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Analysis of the Utilization of Science Laboratories in Integrated Islamic Junior High Schools

Ulfah 'Aini [1*], Niken Indrata Marselina [2], Arfy Masyhuri [3], Doriani [4], M. Rahmad [5*], Roza Linda [6]

[1,2,3,4,5,6] Master of Science Education Study Program, University of Riau, Indonesia

E-mail correspondence : ulfahaini20@gmail.com

Abstract

This research was conducted to examine the management of the science laboratory at Al Fityah Integrated Islamic Junior High School Pekanbaru, which has not been optimal, thereby hindering the effectiveness of practical-based learning. The research aims to describe and analyze science laboratory management based on four management aspects: (1) planning, (2) organizing, (3) implementation, and (4) monitoring and evaluation. This study uses a descriptive research method with a case study approach. The research subjects include eighth-grade students, the school principal, the laboratory head, and science teachers. Data was collected through observation, interviews, documentation, and questionnaires. Data analysis followed the Miles and Huberman model (data reduction, data presentation, and conclusion drawing) with source triangulation to ensure validity. The results indicate that: (1) Laboratory management planning is not systematic—there are no SOPs, work programs, or written practical schedules; (2) Organization does not follow management principles—the organizational structure is informal, with the laboratory head also serving as a teacher without laboratory staff support; (3) Implementation is suboptimal—practicals are rarely conducted in the laboratory (mostly in classrooms), equipment is limited, and there are no occupational health and safety (OHS) procedures; (4) Monitoring and evaluation are informal, lacking documentation or external supervision. Based on the findings, the science laboratory management in this school does not meet the standards, primarily due to weaknesses in the management system across all four aspects. Therefore, comprehensive improvements are needed to support practical-based science learning in the laboratory.

Keywords *: Science Laboratory Management, Planning, Organizing, Implementation, Supervision and Evaluation*

INTRODUCTION

Natural Science (IPA) learning at school level aims to develop students' understanding of the natural environment through structured scientific activities, such as conducting observations, experiments, and compiling concepts logically and systematically (Herlina et al., 2020). In the context of implementing the Independent Curriculum, the IPA learning approach emphasizes student involvement in activities that stimulate their intellectual abilities through a comprehensive and efficient scientific process (Kemendikbud, 2022). It is
hoped that through this approach, students will be able to build a high sense of curiosity and have the ability to solve environmental problems directly and responsibly.

Through the Merdeka Mengajar platform, students are directed to develop their abilities in identifying problems, analyzing them, and formulating concrete solutions through science learning activities (Ministry of Education and Culture, 2022). This science provides students with the opportunity to understand various natural phenomena comprehensively while developing investigative abilities, research skills, and the formation of scientific concepts that can be applied in everyday life (Kalemben et al., 2018).

The science learning process also prioritizes empirical experience as a means of building student competencies in facing environmental challenges with a scientific approach (Isnaini & Anwar, 2018). The curriculum implemented has designed a systematic science learning flow according to the level of education (Wisudawati & Sulistyowati, 2022). However, the effectiveness of science learning is greatly influenced by various aspects, such as student characteristics, the learning methods used, and a deep understanding of the nature of science itself.

Through the learning process, students are expected to achieve competencies in accordance with the learning outcomes that have been designed in the curriculum module (Wisudawati & Sulistyowati, 2022). However, in practice, science learning is often considered challenging because it requires active student participation in a series of scientific stages, starting from observing, formulating questions, conducting experiments, reasoning, to conveying the results (Rohmawati et al., 2018).

Science learning emphasizes the importance of practical activities in the laboratory as one of the main approaches (Rahmadhani et al., 2022). Through practical work, students can develop science process skills, sharpen critical thinking skills, and deepen their understanding of the concepts being studied (Sitti Mulia & Sitti Murni, 2022). In a competency-based curriculum, the laboratory is key components in science learning (Susilo & Amirullah, 2018).

Optimal use of laboratories enables students to learn science concepts through direct experience. The laboratory not only functions as a place for experiments, but also as a means to develop logical and creative thinking skills. Through practical activities, students are trained to observe, test hypotheses, and conclude experimental results scientifically to strengthen theoretical understanding (Sutrisno, 2017; Rustaman et al., 2005).

However, the implementation of laboratory functions in schools does not always run effectively. In several educational units, for example in one MTs, the use of laboratories faces various obstacles such as limited training, inadequate facilities, and teacher backgrounds that are not fully relevant to the science field (Ismiyanti et al., 2021). In addition, concerns about equipment damage often hinder student access to laboratories.

According to Rostiyana et al. (2022) , management of science laboratories in a number of schools has not yet reached an optimal level, especially regarding spatial planning, cleanliness, and waste management. Meanwhile, Setiawati et al. (2021) highlighted that limited manpower, especially laboratory personnel, is one of the main obstacles in managing these laboratories. Even in schools with complete facilities such as SMPN 2 Tempurejo, problems are still found related to student accuracy in using equipment, which

results in damage to equipment during the cleaning stage (Amalatus et al., 2021).

A number of previous studies have examined the use of laboratories in science learning, which generally highlight the ideal conditions of laboratory facilities in schools (Rahman, 2017; Munarti & Sutjihati, 2018; Pertiwi, 2019; Nulngafan & Khoiri, 2021). Some schools have even begun to adopt a new, more flexible approach to laboratory management, considering the high costs of equipment maintenance and procurement (Ezrailson, 2013; Anggereni & Ikbal, 2018).

To ensure the function of the laboratory as a proper scientific practice facility, the government has set minimum standards for science laboratories through the National Education Ministerial Regulation Number 24 of 2007. This regulation requires every junior high school/Islamic junior high school to have a special laboratory space separate from regular classrooms, and equipped with educational furniture and tools such as human body models, lenses, mirrors, globes, magnifying glasses, and science-themed posters. In addition, supporting aspects such as closed tool cabinets, trash bins, hand washing areas, ventilation, and lighting are also part of the standard provisions. In addition, Permendikbud Number 26 of 2008 emphasizes the importance of the existence of competent laboratory technicians or laboratory personnel to ensure the safety and effectiveness of practicums. (Kemendiknas, 2007; Kemendikbud, 2008)

However, the implementation of these standards is not yet evenly distributed across all educational units. One concrete example is the condition of the science laboratory at Al Fityah Integrated Islamic Middle School, which is the object of study in this research. Based on the results of observations and documentation, the laboratory in this school does not yet meet the ideal criteria as regulated in the Minister of National Education Regulation. Laboratory rooms are often converted for non-academic purposes such as religious activities or storage of goods, which are contrary to the function of the practice room as it should be.

In addition, limited tools and materials for practical work, minimal posters or visual aids, and the absence of laboratory technical personnel also become obstacles in supporting experimental-based learning. This condition is exacerbated by the absence of a routine budget for laboratory maintenance and the absence of Standard Operating Procedures (SOPs) that regulate the implementation and maintenance of laboratory activities systematically. As a result, students rarely gain direct experience in practical activities. This has the potential to hinder students' achievement of psychomotor competencies (Fadhilah, 2019).

A review of previous research shows similarities and differences with this research. The similarity lies in the focus of the study which discusses laboratory standardization in schools with a descriptive approach. Meanwhile, striking differences are seen in the data sources and focus of the study. The focus of this study covers four aspects of management: (1) planning, (2) organizing, (3) implementation, and (4) supervision and evaluation in the Science Laboratory of Integrated Islamic Middle Schools. Therefore, this study aims to evaluate how the science laboratory is used in the school, including aspects of compliance with standards and its relevance to the science learning process.

METHOD

This study uses a descriptive approach to gain a comprehensive understanding of the phenomena experienced by the research subjects, including their behavior, actions, and interests. The type of approach used in the study is a case study. Case studies are conducted holistically by presenting data narratively using natural language that describes the actual conditions in the field (Wicitradari, 2024). In addition, this approach is used so that information from the social unit in focus can be explored in depth and in detail. From the application of this approach, it is hoped that research can produce a comprehensive understanding of the object being studied.

The research was conducted in 2025 at Al Fityah Integrated Islamic Junior High School in

Pekanbaru. The subjects who were respondents in this study consisted of the Principal, Head of Laboratory, 2 Science Teachers, and 42 students in grade VIII who were involved in laboratory activities. The main focus of the study included four aspects of science laboratory management, namely planning, organizing, implementing, to monitoring and evaluation.

This study uses primary data in the form of interview results with the principal, laboratory head, teachers, observations of laboratory conditions, closed questionnaires from students, and documentation.

The data analysis technique used is data analysis developed by Miles and Huberman, including: (1) Data reduction, namely the process of selecting focus, simplifying, grouping and collecting information in various groups based on the known problem focus (2) presenting data with displaying information grouped according to what you want to know, using narrative with Add tables and images to support data (3) Conclusions and verification with review data needed to check repeat until a conclusion is reached . In this study, the validity of the data was tested using the source triangulation method and data collection techniques (Widiyanto, Bayu, M. Nur Hayati, & I. Ngesti Utami, 2025).

Then the presentation and verification of the power carried out, are categorized against the level of suitability of the science laboratory conditions in schools with national standards stipulated in the Regulation of the Minister of National Education Number 24 of 2007. The classification of this category is limited to two main categories, namely appropriate and inappropriate. The category used according to the criteria if the aspects of the analyzed indicators show minimal fulfillment as stated in the national standards, while the inappropriate category is given if the indicators have not been substantially fulfilled. This assessment is carried out on four aspects of laboratory management, namely: planning, organizing, implementing, and monitoring and evaluation.

RESULTS AND DISCUSSION

The results of the analysis of the suitability of the Al Fityah Integrated Islamic Middle School Science Laboratory with the standards of the Minister of National Education Regulation No. 24 of 2007 based on the aspects of planning, organizing, implementing, and monitoring and evaluation can be seen in Table 1.

Table 1. Results of the Analysis of the Suitability of Science Laboratories Based on 4 Management Aspects and Permendiknas No. 24 of 2007

No	Management Aspects	Indicator	Findings in School	Minister of National Education Standard No. 24 of 2007	Compliance
1	Planning	Availability of laboratory SOPs	No written SOP available	There must be a written SOP that regulates laboratory use and safety.	It is not in accordance with
		Science practical schedule	There is no practical schedule	Practicums must be scheduled systematically in the learning program.	It is not in accordance with
		Procurement plan for tools and materials	Not available	Annual planning is needed based on the need for practical tools and materials.	It is not in accordance with
2	Organizing	Head of laboratory	Accompanied by science teacher	It is best held by special personnel or teachers with additional duties.	It is not in accordance with
		Laboratory staff	No laboratory staff available	It is recommended to have laboratory staff according to Permendikbud No. 26 of 2008	It is not in accordance with
		Inventory of tools and	Not available	There must be a locked inventory and tool	It is not in accordance

No	Management Aspects	Indicator	Findings in School	Minister of National Education Standard No. 24 of 2007	Compliance
		materials		storage cabinet.	with
3	Implementation	Use of laboratory space	Often converted (religious/storage)	Must be used specifically as a science lab room	It is not in accordance with
		Availability of science tools and media	Many tools are not available (posters, anatomical models, optical instruments, etc.)	There must be at least basic tools available according to the national standard list.	It is not in accordance with
		Implementation of practical work	Practicums are not routine, only demonstrations by the teacher	Practicums must involve students actively and continuously.	It is not in accordance with
		Safety and comfort facilities	First aid kits, personal protective equipment (PPE) are not available, and lighting is inadequate.	Safety and hygiene facilities must be available in the laboratory space.	It is not in accordance with
4	Monitoring & Evaluation	Evaluation of use and maintenance	No laboratory evaluation documents	Periodic evaluations of equipment use and condition must be carried out.	It is not in accordance with
		Principal supervision	Supervision is not routine, not documented	The principal needs to carry out regular supervision and recording.	It is not in accordance with

Planning

Based on the results of observations, the planning of the management of the science laboratory at Al Fityah Integrated Islamic Middle School has not been implemented systematically. No written documents were found, such as Standard Operating Procedures (SOP), work programs, or practicum calendars, which should be the basis for implementing laboratory activities. Practical activities are not scheduled in the semester program, and there is no plan for the gradual or periodic procurement of laboratory equipment and materials. The absence of this formal document shows that the school does not yet have a plan that refers to laboratory management standards as regulated in the Minister of National Education Regulation Number 24 of 2007.

The results of the interview with the head of the laboratory who also serves as a science teacher confirmed the observation findings. He stated that the practicum activities were carried out incidentally, depending on the readiness of the teacher or the available tools, not based on the official practicum schedule. There were no SOPs that regulated the borrowing of tools, the implementation of practicums, or the maintenance of laboratory facilities. This reflects weak planning, which causes laboratory activities not to run in an organized and sustainable manner.

Findings from the student questionnaire also support this conclusion. Most students stated that they did not know about the existence of SOPs, practical schedules, or laboratory work programs. The low level of student understanding of laboratory activity planning indicates that there has been no adequate socialization or communication from the school or teachers regarding formal laboratory management.

Overall, the science laboratory planning aspect in this school is in the category of not complying with the standards of the Minister of National Education Regulation No. 24 of 2007. The absence of clear planning documents, the absence of special space and time, and minimal

socialization to students are the main obstacles in optimizing laboratory functions. As a result, practicum activities tend to be unscheduled, situational, and do not provide structured scientific experiences for students. This finding is in line with the opinion of Setiawati et al. (2021), who emphasized that weaknesses in laboratory planning will hinder the implementation of practicum programs effectively and in a structured manner.

Organizing

Based on the results of observations, the aspect of organizing the science laboratory at Al Fityah Integrated Islamic Middle School has not been implemented formally and systematically. No laboratory organizational structure was found either in visual form in the laboratory room or in written documents. The head of the laboratory, who also serves as a science teacher, carries out all management functions without the support of laboratory staff or technicians. This results in there being no clear division of tasks between management and teaching functions.

In-depth interviews with laboratory heads confirmed that there were no official job descriptions or supporting administration such as inventory lists, equipment loan forms, or laboratory usage records. The entire management process was carried out independently, without technical assistance or supervision from other parties. In addition, laboratory heads and science teachers did not have special training or certification in laboratory management, indicating that competency standards as stipulated in Permendikbud No. 26 of 2008 concerning School Laboratory Personnel Standards had not been met.

The results of the student questionnaire also strengthened these findings. In general, students stated that they did not know the organizational structure of laboratory management and did not understand the roles and duties of its management members. They also stated that they were not aware of any inventory list of tools and materials available in the laboratory. The lack of information received by students regarding the structure and management of laboratories shows that the organizing function has not been well socialized in the school environment.

Overall, the organizational aspect of the management of the science laboratory at Al Fityah Integrated Islamic Middle School is in the category of not in accordance with the laboratory management standards according to the Regulation of the Minister of National Education and the Regulation of the Minister of Education and Culture. The absence of formal structures, unclear division of roles, lack of support staff, and weak internal documentation and information systems have the potential to hinder the effectiveness and efficiency of laboratory functions. If not immediately corrected, this condition can lead to a decline in the quality of laboratory services and an increased risk of procedural errors in the implementation of practicals.

This finding is in line with the research results of Ismiyanti et al. (2021), which stated that unsystematic organization will have a negative impact on the effectiveness of laboratory management in schools.

Implementation

Based on the results of observations, the implementation of science laboratory activities at Al Fityah Integrated Islamic Middle School has not been running optimally. The laboratory does not have a fixed usage schedule and no practical activity plans were found that were prepared based on the curriculum. Practical work is mostly done incidentally, depending on the teacher's readiness and the availability of tools and materials. Observations also show that laboratory space is not used exclusively for practical activities. This space is often converted into a multi-purpose room, used for meetings, storing goods, or other extracurricular activities. As a result, laboratory space cannot be used consistently as a place for scientific experiments, and most practical activities are diverted to the classroom.

Interviews with science teachers who also serve as laboratory managers confirmed the observation findings. The teacher said that there

was no formal schedule for the practicum, and its implementation depended on class conditions and equipment readiness. The teacher also revealed that all practicum preparations were done by themselves, without assistance from laboratory staff or technicians. Even in some cases, teachers have to use simple tools or ask students to bring materials from home. There is no system for borrowing equipment or procedures for using laboratory space. In addition, no explicit occupational safety standards were found to be implemented, such as safety signs, tool usage instructions, or laboratory SOPs.

The results of the student questionnaire reinforce this picture. Most students stated that they rarely do practical work in the laboratory and have never received official information regarding the practical schedule. Practical work is mostly done in the classroom, with limited facilities. Students also felt that the laboratory facilities were incomplete, and they did not find safety instructions or other technical information that should be available in the laboratory room. This shows that practical activities have not been carried out systematically and have not been supported by a safe and complete learning environment.

Overall, the implementation aspects of the science laboratory in this school do not yet meet the principles of good laboratory management as regulated in the Minister of National Education Regulation No. 24 of 2007. Practical work is not yet a structured part of science learning, there is no official schedule, laboratory space is not used specifically, and facilities and infrastructure are inadequate. The absence of supporting staff and the non-implementation of safety standards further weaken the implementation of laboratory activities. Although teachers demonstrate adaptive efforts to overcome limitations, this is not a substitute for the importance of systemic support from the school.

This finding is in line with research by Fadhilah (2019) and Sitti Mulia & Sitti Murni (2022), which states that the implementation of practicums that are not supported by facilities and infrastructure, safety procedures, and support systems will have an impact on the low quality of experimental-based science learning.

Monitoring and Evaluation

Based on the results of observations, in-depth interviews, and documentation at Al Fityah Integrated Islamic Middle School, it is known that the supervision and evaluation aspects of science laboratory activities have not been implemented systematically and documented. No written reports were found regarding the evaluation of the laboratory work program, either in the form of daily checklists, reports of practical activities, or assessment documents regarding the use of tools and materials.

The results of interviews with the head of the laboratory conveyed that evaluations were carried out verbally and informally, usually only when there were certain obstacles. Evaluation of the condition of the tools and materials was also carried out after the practical activities were completed, but was not followed by official documentation such as damage records or maintenance reports. As a result, there is no historical data available to track problems or design improvements for the next period.

From the external supervision side, there was no routine supervision from the education office or school supervisors. Supervision of the implementation of laboratory activities was only carried out internally, by the principal or teacher, but also without a fixed schedule or formal evaluation format. The absence of structured supervision shows that laboratory management has not been a primary focus in the school quality management system.

The lack of monitoring systems and the absence of evaluative documentation have an impact on the difficulty of making continuous improvements. When there is no written evidence of the implementation of practicums, the use of tools, or obstacles that occur, then follow-up planning and laboratory development are not data-based, and tend to repeat the same pattern from year to year.

The results of the student questionnaire also strengthened these findings. The majority

of students did state that science teachers conducted evaluations after the practicum, but these evaluations seemed to be more related to students' understanding of the material or learning outcomes, rather than to the laboratory work system as a whole. This shows that academic evaluation is still ongoing, but has not been accompanied by a functional evaluation of the laboratory as a learning facility.

Regarding supervision by the principal, some students stated that they had seen the principal's involvement in supervising practical activities, but this involvement was not routine or systematic. Meanwhile, most students said that teachers were not always present to supervise the practice directly. This lack of direct supervision is an indicator that laboratory management has not received serious attention in the daily practice of science learning.

Overall, the supervision and evaluation aspects in the management of the science laboratory at Al Fityah Integrated Islamic Middle School are in the category of not in accordance with the principles of good laboratory management as regulated in Permendiknas No. 24 of 2007. Informal evaluations, internal supervision without a standard format and schedule , and the absence of external supervision indicate that the laboratory has not been integrated into the school quality management system. This finding is in line with the studies of Pertiwi (2019) and Najemah (2020), which emphasize that without documented evaluation and supervision, laboratory management cannot be directed towards improvement, and decision making will tend not to be data-based.

CONCLUSION

The management of the science laboratory at Al Fityah Integrated Islamic Middle School is not yet fully in line with the principles of effective education management and has not met the standards set out in the Minister of National Education Regulation Number 24 of 2007. This is reflected in the weak implementation of laboratory management in the four main aspects: planning, organizing, implementing, and monitoring and evaluation.

However, the observation results also show that the laboratory space is physically available and has a suitable basic form, although its function has not been optimally utilized. Science teachers also showed initiative and adaptation in conducting practicals, even with limited tools and without technical support. This shows that there is potential for development, if supported by systematic planning and supportive policies.

This finding confirms that a comprehensive improvement is needed in laboratory governance, both in terms of institutions, program planning, resource provision, and evaluation systems. Thus, the laboratory can function according to its purpose in science learning that emphasizes empirical, exploratory, and scientific process-based experiences. The implementation of effective laboratory management is very important to shape students' scientific skills and strengthen the quality of science learning in schools.

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