

The Effect of Laboratory Services on Student Learning Effectiveness in High School Physics Subjects

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Abstract- This study was conducted to see if there was an influence on laboratory services on the effectiveness of student learning in school, especially in physics subjects. This study uses a *literature review* methodology from various references/references derived from previously published articles. This study discusses the definition of education, the explanation of effectiveness, the results of PISA Indonesia and its influence, the explanation of the laboratory, and the results of the influence of laboratory services on the effectiveness of student learning in school in physics subjects. The results of the study show that good laboratory services can increase students' motivation and understanding of physics materials, as well as contribute to improving learning outcomes. Thus, this study concludes that there is a positive influence between laboratory services and student learning effectiveness in physics subjects at the high school level.

Keywords: Education, Effectiveness, Laboratory, PISA,

1 Introduction

Education is a basic need that should be felt by the community without exception. One of the institutions that plays an important role in the implementation of education is schools. The school functions as a place to guide students to have insights, skills, and a strong noble character (Qonita Ekosari et al., 2018). Education is also defined as the process of supporting individuals to be able to complete their responsibilities independently. Thus, education encompasses various aspects that affect a person's development, changes, and condition. The change is directed at developing the potential of students. (Pristiwanti et al., 2022).

Physics is a branch of science that studies energy and its interaction with matter (Owusu, 2023). Based on Demir's opinion quoted in the research of Ike Lusi Meilina et al. (2024), student enthusiasm in learning can increase significantly if various teaching methods are applied, compared to the use of conventional teaching techniques. In the learning process, students are given the freedom to choose topics that suit their interests. The theory of multiple intelligences reveals that each student has a different uniqueness, level of intelligence, and learning style. Previous research has shown that the material will be easier for students to understand if there is a choice of activities to do. Students tend to choose *Multiple Intelligence* tasks that are in accordance with their abilities, so they are more motivated to complete them. This can ultimately improve student achievement and learning success (Lusi Meilina et al., 2024).

Effectiveness is the main element to achieve the goals that have been set. A thing is considered effective if the planned goals or objectives can be achieved. Soewarno Handyaningrat in Abdul Pandi (2022), explained that success in achieving the goals that have been set is measured through effectiveness.

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Effective comes from the word *effective*, which can be translated as successfully achieving a goal. In the Popular Scientific Dictionary, Effectiveness can be defined as the ability to use something appropriately, element in ensuring that every organizational goal, program, or activity can be achieved according to the plan (Pandi, 2022).

Practicum activities have a very important role in science learning (Maulidah & Prima, 2018). There are many factors that affect the effectiveness of laboratory services, including the infrastructure and facilities contained in the laboratory. A laboratory must comply with the standards set by the Indonesian government. A literature that comes from Katili (in M. Syaiful Rahman, 2017), the facilities and tools in the laboratory at the State High School in Jembrana Regency do not reach two-thirds of the minimum standards set by the government, so *the quality of student learning outcomes* in the high school decreased. In addition, there is another literature that shows that the facilities and facilities of the physics laboratory at SMA Negeri in Denpasar, Bali have not met the standards, thus reducing the effectiveness of the use of laboratory space. This shows that the availability of infrastructure must be adjusted to what is determined to be very crucial in order to realize the success of physics learning (Rahman, 2017).

Laboratories as one of the educational facilities need to be managed and organized with a structured working mechanism in order to function effectively and efficiently, which requires the implementation of laboratory management (Kusyanti, 2022). In general, service is defined as an activity provided by a person or an institution for all users that has an intangible and non-possessable nature (Ode Wero et al., 2022). In the context of the laboratory, the users who work there are highly dependent on the laboratory. The type of service received will affect the user's reaction, both in the form of positive and negative responses (Anies et al., 2017).

In school, there are certain subjects that utilize laboratories, one of which is high school physics. In the study of physics, there are two main aspects that are interconnected and must be had, namely theory and observation through laboratory activities. These two aspects complement each other and have a close relationship. Physics is understood as a combination of *process and product*, so that the success rate of the physics studied is very much in need of an effective and efficient approach. Physics presents learning skills that are useful in development *analytic and critical thinking*. This skill not only helps students from the elementary/intermediate level to higher grades, but is also useful for solving various problems experienced in the student's daily life. One of the most crucial things is to use laboratory facilities. Experimental activities can help students understand the phenomena surrounding and where physics itself comes from more concretely through demonstration and proof. Practicum also helps students develop independent attitudes, scientific attitudes, interest in learning, honesty, and psychomotor skills (Sarjono, 2018).

However, in the school environment, teachers often face various challenges or obstacles. One of the main obstacles experienced by physics teachers is the limitation of funds, infrastructure, equipment, and adequate educators. This condition limits the ability of schools and teachers to provide quality education to students. Problems like this are generally more common in rural areas or areas affected by natural disasters. In addition, the lack of resources can also exacerbate the educational gap between more prosperous and less developed regions (Syafi'i et al., 2023).

2 Research Methodology

This study uses a quantitative approach with *the literature review method* to analyze the influence of laboratory services on student learning effectiveness in physics subjects. This method measures the relationship between laboratory services and the effectiveness of physics learning. The data collected was analyzed using descriptive statistical analysis techniques to identify the characteristics of the relationship between the quality of laboratory services and student learning effectiveness. This study aims to provide an understanding of the influence of laboratory service quality on student learning effectiveness in physics

subjects. The results of the research are expected to be the basis for improving the management and implementation of practicum activities in schools.

3 Results and Discussion

Based on the various literature and scientific articles that we reviewed, we found several findings, including the results of Indonesia's PISA which is still below the global average in 2022, even though Indonesia's ranking has increased by 5-6 ranks. In 2022, the OECD average score for reading was 476, for science literacy was 485, and for mathematics was 472.

Table 1. Indonesian PISA Score Results 2009-2022

Year	Reading Field	Mathematics	Science Literacy	Rank	Number of Participating Countries
2009	402	371	383	60	65
2012	396	375	382	64	65
2015	397	386	403	62	70
2018	371	379	396	72	77
2022	359	366	383	69	81

Source : OECD



Picture 1. Indonesian PISA Score Chart 2009-2022

Source: GoodStats

Based on the results of PISA Indonesia in Figure 1, there was a decline in scores in 2018 and 2015 in all areas assessed (Yusmar & Fadilah, 2023). In addition, the PISA results also show a consistent decline in Indonesia's PISA score from 2009 to 2022. In Figure 1, it can be seen that Indonesia's PISA score decreased in 2022 compared to 2018 in all areas tested, namely reading, mathematics, and science literacy. As a result, Indonesia ranks 69th out of 81 participating countries, although there is an increase of 5-6 rankings from 2018, where Indonesia is ranked 72nd out of 77 countries. The decline in the PISA score is a serious concern, especially when compared to the international average score, where Indonesia is quite far behind.

There are several factors that cause low PISA scores, especially in the field of science literacy in Indonesia. Science literacy skills are very important and need to be possessed by Indonesian students from an early age, considering the competition in the field of technology and information in the 21st century which requires individuals to be able to compete and keep up with global developments (Mijaya et al., 2019;

Yusmar & Fadilah, 2023). Focusing on science as a collection of knowledge is carried out by presenting, discussing, or asking questions to remember facts, concepts, principles, laws, and theories in an interrelated manner (Nur Hasan et al., 2018). The ability of the science process is believed to provide students with an immersive learning experience as it supports them in developing advanced thinking skills (Darmaji et al., 2019). In addition, laboratory teaching develops students' experimental skills (Kandamby, 2019), get to know concepts and theories in science and broaden the horizons of scientific knowledge (Mihret et al., 2023). The experiments also improve their in-depth understanding of the procedural and conceptual aspects of science projects (Pols & Dekkers, 2024).

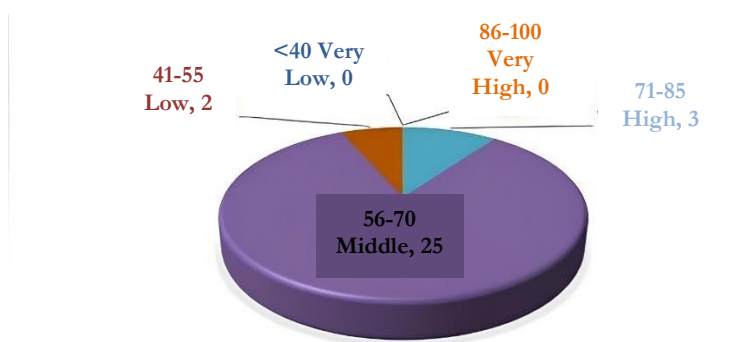
This factor is also influenced by the services of physics laboratories in schools. The physics laboratory in the school functions as an educational facility. According to Sarjono (2018), the school physics laboratory plays a role in becoming a means of learning physics or supporting in the physics learning process at school. The literature presented by Herlina et al. (2023) explains that the availability of laboratory equipment has a positive impact on students' science literacy skills. This visible difference in science literacy ability between the control class and the experimental class is due to the improvement of practical skills due to the completeness of laboratory equipment. With adequate equipment, students can conduct various experiments and science practices more effectively (Herlina & Gultom, t.t.).

Table 2. Data on Tool Results and Percentage of Laboratory Use with Learning Outcomes

No.	School	Presentation of Tools/Facilities (%)	Presentation Tool Used Factor (%)	Total Usage (%)
1.	E	90,61	13,55	12,27
2.	A	85,71	11,46	9,82
3.	B	46,34	14,58	6,75
4.	D	45,75	13,54	6,19
5.	C	45,17	7,29	12,08

Source: Yanti et al (2016) in Laila et al. (2018)

The above research was conducted by Yanti et al. (2016) quoted in Laila et al. (2018) analyzing data on facilities and infrastructure in 5 State High Schools in Jember. This study uses the 2013 curriculum and shows quite good results based on the percentages presented (Qonita Ekosari et al., 2018). The results of the study indicate that, based on the percentage, the total use of tools and facilities in each school does not exceed 13%, with the highest factor of tool use not reaching 15%.



Picture 2. Understanding Physics Concepts Using Real and Virtual Laboratories

Source: Zainuddin et al. (2022).

Learning to understand physics concepts to students in classes carried out using physical laboratories and virtual laboratories in urban schools showed very high results in the medium category of 25 people

(83.33%). This proves that the level of understanding of physics is at a medium level, which means that they only know the concepts of physics without knowing their use in daily life (Zainuddin et al., 2022).

By *literature review* by Ulfi Saharsa et al. (2018), students who were tested in comprehension after categorization showed that there were 2 students with a very low understanding of the concept in the very low category, 2 people in the low category, 7 people in the medium category, 7 people in the high category, and 10 people in the very high category. Meanwhile, in other groups, after categorization, 1 person is in the very low category, 9 people are in the low category, 7 people are in the medium category, 7 people are in the high category, and 2 people are in the very high category. From these results, it can be concluded that the average value of students' concept understanding in the control group taught using the conventional model is in the medium category (Saharsa et al., 2018).

Technical training for laboratory workers in school physics laboratories can significantly increase the effectiveness of student learning in high school. Based on literature from Nyoto Suseno and Riswanto (2017) at SMA/SMK/MA Metro City, Lampung Province, with the following results.

1. In the technical guidance activity for laboratory personnel with the target being the head of the laboratory and laboratory personnel, the results are that the average pretest score is 61, the average posttest result is 73 with a gain (normal) of 30.8%.
2. *The workshop* prepared a laboratory management manual with the target of laboratory heads, laboratory workers and teachers, the result is that hopefully the laboratory management manual has been properly checked and submitted to the principal.
3. In the inventory data collection, labeling, and disposal of laboratory tools and materials, the target is that the facilities/infrastructure and laboratory tools and materials are identified both in number, type, and condition. The result is that at SMAN 1 Metro has not been implemented and SMAN 2 Metro type of laboratory equipment there are 196 types of tools with a total of 907 laboratory tools, all in good condition.
4. In the activity of making a laboratory work program, the target is the formation of semester and annual programs that are in accordance with the conditions and needs of the school. As a result, SMAN 1 Metro has not been realized and SMAN 2 Metro has been realized.
5. In the laboratory use trial activity, the target is that experimental activities in the physics laboratory are carried out according to the lesson schedule without disturbing other subjects. The result is
 - a. Experiment SOP according to lesson schedule
 - b. Schedule of experimental activities
 - c. Discipline of teachers and students in the use of physics laboratories (Suseno & Riswanto, 2017).

4 Conclusion

Education is a continuous process that aims to improve individual potential. In the context of physics learning, this study highlights the importance of the role of laboratories and the competence of educators. The results of the study show that the existence of adequate laboratory facilities, supported by improving the competence of educators through technical guidance, can improve the quality of student physics learning. Thus, it can be concluded that the effectiveness of physics learning is influenced by the synergy between laboratory facilities and infrastructure and the quality of educators and it is proven that laboratory services have an influence on the effectiveness of student learning in high school in Physics subjects, especially in Indonesia.

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