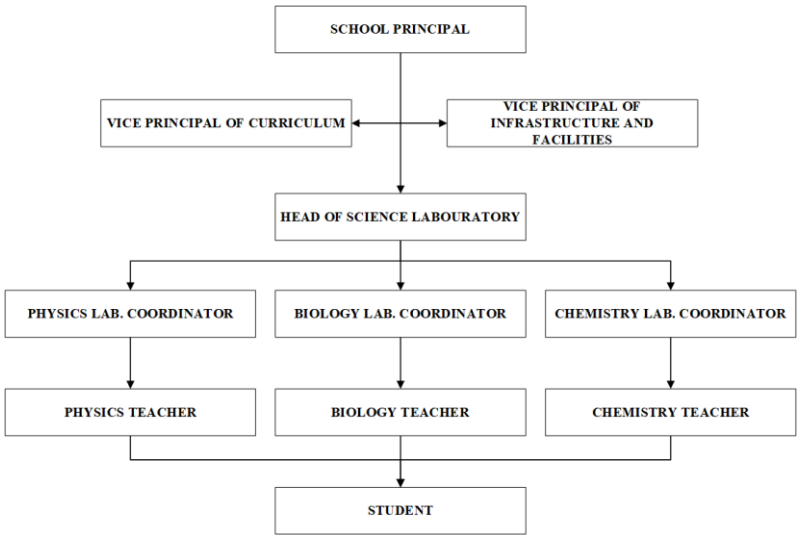

Figure 2d. Organization Structure of Biology Laboratory of Public Senior High School 4

Laboratory Administration

Administration is a documentation process that records activities of all facilities and infrastructure, human resources, laboratory finances, and activities (Rosada et al., 2017). According to Lestari & Agustina (2019), laboratory administration includes an inventory of laboratory equipment and facilities, administration of laboratory use, borrowing of laboratory equipment and materials, and maintenance of laboratory equipment and materials. According to Susanti et al. (2021), laboratory administration activities are equipped with laboratory administration tools, which include inventory books of tools and materials, stock cards, loan cards for tools and materials, books listing damaged tools and materials, repair cards, laboratory work programmes, laboratory activity schedules, daily logbooks of laboratory activities, lists of proposals for procurement of laboratory tools and materials.

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1) Inventory of laboratory tools and materials

Inventory is an activity of recording and compiling an inventory list of goods regularly according to applicable regulations. The benefit of inventory activities is to facilitate the preparation and effective supervision of all facilities owned by the laboratory (Agustina et al., 2019). The purpose of inventorying, according to Susanti et al. (2021), is to prevent loss and misuse of laboratory equipment and materials, Reduce operational costs, Facilitate checking, procurement, and accountability, Improve the work process and its results, and Prevent excessive usage.

2) Administration of laboratory use

Administration of laboratory use includes laboratory use schedules and laboratory use rules. Some schools did not have a fixed laboratory use schedule or followed the biology class schedule and adjusted to the biology teacher's needs for the implementation of a practicum on certain materials. Only in Public Senior High School 2 is there a definite schedule of practicum implementation in a month. In addition to being used for practicum activities, biology laboratories can be used to organise education or training with supporting facilities to serve students' educational activities, as stated in Permendikbud No. 145 of 2014. Based on the results of the research, only Public Senior High School 2 and Public Senior High School 3 allowed the use of biology laboratories for other activities outside the learning process, such as being used as a place for the implementation of extracurricular activities of the Youth Scientific Group, Olympic coaching, laboratory introduction activities to Integrated Islamic Elementary School Majalengka students, and the implementation of research by Majalengka University students.

The biology laboratory of Public Senior High School 2 was once used as a place for vaccination and a photoshoot for students' yearbooks outside of educational activities, but it was not in accordance with the standards. There is no written SOP regarding the technical licensing of the use of the laboratory room; there is only an unwritten procedure implemented by the school. For licensing, the use of the laboratory is adjusted to the party that will use it. If the students are going to use it, then the supervisor's permission is enough with the supervisor of infrastructure facilities. Meanwhile, if an outside party is going to use it, it is necessary to get permission from the principal first.

3) Administration of the loan of laboratory tools and materials

Only Public Senior High School 2 has a book for borrowing laboratory equipment and materials, while other schools do not have borrowing administration, only verbal permission to the school laboratory staff or to the head of infrastructure.

4) Administration of laboratory maintenance and treatment

Based on the results of the study, maintenance activities in the biology laboratory of senior high schools in the Majalengka Regency are not scheduled and not recorded, while maintenance is recorded but not carried out. Maintenance activities are usually carried out routinely every day by cleaning the infrastructure that has been used, storing it back in its place, giving instructions to teachers or laboratory assistants to supervise students in the use of laboratory tools and materials, and reporting to teachers or laboratory assistants if there are facilities and infrastructure that are damaged during practicum.

Public Senior High School 3 has a record of the tools that need to be repaired, although, in its implementation, it calls for technicians from outside. Other schools were only noted on the list of proposals and did not implement them. Based on the results of the interview, the laboratory manager did not know where to go to do the maintenance, and the head of the laboratory admitted that he lacked knowledge if he had to repair laboratory equipment so that laboratory equipment that needed to be repaired was left damaged so that it could not be used

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properly. Meanwhile, according to So, the maintenance activities of laboratory equipment are less implemented.

Work safety in the laboratory

Occupational safety is an action to prevent accidents to humans, damage to tools and materials, damage to buildings or workplaces, and damage to the environment (Ramadhani, 2020). To prevent work accidents in the laboratory, you should have adequate safety and security facilities, obey the applicable rules, and always be careful when using laboratory tools and materials. Accidents in the laboratory can be avoided by working in a disciplined manner, being aware of things that can cause danger, and obeying and learning the rules that have been made (Elsha et al., 2020). The anticipation of accidents in the laboratory of Public Senior High School in Majalengka Regency is by supervising students when carrying out practicum by going around, reminding students about things that must be done and should not be done when in the laboratory room, warning students when using laboratory tools and materials, helping students if they experience problems when carrying out practicum, providing basic K3 knowledge in the first year of school, having adequate work safety and security facilities, and others.

Discussion

Biology Labaratory Room

The laboratory can be located close to other laboratories to facilitate the use of facilities that support each other (Susanti et al., 2021). However, to maintain the comfort, security and safety of laboratory users, the laboratory should be located 3 meters from other buildings (Ramadhani, 2020). The biology laboratory room of Public Senior High School 1 is adjacent to the physics laboratory. Public Senior High School 2 laboratory room is separated from other rooms. Public Senior High School 3 has a biology laboratory adjacent to the physics laboratory, sports equipment storage, and library. Public Senior High School 4 has a laboratory adjacent to the chemistry laboratory and classrooms.

According to Sangi & Tanauma (2019), the laboratory room should have a good ventilation system. The better the air circulation, the healthier the laboratory will be. The biology laboratory room should also have facilities that allow adequate lighting to read books and observe experimental objects, as stated in Permendiknas No. 24 of 2007. All biology laboratories have ventilated air holes, but only Public Senior High School 1 and Public Senior High School 3 are equipped with fans as artificial ventilation to keep the air circulation in the room stable and not too hot. Only Public Senior High School 3 has less natural lighting, so it needs to be supported by lamps.

The biology laboratory room consists of three rooms: the practicum room, preparation room, and storage room or warehouse. The size, plan, or layout of each room needs to be designed in such a way as to optimise the implementation of practicum experiments or other things (Sani, 2018). based on the results of the research, only the biology laboratories of Public Senior High School 2 and Public Senior High School 3 have these three rooms. In contrast, the biology laboratory rooms of other schools do not have a preparation room. The biology laboratory should have a good evacuation route. Therefore, the laboratory has at least two exits at a considerable distance, as stated by Sangi and Tanauma (2019). However, only Public Senior High School 3 does not have an emergency exit. The readers can understand again about biology laboratory room in Table 2.

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Biology Laboratory Management

Each laboratory needs to be managed in such a way that the quality or quality of the laboratory can be maintained and the activities carried out in it can run optimally and optimally. Laboratory services can run optimally if the biology laboratory manager is competent in carrying out his duties and responsibilities in running and managing the laboratory (Surapranata, 2017). In addition, laboratory users must also be aware of the situation and be responsible for managing the laboratory.

Laboratory Organization

Based on the study's results in Figure 2a to Figure 2d, it is known that the managers of biology laboratories of senior high schools in Majalengka Regency generally consist of school principals, vice principals of curriculum, infrastructure and facilities, laboratory heads and biology teachers. Only Public Senior High School 3 has a laboratory assistant. Laboratory assistants and laboratory technicians play an important role in managing the laboratory. As stated in Permendiknas No. 26 Of 2008, the laboratory head, laboratory assistants and laboratory technicians are included in the qualified school laboratory personnel standard. The absence of laboratory assistants or laboratory technicians is due to the assumption that the role of laboratory assistants and laboratory technicians can be carried out by not too important because there is a laboratory head, lack of funds to recruit laboratory assistants or technicians, and limited training to become laboratory assistants or technicians. However, with the limited energy and knowledge of the head of the laboratory and biology teacher, it is hoped that the school will immediately recruit a laboratory assistant or technician who is an expert in his field to manage the biology laboratory. The presence of competent laboratory personnel in accordance with government standards is expected to have a good impact on the development of laboratory quality, especially the aspect of laboratory management.

Laboratory Administration

All senior high schools in Majalengka Regency have conducted an inventory of biology laboratory lab tools and materials, except Public Senior High School 4, which has no longer conducted laboratory inventories since 2018. However, not all of them have been inventoried, and the inventory is conducted once a year during the RAKS submission. The inventory results are stored in the form of an inventory book. The laboratory inventory book can show the inventory of tools and materials in the laboratory if there are items that are reduced for several reasons, such as shrinking, damage, loss, consumables, and others. Then, it is necessary to delete them so that there is no confusion or mismatch between the available items and the recorded items (Mustofa & Ramdani, 2020). Generally, each school stores the inventory results in the form of books and softfiles. At Public Senior High School 1, the inventory is made by the head of the laboratory and stored by the school's TU archivist. Public Senior High School 2, the inventory is managed and stored by the laboratory head. Public Senior High School 3 The inventory is managed and kept by the laboratory assistant.

While using the laboratory, all parties must follow the rules for using the laboratory, not interfere with practicum activities, and maintain the cleanliness and safety of the laboratory space used. In addition to the schedule of laboratory use, laboratory managers also need to make Standard operating procedures for the use of biology laboratories, better known as the rules of laboratory use. The rules for using this laboratory are to maintain the smoothness and safety of working in the laboratory (Mustofa & Ramdani, 2020). Laboratory managers make different laboratory use rules according to school policies. Based on the results of the study, it was found that each school has a laboratory code of conduct that is also displayed in the laboratory room, but students only know some rules that are usually conveyed by the teacher before starting the practicum.

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Usually, some schools apply sanctions to improve student discipline. Sanctions, in general, can have a function as a punishment or threat, which can prevent student behaviour, so if a student violates school rules, then he will get sanctions according to his actions (Rinaldi, 2022). Some sanctions can be applied, such as practitioners not being allowed to take part in a practicum in the laboratory and replacing laboratory equipment if it is accidentally damaged (Mustofa & Ramdani, 2020). However, only a few schools apply sanctions. Public Senior High School 1 will postpone the practicum if students do not bring the practical materials that have been informed by the teacher. Public Senior High School 3 students who do not wear laboratory coats will do laboratory picket and replace laboratory equipment if there are tools that are accidentally damaged. Meanwhile, Public Senior High School 2 does not impose sanctions but only applies an additional value system to increase students' enthusiasm and discipline in carrying out practicum.

Administration of the loan of laboratory equipment and materials is a clear policy regarding the tools that may and may not be loaned, as well as the rules and procedures for borrowing (Fauziah et al., 2014). Therefore, the laboratory manager should apply to the SOP for borrowing laboratory equipment and materials to minimise the loss or mismatch of returned equipment and materials and to avoid misunderstandings between the laboratory manager and students who borrow laboratory equipment and materials.

Maintenance and care activities for laboratory equipment and materials should be scheduled and recorded (Rosada et al., 2017). Maintenance and care activities for laboratory equipment and materials are carried out to maintain the quality of laboratory equipment and materials. This is because there are several tools and materials in the laboratory that have high prices, while the realisation of the procurement of laboratory goods is not carried out in each of them. The parties involved in the maintenance of facilities and infrastructure in biology laboratories of senior high schools in Majalengka Regency are all people involved in the use of laboratory facilities and infrastructure, including laboratory users and managers. Even so, the one who plays an important role in the maintenance of this infrastructure is the head of infrastructure facilities, as stated in Permendiknas No. 19 of 2007. If all laboratory users and managers are involved, then the maintenance of facilities and infrastructure in this laboratory should be done optimally. However, some schools are not optimal in carrying out maintenance of infrastructure facilities, so the laboratory is not neatly arranged. There are even schools that cannot use the laboratory room because it is dirty and there is no fresh water available. Some schools recorded maintenance activities on the list of proposed procurements of tools and materials.

Work safety in the laboratory

The introduction of laboratory K3 will also minimise the occurrence of accidents in the laboratory. According to Rosada et al. (2017), The occurrence of accidents can be prevented by determining appropriate K3 guidance and supervision efforts effectively and efficiently. This is in accordance with Permendiknas Number 26 of 2008, which states that the laboratory must establish provisions regarding K3 in the laboratory. However, the handling of accidents is still lacking because students usually do not tell the teacher if there is a minor accident. Not all teachers help students handle accidents they have experienced. Only on several occasions does the teacher help; sometimes, the teacher also asks students to handle it themselves by giving directions on what needs to be done. For accidents such as fires, slips and splashes of substances, researchers did not find such cases.

Although an understanding of K3 in the laboratory has been given, every school needs to have adequate work safety and security facilities such as first aid equipment, fire extinguishers, laboratory coats, and gloves, which can be used to get out if a fire occurs in the laboratory (Ramadhani, 2020). As according to Rosada et al. (2017) that laboratory coats include

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work safety equipment that is used daily. Laboratory coats need to be used by practitioners to prevent various possibilities of work accidents, such as being exposed to chemicals, being exposed to splashes of chemicals, being exposed to broken glass, being hit by objects, and others. However, not all schools have and provide them. Public Senior High School 1 only has a laboratory coat. Public Senior High School 2 only has a fire extinguisher and a laboratory coat. Public Senior High School 3 has a first aid kit and a laboratory coat. Meanwhile, Public Senior High School 4 does not have any safety and security facilities. Therefore, it can be assumed that the biology laboratory has a high risk for its users, especially for Public Senior High School 4.

CONCLUSION

Based on the results of the research analysis of the quality of biology laboratories of senior high schools in Majalengka Regency in the academic year 2023/2024 on the indicators of laboratory space and biology laboratory management. It can be concluded that the average percentage of suitability of the biology laboratory room is 77.5% with a good category. The indicators that determine this percentage are meeting the minimum area ratio (1.5 of the classroom area), accommodating one study group, having a preparation room, having a storage room or warehouse, having adequate air ventilation, having sufficient lighting, having an emergency exit, is located ≥ 3 metres from other rooms and the laboratory door opens outwards. Overall, laboratory management is good but not optimal and not optimal. Things that are less than optimal include incomplete laboratory administration, non-implementation of laboratory equipment maintenance activities in several schools, lack of supervision of the use of practicum, the absence of laboratory assistants in several schools, and the lack of safety and security facilities in the laboratory. In the absence of those who manage the biology laboratory directly, the biology laboratory room becomes neglected, damaged and cannot be used.

Conflict of interests

There are no known conflicts of interest associated with this publication.

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