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2 Science Laboratory Activities: A Profile of the Implementation and Constraints of Junior High School Natural Science Teachers

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abstract

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This study aims to describe the implementation and various obstacles of laboratory activities in junior high schools. The study employed the descriptive quantitative method. The subjects of the study were science teachers in 41 junior high schools representing 4 areas of the Natural Sciences Teachers' Consultative Assembly (MGMP IPA) in Jawa Barat Province. The instrument employed was a questionnaire. The technical analysis of the data was conducted by calculating the average percentage of each answer choice of each statement. This research reveals that 1) the students' motivation for conducting laboratory activities is high; 2) the implementation of laboratory activities is conducted separately by employing theoretical classroom learning; 3) the source of guidance for laboratory activities is a model of cookbook laboratory; and 4) some obstacles in laboratory activities include insufficient laboratory spaces, less standardized and insufficient number of most equipment, the availability of manuals for laboratory activities, insufficient instructions to use laboratory equipment, and teachers' difficulties in designing, implementing, and evaluating laboratory activities. It is concluded that in general teachers and students are very enthusiastic about conducting laboratory activities in science learning, but they still have several constraints, especially in the available infrastructures. ³

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1. Introduction

The implementation of the science learning process generally has several criteria to fulfill the scientific methods that are compulsorily achieved. The criteria include the aspects of process, product, and attitude (Zeidan & Jayosi, 2015). The aspect of process is a series of learning activities of delivering knowledge and skills to students to become a scientist. The aspects of science products include clear and raw facts, concepts, theories, or laws that public can accept. The aspect of attitude is an internal factor built after the students follow the learning process. It includes a mindset, behavior, angle of view, and perspectives on problem solving (Obe, 2018)

School learning, the dominant aspect to develop, and train the students are still oriented to the aspect of products. Students are presented and given an overview of the phenomenon, concepts, theories, and laws, and they are then granted with sets of problem. The implemented

pattern of learning has a small possibility to build competence in the form of process skills and scientific attitudes (Rizal, 2019).

Process and attitude competencies can only be built with learning that keeps students actively discovering and conducting a series of learning activities (McKinley et al., 2017). One of the lessons that build process and attitude competencies is experiment-based learning that gives students a deep pace to build their knowledge with instructions and guidance from teachers as a facilitator. Consequently, students will greatly uphold their learning process because when they fail or misconduct learning process as directed by teachers, they will certainly get wrong knowledge/misconception. Furthermore, scientific attitudes, such as discipline, thoroughness, and responsibility will emerge through routines and true habituation (Octaviani, Subekti, & Putri, 2018).

The findings of previous studies indicate that the frequency of implementing laboratory activities, especially in secondary schools, is still rarely conducted (Simamra, 2018). Several reasons found in the school are 1) the existence of insufficient facilities and infrastructures, 2) insufficient learning hours during the busy class, 3) irrelevant depth of material to several types of laboratory activities at school, 4) compulsory maintenance of equipment, and 5) teachers' perspectives that laboratory activities are insignificant and time-consuming (Gatua, 2015; Junaidi, Hadisaputra, & Al-Idrus, 2017; Lestari, Yolida, & Achmad, 2017; Paramita, 2016).

These findings indicate that the teachers' paradigm is negatively valued to the students' cognitive development that primarily relates to the provision of learning experience in the form of laboratory activities. This research aims to provide an overview of the implementation of laboratory activities at junior high schools in Jawa Barat Province. This description is useful to map schools' performance on laboratory activities, investigate the levels and types of implementation of laboratory activities, and gain insights into barriers and constraints of the implementation of laboratory activities.

2. Method

This research employed the quantitative descriptive method to analyze the data. The data were collected by distributing a poll consisting of 7 questions about identity, 79 questions about the management and function of laboratories, 12 questions about student worksheets, and 11 questions about the correlation between development and training on 21st century

ability through activities laboratory. The data were collected by distributing online poll to 41 teachers of the Natural Sciences Teachers' Consultative Assembly (MGMP IPA). The questionnaire data were analyzed by employing an average percentage analysis of each item and item groups (Putri & Risdianto, 2014).

3. Result and Discussion

The poll obtains an overview of the implementation of activities laboratory in the schools as the research subject. Furthermore, the results of this study focus on discussing the availability of school laboratories, supporting facilities, and the implementation as well as constraints of laboratory activities.

Research Participants

This study involved 41 respondents who came from four areas of the Natural Sciences Teachers' Consultative Assembly (MGMP IPA) in Jawa Barat Province. The teachers who became the respondents were from Junior High School. Furthermore, the respondents' educational backgrounds varied: 0% is from science education background, 26.8% was from physics education, 41.5% was from biology education, 0% was from chemistry education, 2.4% was from mathematics education, 4.9% was from physics, 4.9% was from biology, 2.4% was from chemistry, 12.2% was from agriculture, and 4.9% was not from natural sciences.

These results posit an idea that the teachers' diverse backgrounds affect the readiness of teaching activities, especially laboratory activities. The curriculum for the junior high school in Indonesia emphasizes the basic materials of most natural sciences composed of physics and biology (Kementerian Pendidikan dan Kebudayaan Republik Indonesia, 2016). Knowledge built in the junior high school will become the foundation of knowledge in a higher level. The result of questioner deploys that the teacher's overall background is physics and chemistry education. The condition possibly implies that the teachers whose backgrounds are not from physics, biology, chemistry, or mathematics education are less competent. The comparative ratio of professional skills and pedagogies required in the junior high schools is 50:50. Therefore, it still requires knowledge of adequate education (Salmawati, Rahayu, & Lestari, 2017).

The data of background profile show that as many as 17.1% of the teachers' backgrounds are not from natural sciences, and 0% of the teachers are from science education. This figure

indicates that there are still schools who employ and students who are taught by teachers whose backgrounds are not in the subject fields. The condition occurs the teachers' experience and level of knowledge are ignored. Thus, one of the factors that possibly causes the inadequate implementation of laboratory activities in the school is the teachers' initial ability and knowledge that are less relevant to the learning needs (Teacher Advisory Council & National Academies of Sciences, 2016). The teachers' profiles can be seen from their duty times during learning at class.

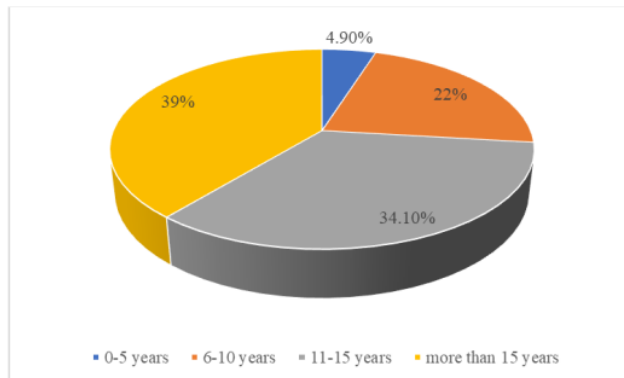


Figure 1. The percentage of teaching experience

The Figure 1 shows that the first highest percentage of teachers' teaching experience is 11-15 years, and the second highest percentage is more than 15 years. It can be concluded that the teachers are senior teachers. This condition possibly contributes to the implementation of laboratory activities at schools. Senior teachers certainly have a lot of experience of recognizing needs and efforts to increase student competencies.

Several factors that become barriers/barriers for senior teachers are usually related to improved ability and updates on the latest learning information (Othman & Masum, 2017). It is known that the education system is experiencing dynamic development along with the rapid rate of technological progress. This will make knowledge attainment and transfer easier anytime and anywhere. Senior teachers need to update information on various technological advances that can be utilized to improve the quality of education (Tahira & Ameen, 2016).

Laboratory equipment

Laboratory completeness is an essential factor in the implementation of laboratory activities. This is considering that laboratory activities require special equipment. An

illustration related to the availability of laboratory assistants who facilitate fluency in laboratory activities is shown in Figure 2.

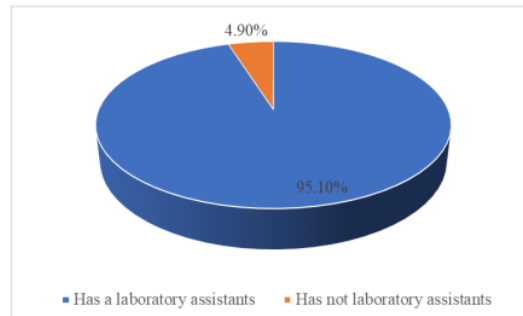


Figure 2. Availability of laboratory assistants

Figure 2 shows that 95.10% of schools already have laboratory assistants who manage school laboratories. Meanwhile, 4.9% of schools do not have laboratory assistants. The findings show that the human resources for supporting the laboratory activities are well prepared. Furthermore, the presence of laboratory assistants will assist and facilitate teachers to plan, implement, and evaluate the laboratory activities. The schools' guidelines for laboratory activities are shown in Figure 3.

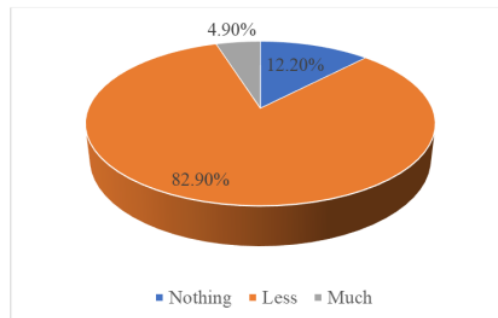


Figure 3. The Guidelines for laboratory activities

The availability of manual instructions supports laboratory activities. The finding reveals that 12.20% of the respondents respond on schools' unavailability of handbooks. Meanwhile, the majority of respondents (82.90%) state that they have insufficient laboratory guidelines, and only 4.90% of them argue that they have sufficient laboratory activities. Broadly speaking, the schools do not provide manuals in laboratory activities. This condition becomes one of the inhibiting factors considering that laboratory activities are procedural activities. The existence of laboratory guidelines will affect the achievement of determined learning objectives (Yerizon, Putra, & Subhan, 2018).

Inadequate laboratory instructions are possibly overcome when the subject teachers provide a student worksheet. The student worksheets can be adjusted to the readiness levels of the school infrastructures and to students for the implementation of laboratory activities. Besides, there are several books discussing the implementation of laboratory activities. However, it should be noted that student worksheets are circulating and traded in the market according to the availability of school facilities and the students' readiness level of conducting laboratory activities (Ariaji & Abubakar, 2017). The guidelines for laboratory activities used by teachers are obtained from a variety of learning resources. The results from the respondents' answers related to the guidelines of laboratory activities are shown in Figure 4.

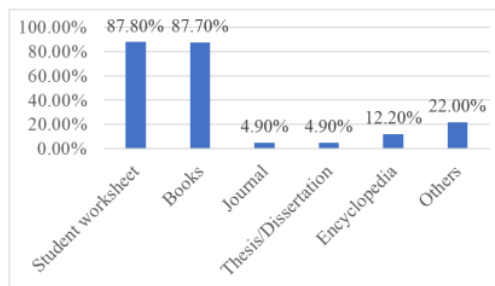


Figure 4. The guidelines of schools' laboratory activities

The majority of laboratory activity guidelines come from student worksheets and textbooks. The laboratory activities on the student worksheets and textbooks usually discuss general topics of natures and do not consider school environmental factors. Furthermore, the form of laboratory activities conducted is still a cookbook or verification that only trains and develops experimenting skills. This is very unfortunate because many scientific journals discuss and develop practical guidelines that can train and develop thinking skills in addition to experimenting skills. Teachers should be able to employ scientific journals as a reference to plan and carry out laboratory activities.

The lack of literacy and willingness to explore the existing problems becomes one of the inhibiting factors in developing education in Indonesia, especially in developing laboratory-based learning. The necessary consideration to optimize the school is to more explore the learning resources in the form of scientific journals. The description of the equipment employed to support laboratory activities is shown in Figure 5.

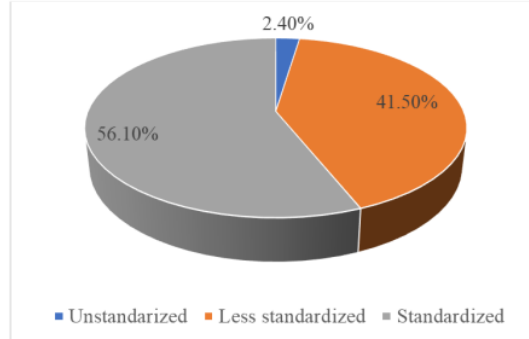


Figure 5. The quality of laboratory equipment

The data show that 56.10% of the laboratory equipment is standardized. Meanwhile, 41.50% of the laboratory equipment is categorized as less standardized and 2.40% of the laboratory equipment is non-standardized. The availability of standardized equipment will determine the smooth operation of the laboratory. This figure indicates that the ability to perform maintenance and repair laboratory equipment is still inadequate (Asih, 2017).

The effort to overcome this problem is to conduct training on the procedures of the laboratory equipment maintenance for teachers and laboratory assistants. Therefore, the equipment can be durable. Meanwhile, the limited number of equipment can be solved by simplifying equipment or using items found in everyday life. Many studies attempt to develop laboratory equipment with simple equipment and up to date developed equipment. Furthermore, teachers are required to more explore the implementation of laboratory activities (Mulhayatiah, Suhendi, Zakwandi, Dirgantara, & Ramdani, 2018). The availability of furniture in the schools to support laboratory activities is shown in Figure 6.

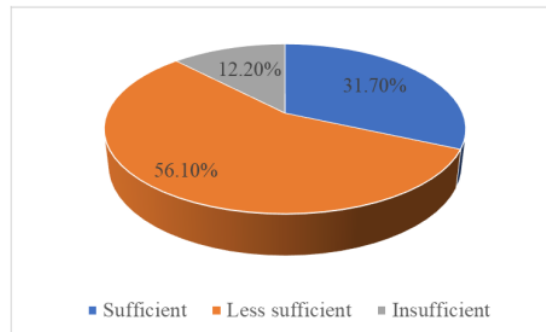


Figure 6. Equipment in laboratory

The data indicate that 56.10% of furniture used to support laboratory activities is categorized as less sufficient, and 12.20% of them is insufficient. The results show that 31.70% of the category is sufficient. The availability of sufficient furniture is very helpful to

tidy up and order laboratory activities. The equipment used in the laboratory activities can be categorized as always, frequently, and rarely used. The equipment is neatly stored if the furniture is available. Furthermore, the implementation of laboratory activities depends on the completeness of the existing furniture.

The existence of furniture is not the primary element supporting the implementation of laboratory activities, but it is very influential in conducting the smooth activities of practicum. The existence of furniture in the activities of the laboratory serves as a contributing factor for the implementation of practicum activities. Furthermore, it is one of the barriers to the implementation of laboratory activities in schools (Dharmayanti, Nurcahyono, & Lestari, 2017).

Laboratory Facilities

The laboratory facilities include the existence of laboratories and supporting facilities at schools. The majority of schools 95.12% already have laboratories to support science learning. The schools that do not have laboratories are only 4.88%. The existence of laboratories at schools is no longer a problem because every school has it. The next investigation is on the shapes of laboratory buildings of each school.

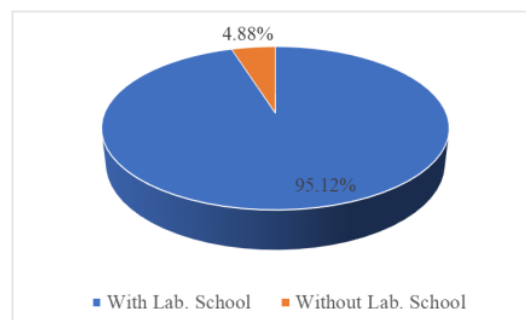


Figure 7. The percentage of schools' with laboratory facilities

The results show of Figure 8 that 82.9% of schools have separated laboratories while 4.9% of schools still use integrated laboratories (one laboratory for various types of practicum activities). Another result show that 12.2% of schools still do not have laboratory, and thus, the practicum activities are conducted in the classroom. An ideal science laboratory is a laboratory built and used for separate purposes because every field of science has different goals, objectives, and characteristics.

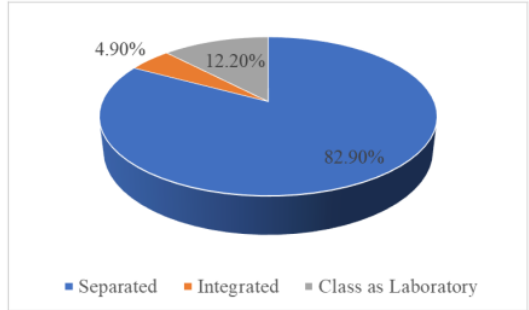


Figure 8. Types of laboratory

The laboratory conditions in the schools are illustrated in Figure 9.

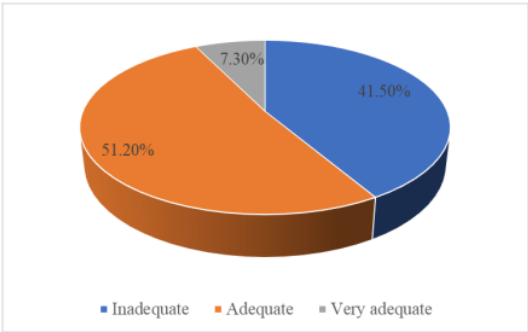


Figure 9. The condition of laboratory

The laboratory conditions of most schools are adequate by 51.20%. Meanwhile, 41.50% of the laboratories have inadequate conditions. Only 7.30% of laboratory have a very adequate condition. These results indicate that the schools' laboratories have adequate condition, and it is expected that teachers can take advantages of these conditions by using the for laboratories science learning activities oriented to the observation and investigation.

The implementation of laboratory activities in schools

It is compulsorily regarded that the implementation of laboratory activities in the junior high schools begins by delivering a view on the scientific mindsets to the students after their learning in the elementary level. The results of this study show that there are several forms, challenges, and barriers in the implementation of laboratory activities in the schools.

The results showed that 97.6% of the teachers in the school have conducted laboratory activities to support the study while only 2.4% of the teachers do not conduct laboratory activities. Furthermore, 26.8% of teachers consider that not all materials require laboratory practices while 73.2% of the teachers state that every material require laboratory practices.

These different paradigms will lead to different types and numbers of practicum activities implemented in the school. The next profile is the laboratory instruction employed in the schools.

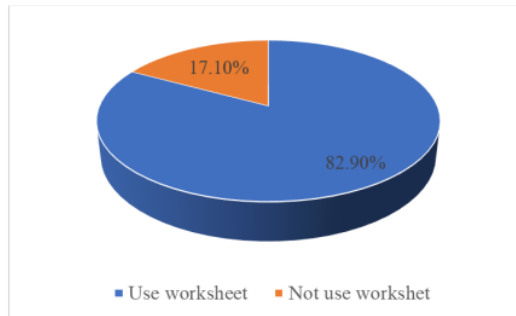


Figure 10. The profil of laboratory activities of worksheet implementation.

This study reveals that 82.90% of the schools already implement worksheets as practical guidelines for laboratory execution. This indicates that the teachers have delivered the guidance of implementing practicum to run properly to the students. Furthermore, there is a difference in the implementation of laboratory activities in which as many as 68.30% of the teachers conduct laboratory activities that are not integrated with theoretical learning while 31.70% of the teachers conducting laboratory activities that are integrated with classroom learning. Some of the obstacles faced by the teachers when conducting laboratory activities are shown in Table 1.

Table 1. The obstacles of laboratory activities

No	Obstacles
1	The low quality of laboratory management
2	The teachers' inadequate knowledge about the designs of laboratory activities
3	Insufficient time to perform laboratory activities until discussion and conclusion parts
4	The teachers' inadequate knowledge of using the available tools
5	The use of classroom as laboratories due to less funded school
6	A limited number of laboratory equipment
7	Some unsupportive and damaged tools
8	The frequently unavailable tools and materials
9	Difficulty in arranging and operating tools
10	Limited numbers of consumables

The majority of the hardship and complaints delivered by the teachers include limited equipment, time management, and ability. Some of the teachers whose educational backgrounds are not from science find difficulties in conducting laboratory activities for the secondary school students. This is a reflection for science teachers that upgrading their knowledge and abilities to implement laboratory activities is necessary. This improvement

can be performed by attending workshops and learning tutorials about the implementation of laboratory activities.

Malik (2010) reveals the ¹³ solution to overcome the limitations of practicum tools in laboratories and time management by using virtual laboratories in laboratory activities. Makiyah et al. (2019) and Sapriadil et al. (2010) state that virtual laboratory learning can be an alternative in learning physics in order to improve the students' ¹⁰ 21st century skills including critical and creative thinking as well as communication skills.

4. Conclusion

The implementation of laboratory activities in junior high school compulsorily becomes the goal of establishing scientific attitudes introduced during primary schools. Some influential factors for the implementation of laboratory activities include teachers' skills, laboratory facilities, completeness of laboratory equipment and instruments, and the resource readiness to conduct laboratory activities. ⁹ The results of this study show that the trend of the implementation of laboratory activities decreases in line with the length of the assignment in which the teachers with shorter task time are more likely to actively conduct practical activities. This is due to the slightly renewed shape and demands of laboratory activities. The possible steps to overcome the problem is to upgrade the teachers' content and pedagogic skills through workshop and training to implement the laboratory activities. The existence of laboratory facilities is directly proportional to the frequency of laboratory activities. It is also in line with the existence of supporting facilities of laboratory activities. The limited facilities, such as student worksheets and equipment, can be solved by simplifying laboratory equipment, such as using items found in everyday life, exploring, and implementing related research results.

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