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Analysis of Chemical Laboratory Management at SMAN 55 Jakarta

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Abstract

An understanding of laboratory management is highly important to be owned by parties related to the laboratory, both directly and indirectly. Laboratories must be managed and utilized properly, because chemical laboratories are one type of laboratory that is considered quite dangerous in the context of carrying out education, research, and / or community service. This study aims to describe the management of a chemical laboratory using qualitative descriptive research methods. Research subjects were the principal, vice chairman of the curriculum, chair of the laboratory, and teachers in the field of chemistry studies. Data collection techniques are observation, interviews, and documentation. The results of the research are: 1) Planning of chemical laboratory work program has been prepared and standardized by the head of the laboratory, 2) Organizing the laboratory structurally already exists, 3) Organizing by the principal involving all those involved in laboratory management, 4) The implementation of the program is suitable with the plan of the work program, 5) Supervision and evaluation of the principal must still be carried out intensively. In other words, laboratory management at SMA 55 Jakarta has been well organized.

Keywords: Chemistry, Laboratory, Management.

INTRODUCTION

Currently learning is centered on students (student-centered) which are used as an approach in the learning process. According to Oemar (2008), states that learning is a combination that is composed including human elements, materials, facilities, equipment and procedures that influence each other in achieving learning objectives. Learning is essentially a process of interaction between students and their environment so that changes in behavior happen for the better. Many factors affect the learning process, both internal and external factors. According to Mulyasa (2007) the most important task of educators is to condition the environment in order to support behavior change for students. Learning activities are directed to empower all potentials possessed by students. It is hoped that students will have competence through efforts to grow and develop attitude, knowledge, and skills.

In a book written Hosnan (2014) states that the qualities that must be realized include creativity, independence, cooperation, solidarity, leadership, empathy, tolerance and life skills of students to shape the character and improve civilization and national dignity. Therefore, to develop the affective, cognitive, and skill domains and increase the potential of students it is not enough to only rely on learning in the classroom (Bakri, 2019, Sumardani, 2019), but it needs to be supported by learning outside the classroom, both in the form of virtual simulation activities (Sumardani, 2020; Bakri, 2019), for example in chemical laboratory (Lynden-Bell,



2007) and physics laboratory (Bakri, 2019), and directed activities in the form of practicum and experimentation in laboratory (Sumardani, 2020). These activities are usually carried out in the laboratory.

The laboratory is a place to carry out practical activities that support learning in the classroom, including workshops/workshops, experimental fields, studios, and studios. School laboratories are a means of learning as an effort to increase students' understanding of the application of facts, concepts, and principles through scientific experiments. The importance of the existence of laboratories as a learning tool for students can determine the quality of learning outcomes. To support the learning process, special attention is needed in managing the laboratory where it must be served by competent school laboratories, complete equipment, and good management. Lack of knowledge and experience from laboratory personnel is often an obstacle in laboratory management (Marlina, 2016).

Thus, special training and upgrading regarding the management of chemical laboratories are necessary to produce reliable laboratory personnel. Improper laboratory management can cause the laboratory to become a dangerous place for students so that work accidents and fatal damage can occur later, especially the chemical laboratory.

METHODS

This research uses a descriptive method using a qualitative approach referring to the results of the research method (Wiersma & Jurs, 2005) because in this study researchers obtained information about laboratory management and its use in learning chemistry at SMA Negeri 55 Jakarta. In addition, this study emphasizes data collection to describe the actual situation that occurs from qualitative data. The subject of this research was a chemistry laboratory at SMA Negeri 55 Jakarta. In the process of data retrieval, research instruments were used in the form of interviews with the head of Jakarta 55 Public High School, head of the laboratory, and teachers in the field of chemistry studies. In addition, to complete the data also used direct observation of the chemistry laboratory of SMA Negeri 55 Jakarta. Data collection techniques in this study were by conducting interviews with the head of the Jakarta 55 High School, the head of the 55 Jakarta High School laboratory and the chemistry study teacher and directly observing the chemistry laboratory of the 55 Jakarta High School as the research subject. The data analysis technique used in this study is qualitative analysis. According to Miles and Huberman (1994: 23) descriptive qualitative analysis consists of four interacting components, namely data collection, data reduction, data presentation, and withdrawal. The instrument that was created was used in data collection at SMA Negeri 55 Jakarta. Data generated from research in the form of qualitative data are presented in the form of descriptions according to the actual situation related to the management of the laboratory in the school.

RESULT AND DISCUSSION

Result

In general, the planning of chemical laboratory work programs, namely: the planning of chemical laboratory work programs in SMA 55, Jakarta, has been systematically arranged. There are coordination and cooperation between the school principal and the representatives of facilities and infrastructure, the head of the laboratory and the chemistry teacher in compiling work programs both short-term work programs and long term work programs.

The chemical laboratory of SMAN 55 Jakarta has not made a plan about work safety in the laboratory resulting from research on organizing a chemical laboratory, namely: organizing a chemical laboratory structurally consisting of the head of the science laboratory and the person in charge. The organizational structure is posted in the chemistry laboratory with the structure of the principal, head of the laboratory, and the responsibility of the chemistry laboratory.

Results of research on the implementation of chemical laboratory work programs, namely: all administrative activities such as: making card stock material, filling card stock material, making labels on tools and materials, making the format of borrowing / using tools and materials, as well as labeling chemicals in laboratories carried out by the head of the laboratory, have not been done thoroughly. The process of procuring practicum modules in the chemistry laboratory does not yet exist so the teacher prepares the modules himself in the implementation of the practice.

The results of research on Supervision and evaluation in the implementation of the chemical laboratory work program that is carried out supervision by the head of SMA 55 Jakarta in managing the chemical laboratory. The principal never sanctions if laboratory personnel does not carry out their duties properly. The principal only gives a warning. Evaluation is done twice a year.

According to Kemendikbud (2007), chemical laboratory are equipped with facilities and infrastructure as listed in table 1. Supporting factors in the management of chemical laboratories at SMA Negeri 55 Jakarta is the availability of tools and materials in chemical laboratories. The obstacles in the management of chemical laboratories at SMA Negeri 55 Jakarta are the absence of laboratory technicians, the absence of fire extinguishers, and lack of air circulation.

Discussion

Planning is a process for determining design. According to Yusuf (2009), educational planning has an important role and is at an early stage in the process of education management, which is used as a guide for the implementation, control, and supervision of the implementation of education. Planning can also be interpreted by a systematic thought process about the activities that must be carried out, the steps, methods, human resources, manpower and funds needed to achieve the specified goals effectively and efficiently. The results of the research show that the planning of a chemical laboratory at SMA Negeri 55 Jakarta has been prepared and standardized in a work program contained in the vision, mission, and goals. The laboratory work program is prepared by the head of the laboratory and approved by the school principal and is socialized at the beginning of each semester and evaluations are conducted at the end of the semester or twice a year.

The determination of personnel in the organization of chemical laboratories is carried out at the beginning of the meeting of the new school year. Personnel who are directly involved in the implementation of laboratory management, namely: school committee, school principal, head of the laboratory, chemistry study teacher. According to (Sudaryanto, 1998) laboratory organization is a system of the collaboration of groups of people, goods, or certain units about laboratories to achieve goals. Organizing a chemical laboratory means arranging a group of people or officers and other resources to carry out a plan or work program to achieve the stated goals. Whereas according to (Torang, 2014) organizations are consciously coordinated social entities, consisting of two or more people with relatively identified boundaries that function sustainably to achieve a common set of goals.

Implementation is an action of a plan that has been prepared carefully and in detail. So, simply, implementation can be applied. Through implementation, deviations will be minimized and make it easier for management to evaluate.

After reviewing the results of the interview, the head of the laboratory checks the tools and materials regularly at the end of the semester, while the chemistry teacher usually checks the tools and materials before the practicum is carried out in the laboratory. Systematic reporting on this matter will be submitted to the person in charge of the deputy head of the field of facilities and infrastructure and then forwarded to the head of SMA Negeri 55 Jakarta.

According to Kemendikbud (2007), chemical laboratory are equipped with facilities is listed in Table 1.

TABLE 1. Types, ratios, and descriptions of chemical laboratories

No	Type	Ratio	Description
1	Furniture		
1.1	Chair	1 unit / student, and 1 unit / teacher	Strong, stable and easy to move.
1.2	Workbench	1 unit/ 7 students	Strong and stable. Adequate size to accommodate participant activities educate in groups of up to 7 people.
1.3	Demonstration table	1 unit/lab	Strong and stable. The size of the table allows for demonstrations and holds the equipment and materials needed. Height of the table allows all students to observe the experiments demonstrated.

No	Type	Ratio	Description
1.4	Preparation table	1 unit / lab	Strong and stable. Adequate size for preparing experimental material.
1.5	Tool cabinet	1 unit/lab	Closed and can be locked. Adequate size for hold all tools.
1.6	Cupboard material	2 units/lab	Strong and stable. Enough to store all ingredients, not easy to rust, the shelf is firmly propped up. Sliding, locked door.
1.7	Hood	1 unit/lab	Minimum size of space in a cupboard 0.9 m x 0.6 m x 0.9 m. The height of the work area from the floor is 70 cm. Material is stainless, acid resistant, has glass doors that can be partly opened and closed, has good lighting, the gas discharge channel goes straight out and pumped up, have clean water channels and outcast.
1.8	Washtub	1 unit / 2 groups and 1 unit in the preparation room	Clean water is available in sufficient quantities.
<hr/>			
2	Educational Equipment		
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2.1	Bottle of substance	Each of 24 units / lab	Bertutup. Volume: 100 ml, 250 ml, dan 500 ml.
2.2	Drop pipette	100 units/lab	Long tip, with rubber. 20 cm in size.
2.3	Stirring bar	Each of 25 units/lab	Diameter: 5 mm and 10 mm, 20 cm long.
2.4	Beaker glass	Each of 12 units/lab	Volume: 50 ml, 150 ml, and 250 ml.
2.5	Beaker glass	Each of 3 units/lab	Volume: 500 ml, 1000 ml, and 2000 ml.
2.6	Erlenmeyer	25 units/lab	Volume 250 ml.
2.7	Volumetric flask	Each of 50, 50, and 3 units/lab	Volume: 50 ml, 100 ml, and 1000 ml.
2.8	Volume pipette	Each of 30 units/lab	Permanent scale. Volume: 5 ml and 10 ml.
2.9	Life-sized pipette	Each of 30 units/lab	Permanent scale. Volume: 10 ml, 25 ml, and 50 ml.
2.10	Funnel	Each of 30 and 3 units/lab	Diameter: 5 cm and 10 cm.
2.11	Mortar	Each of 6 dan 1 units/lab	Ceramic material, glazed inside. Diameter: 7cm and 15cm.
2.12	Spray bottle	15 buah/lab	Bahan plastik lentur. Volume 500 ml.
2.13	Graduated Cylinder	Each of 15, 15,15, 3, and 3 units/lab	Volume: 10 ml, 50 ml, 100 ml, 500 ml, and 1000 ml.

No	Type	Ratio	Description
2.14	Burette + clamp	10 units/lab	Permanent scale, hand burette clamps easily actuated, class B. Volume 50 ml.
2.15	Stative and clamps	Each of 10 units/lab	Iron, stainless, stable, strong, smooth surface. Boss clamp clamps.
2.16	Watch glass	10 units/lab	Diameter 10 cm.
2.17	Split funnel	10 units/lab	Glass material. Volume of 100 ml.
2.18	Distillation tool	2 sets/lab	Glass material. volume of 100 ml.
2.19	Scale	2 sets/lab	Accuracy of 10 mg.
2.20	pH meter	2 sets/lab	Accuracy of 0.2 (analog) and 0.1 (digital).
2.21	Centrifuge	1 unit/lab	Using electric power, minimum 4 tubes.
2.22	Barometer	1 unit/lab	For lab walls, equipped thermometer.
2.23	Thermometer	6 units/lab	Can measure the temperature of 0-100 °C, accuracy 1 °C, does not contain mercury.
2.24	AC / DC multimeter, 10 kilo ohms / volt	6 units/lab	Can measure voltage, current and resistance. Minimum current measurement limit of 100 mA-5 A. The minimum voltage measurement limit for DC 100 mV-50 V. The minimum voltage measurement limit for AC 0-250 V.
2.25	Spiritus burners	8 units/lab	Glass material, lid.
2.26	Three feet + gauze base Wire	8 units/lab	Height adjustable height spiritus burner.
2.27	Stopwatch	6 units/lab	Accuracy of 0.2 seconds.
2.28	Calorimeter	6 units/lab	Can provide data for reaction enthalpy learning. Low material heat capacity. 250 ml volume.
2.29	Test tube	100 units/lab	Glass. Volume: 20 ml.
2.30	Test tube rack	7 units/lab	wood. Minimum capacity of 10 tubes.
2.31	test tube brush	10 units/lab	Fuzz. Diameter of 1 cm.
2.32	Centrifuge tube	8 units/lab	Glass, size according to centrifuge.
2.33	Periodic Table of the Elements	1 unit/lab	Poster, 220 gram paper, laminate, can be hung.
2.34	Molecule model	6 sets/lab	The minimum can indicate hydrogen, oxygen, nitrogen, sulfur and carbon atoms, and can strung together into molecules.
2.35	Experiments manual	6 units/ experiment	

No	Type	Ratio	Description
3	Educational media		
3.1	White board	1 unit/lab	Minimum size is 90 cm x 200 cm. Placed in a position that allows all students to see clearly.
4	Consumables		Consumables available in the laboratory include chemicals, with a lot at any time 1.2 x much needed. Chemicals include substances needed in experiments: Introduction to Chemical Reactions, Techniques Separation and Purification, Acid-Base Titration, Electrochemistry, Energetics, Manufacturing of Applied Chemical Knowledge Products
5	Others		
5.1	Electrical socket	9 units/lab	1 socket for each student table, 2 sockets for the demo table, 2 sockets for the preparation room.
5.2	Fire extinguisher	1 unit/lab	Easy to operate.
5.3	First aid kit	1 unit/lab	Consist of first aid kit and its contents are not expired including first aid medicine for burns and wounds open.
5.4	Trash can	1 unit/lab	
5.5	Wall clock	1 unit/lab	

The table above is an indicator of the Kemendikbud regarding a good chemistry laboratory. The interview revealed that the monitoring and evaluation process was carried out twice a year with details at the end of each semester. According to Mrs. Nidaa as the person in charge of chemical laboratories as well as chemistry teachers at SMA Negeri 55 Jakarta that the recent evaluation found that the availability of tools and materials in the laboratory reached 92% and according to Mr. Nelson Sirait as the head of the chemistry laboratory the laboratory feasibility level reached 70%.



FIGURE 1. Medium-Scale wooden glass cabinet



FIGURE 2. Medium-Scale stainless steel glass cabine



FIGURE 3. Practicum Table And Stative



FIGURE 4. Tool Washbasins



FIGURE 5. Practical Table and Scale



FIGURE 6. The Drawer under The Practicum Table



FIGURE 7. The Chemical Storage Cabinet



FIGURE 8. PPE Storage Cabinets



FIGURE 9. Acid Cabinets



FIGURE 10. Wooden Cabinet for Tool Storages

The results of research conducted by researchers supporting factors in managing chemical laboratories are the availability of adequate tools and materials. Appropriate tools and materials can facilitate the work of chemistry subject teachers in explaining practicum to students.

Other research results are found that the absence of laboratory staff is an inhibiting factor in the management of chemical laboratories because all the main tasks and functions (tupoksi) of the laboratory assistant must be done indirectly by the head of the laboratory and subject teachers when carrying out practicum activities. Other inhibiting factors are the absence of APAR in the laboratory and lack of air circulation.

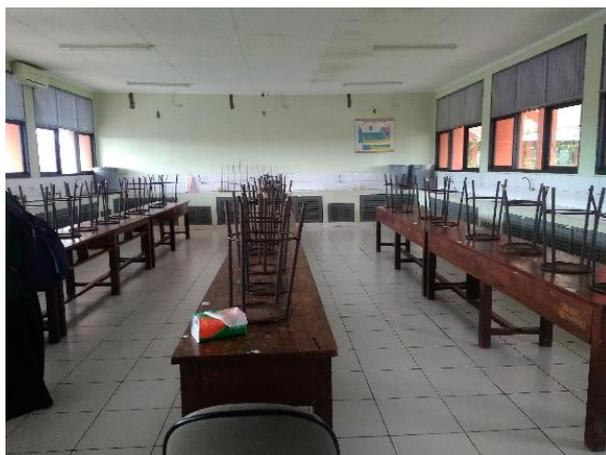


FIGURE 11. The Condition of Air Vents in The laboratory Room



FIGURE 12. The Condition in the Corner of the Lab That Doesn't yet have a Fire Extinguisher.

In the Regulation of the Minister National Education of the Republic of Indonesia in the laboratory it is explained that there must be a medium or large-scale glass tools as shown in Figure 1, Figure 2 and Figure 10, then there is a practicum table and a stative device along with clamp clamps in the Figure 3 and scale to measure mass from a substance such as the balance sheet in Figure 5, then there is a sink as a place for washing tools and disposal of waste materials or waterways as in Figure 4, after that there is a wooden cabinet as a chemical storage area in Figure 7 or storage of personal protective equipment in Figure 8 and the fume hood in Figure 9, then in Figure 11 and Figure 12 show the condition of the air ventilation and corner of the laboratory room that does not yet have a fire extinguisher.

According to (Ministry of National Education Directorate General of PMPTK, 2010), lack of knowledge and experience from laboratory personnel is often an obstacle in laboratory management. For this reason, it is very necessary to have special training and upgrading regarding the management of chemical laboratories so as to produce qualified laboratory personnel, especially the head of the laboratory.

CONCLUSION

From the results of chemical laboratory management research in SMA Negeri 55 Jakarta, the results show that: chemical laboratory planning has been arranged and standardized in a work program contained in the vision, mission, and goals of Jakarta 55 Public High School. The standardization of planning used refers to the Regulation of the Minister of National Education of the Republic of Indonesia Number 24 of 2007 concerning means and infrastructure standards for elementary school/madrasah ibditaiyah (SD/MI) first middle school/madrasah tsanawiyah (SMP/MTS), and middle schools/madrasah aliyah (SMA/MA), which was held in a meeting at the beginning of semester meeting to reach consensus and agreement together which subsequently serves as a mandatory policy to be obeyed by all school officials. In organizing a chemical laboratory already exists and consists of the principal, head of the laboratory, the person in charge of the chemical laboratory and the chemical laboratory. The checking of chemical laboratory equipment and materials at SMA 55 Jakarta is good and is done regularly by the head of the chemical laboratory. Monitoring and evaluation on a large scale are carried out twice year by all school authorities. However, each week there will be supervision and evaluation by teachers I the field of chemical studies, especially for teachers who will use the laboratory from practicum where the availability and condition of tools and materials are checked. Thus, this is considered quite effective in laboratory supervision and evaluation. Supporting factors from the chemical laboratory at SMA Negeri 55 Jakarta is the presence of tools and chemicals that are complete and suitable for use by students at SMA Negeri 55 Jakarta. The inhibiting factors are lack of air circulation, unavailability of light fire extinguishers, and also the absence of laboratory assistants. In other words, the management of chemical laboratories at SMA Negeri 55 Jakarta is well organized.

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