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Research Article

Is VIRAL Lab Needed? Analysis of Teacher's Needs in Aceh Physics Lab

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Abstract.
Virtual and real (VIRAL) laboratories are instructive facilities that can improve both learning results and have their particular advantages. The merger of the two laboratories is expected to significantly increase the effectiveness of the laboratory in learning physics. This study aimed to analyze laboratory activities, especially the VIRAL Lab on school physics subjects in Aceh. The study was conducted on 33 school Physics instructors (8 male and 25 female) in Aceh. This study used a survey method with a questionnaire instrument for laboratory usability investigation. The analysis used was descriptive quantitative. The results of the study illustrate that more than 80% of physics teachers in Aceh require hands-on and virtual labs in online and offline learning, 97% of physics teachers in Aceh still require virtual lab designs, and only 39.3% of teachers have combined VIRAL labs in one physics subject in Aceh.

Keywords: VIRAL lab, teacher's needs, physics lab

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1. INTRODUCTION

Currently, hands-on laboratories and virtual laboratories have been used in schools, because both laboratories have their respective advantages which when combined will produce maximum learning outcomes. Hands-on laboratories can make students directly involved and understand real systems, processes, or phenomena [1, 2]. Virtual laboratories can facilitate the practicum process by providing affordable facilities, facilitating abstract learning, and safe from the dangers of tools or materials [3].

Researchers have conducted research by combining hands-on labs and virtual labs [4, 5]. The merger of the two laboratories is called the VIRAL Lab. That is, there are things that must be changed from the habits of teachers when carrying out learning activities, especially in conducting experiments using laboratories. Therefore, an

analysis of teacher needs for experimental activities using laboratories is needed so that researchers know the conditions being experienced by teachers in each school. The phenomenon that occurs in schools illustrates that teachers do not use laboratory facilities in their learning, learning should be carried out by conducting investigations related to the concepts being studied by students. Without practical experience using the lab, students find it difficult to understand physics concepts optimally and lack motivation to study physics [1].

Creativity in the laboratory is meant here is creating something new in the laboratory, whether it is really a new thing or something new idea such as connecting some things that already exist and making it something new in the laboratory. One of the most important things a teacher can do is provide a positive learning experience [6] and creative [7]. Many studies have been carried out regarding the use of laboratories in learning, so that experimental learning activities usually use the laboratory directly, there is now a virtual laboratory that carries out various laboratory innovations [8–11], with various improvements in learning outcomes offered by researchers. They conduct research so that laboratories improve student learning results. Such as improving the conceptual [10, 12–16], problem-solving [13, 17], creativity [6, 18, 19], literacy [20, 21], attitude [11, 14, 22, 23], critical thinking [8], and metacognitive skills students [24].

We already know the hands-on lab is already very common use in physics teaching in the classroom. Due to the limitations of laboratory equipment available in schools, such as the potential dangers when using tools and materials, the high cost of tools and materials, and so on, for this problem a virtual laboratory can be an option [12]. The reason why virtual laboratories are needed, especially for studying physics lessons that contain a lot of abstract concepts [3]. In understanding the concept of physics, students must be able to use their imagination well so that the concept of physics can be drawn correctly in their minds. As in the concept of circular motion, students know that objects that move in a circle have centripetal and centrifugal forces, shown at Figure 1.

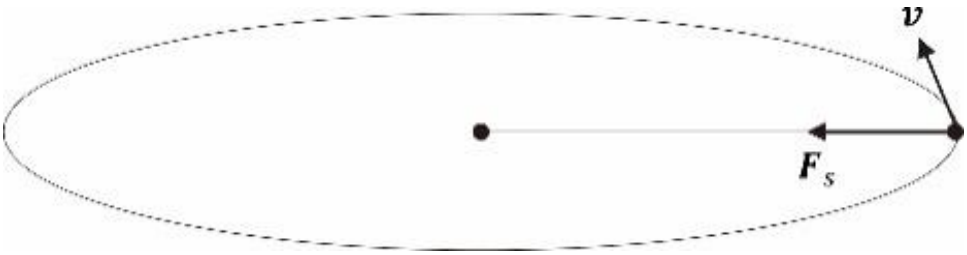

Figure 1: Circular motion system.

But to understand the concept and the reasons why the centripetal and centrifugal force has the same value to the equation $F_s = m\frac{v^2}{R}$ but having the inverse direction,

Figure 2: The centripetal force F_s and the centrifugal force F'_s.

teachers need to explain the concept by conducting experiments, especially experiments using virtual laboratories.

VIRAL lab is a combination of hands-on and virtual labs. Because the benefits of the two laboratories can be said to be different, the researchers have combined them so that learning using the laboratory will be more effective. Research results that the combination of hands-on labs and virtual labs gives students better results in learning inquiry skills, science process skills and help students gain a deeper understanding of science [12, 25, 26], but virtual laboratories should not replace hands-on laboratories. How VIRAL Labs works to help students understand complex physics concepts and understanding is explained in the Figure 2.

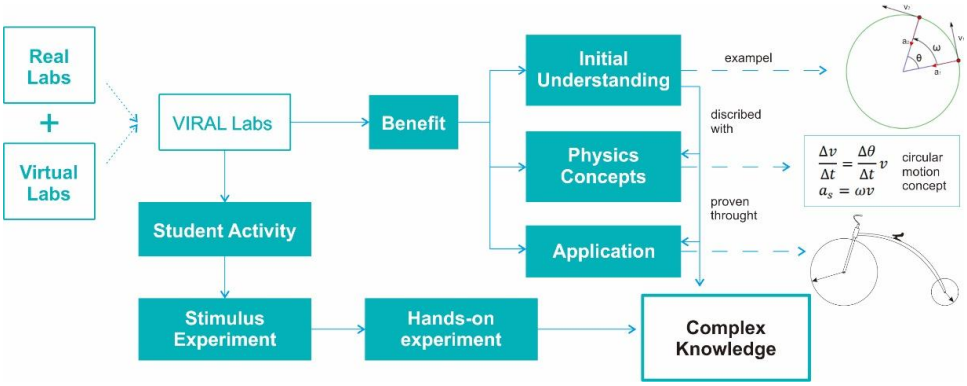

Figure 3: How VIRAL labs work on physics concepts and complex knowledge.

In Figure 2, that VIRAL labs have two important parts, the first is benefits such as early understanding when learning, physics concepts, and applications in everyday life. These three points these benefits relate to each other so that the benefits and student activity, students may have knowledge of a complex that does not exist when only using one type of lab course.

Before discussing how VIRAL labs can improve learning outcomes, it is necessary to analyze the needs of teachers in using the lab. Then research questions that guided the study are:

1. *Do teachers have problems when doing online learning?*
2. *Do teachers have any problems using hands-on and virtual laboratories?*

3. *How can teachers be creative with the types of the laboratory?*
4. *Do teachers combine virtual laboratories and hands-on laboratories in a learning activity?*

2. RESEARCH METHOD

This research is a descriptive research with a qualitative approach. This study aims to describe the needs of teachers in experimental activities using the lab in physics learning. The procedure of this research is described in Figure 3.

Figure 4: Research procedure.

The respondents of this study were 33 physics teachers who teach in Aceh. With the following characteristics: 8 male physics teachers and 25 female physics teachers. 29 of them are graduates of Bachelor of Physics Education and 4 graduates of Master of Physics Education. The instrument used in this study is a questionnaire instrument needs teacher with six indicators are:

1. online learning problem
2. The need for hands-on labs and virtual labs when learning online or offline
3. Use of hands-on and virtual laboratories
4. Impediments in carrying out experiments using hands-on labs and virtual labs
5. The important role of the laboratory in learning
6. The idea of combining both virtual labs and hands-on labs in one lesson chapter.

Of the six indicators, 23 statements were produced. In this analysis, only 4 scales are used, namely strongly agree, agree, disagree, and strongly disagree. Mid-scale or neutral is not used with the intent to make teachers siding. Data analysis using interactive analysis by Miles and Huberman [27], with stages:

1. Data collection. At this stage, a needs analysis questionnaire was distributed to school physics teachers in Aceh.

2. Data reduction. At this stage the researcher collects and calculates the results of the needs analysis questionnaire, discards unnecessary data, leaving data that needs to be presented.
3. Data presentation. At this stage the researcher presented the data in the form of presentations, tables, and graphs.
4. Conclusion. At this stage the conclusions drawn from the data that has been collected and presented.

3. RESULTS AND DISCUSSION

Based on the results of the needs analysis questionnaire, it is known that 66.7% of the total respondents came from rural schools, while 33.3% came from urban schools. For further discussion of teacher problems related to online learning and the need for laboratories in learning, it can be explained in Table 1.

TABLE 1: Laboratory needs in learning in online and offline conditions (%).

Indicator	Statement	SA	A	DA	SDA
Problems on online learning	Physics teachers feel the need to adapt to learning when learning online	57.6	36.4	6.06	0
	Online learning is often passive and one-way	51.5	42.4	6.06	0
Laboratory needs in learning	Physics teachers need hands-on lab equipment when learning offline	63.6	27.3	6.06	3.03
	Physics teachers need hands-on lab equipment when learning online	54.5	30.3	15.2	0
	Physics teachers need virtual labs when learning offline	42.4	42.4	15.2	0
	Physics teachers need virtual labs when learning online	54.5	30.3	15.2	0

Note:
SA: Strongly Agree
A: Agree
DA: Disagree
SDA: Strongly Disagree.

Based on Table 1, it can be seen that 57.6% of respondents chose strongly agree and more than 36.4% chose to agree that teachers must adapt when doing online learning. And this causes learning to only go one way. 51.5% of respondents chose strongly agree and 42.4% of respondents chose to agree that learning only goes one way. This happens because the teacher cannot control student learning activities during learning activities. Therefore, learning should go both ways between teachers and students by conducting experiments from the laboratory. When viewed from other statements, it

turns out that teachers really need a laboratory to apply it to physics learning, the statement is shown in Figure 4.

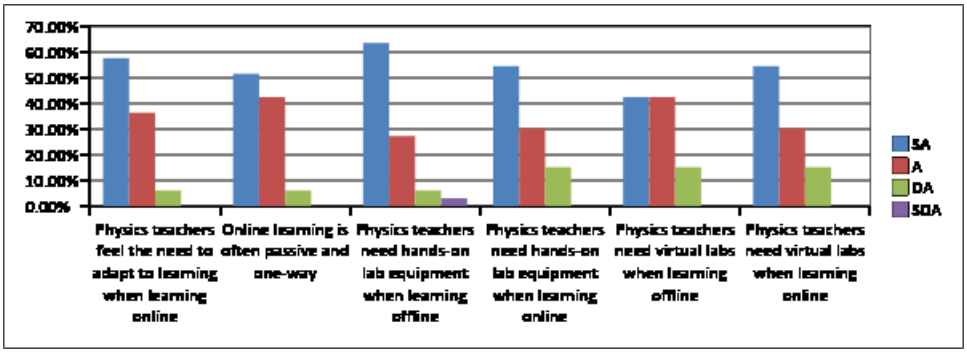

Figure 5: Graph of laboratory needs in learning in online and offline conditions.

Based on the results of the questionnaire in Figure 4, it is known that more than 40% of respondents strongly agree with every statement regarding the need for hands-on and virtual laboratories in physics learning. On the statement 'physics teachers need hands-on lab equipment when learning offline', 63.6% of respondents strongly agree and 27.3% of respondents agree. Then the statement 'physics teachers need hands-on lab equipment when learning online', 54.5% of respondents strongly agree and 30.3% of respondents agree. This shows that most physics teachers feel that hands-on lab equipment is still used even during online and offline learning, this can be seen from the difference in the answers of respondents who strongly agree and agree that hands-on labs are used during offline learning with online learning only 9.1% and 3% which explain that hands-on labs are needed even in online and offline learning situations. Then in the statement 'physics teacher requires a virtual lab currently offline learning', 42.4% of respondents strongly agreed and 42.4% of respondents agreed. While in the statement 'physics teachers need a virtual lab when learning online', 54.5% of respondents strongly agree and 30.3% of respondents agree. This shows that most physics teachers also feel that virtual labs are also needed when learning online or offline. It can be seen from the difference in respondents' answers that they strongly agree and agree to the virtual lab used during offline learning with only 12.1% and 12.1% online learning, which explains that virtual labs are also needed even in online and offline learning situations. Although most teachers require hands-on and virtual labs, there are also obstacles experienced by some teachers which will be explained in Table 2.

Based on the results of the questionnaire in Table 2, it can be seen that more than 50% of physics teachers in Aceh strongly agree that hands-on laboratories are difficult to reach due to limited equipment. However, table 2 explains that most of the teachers have no difficulties when using hands-on or virtual laboratories. This can be seen in the

Table 2: Laboratory needs in learning in online and offline conditions (%).

Indicator	Statement	SA	A	DA	SDA
Laboratory issues for teachers	The real laboratories are difficult to reach because of limited equipment	54.5	33.3	6.06	6.06
	Hands-on laboratories are very difficult to use in learning physics in class	18.2	33.3	36.3	12.1
	Virtual laboratories are very difficult to use in learning	9.09	48.9	30.3	12.1
	Teachers have difficulty in selecting/finding suitable virtual laboratory tools for physics learning	27.2	54.5	12.1	6.06
Teacher's expectation of physics laboratory	Teachers need a virtual laboratory tool design for physics learning	57.5	39.39	3.03	0
	Teachers often combine virtual labs and real labs in one lesson chapter	12.12	27.2	45.4	15.1
	Teachers need to combine hands-on labs and virtual labs in one lesson chapter	18.2	69.7	12.1	0

difference between respondents agreeing and disagreeing from the statement 'hands-on laboratories are very difficult to use in learning physics' and the statement that virtual laboratories are very difficult to use', only has a difference of 3.06% and 18.18%. This explains that most teachers do not find it difficult when using the laboratory, it's just that most teachers have difficulty finding virtual lab tools for learning physics with a percentage of 27.27%.respondents strongly agree and 54.54% respondents agree.

Then on the indicator of teacher expectations in the statement 'teachers need a virtual laboratory tool design for learning', 57.57% of respondents chose strongly agree and 39.39% of respondents chose to agree. This explains that currently most teachers still really need a virtual lab design for their learning. Then on the statement 'teachers often use hands-on and virtual labs in one subject', 15.15% of respondents chose strongly disagree and 45.45% of respondents chose to disagree. This means that most teachers have never combined a hand-on and virtual laboratory (VIRAL lab). However, 18.1% of respondents strongly agree and 69.69% of respondents agree that this VIRAL lab is developed.

In this era, along with technology that is developing so fast, teachers are very familiar with digital technology. Even so, hands-on labs are still the teacher's choice in learning, even though currently virtual labs have been widely developed. In table 1, 90.9% of teachers agree to choose a hand-on lab in offline learning and 87.5% of teachers agree to choose a hand-on lab in online learning. This means that hands-on laboratories cannot be replaced from physics learning [25], but very minimal tools are available. That's why virtual labs are needed. Virtual laboratory is also needed for most teachers

with learning even do online (84.8%) or offline (88.4%) as a virtual lab can help physics concepts that are invisible [28, 29]. The problem obtained from table 2 is that 97% agree that the teacher requires a virtual lab design, meaning that 97% of teachers still need a virtual lab design by scientists to design it for learning activities, considering that many respondents come from rural areas. Then the merger of hands-on and virtual labs (VIRAL), which was mostly done by previous researchers, is still not needed urgently, considering that virtual laboratories are still very much needed in Aceh and only 39.3% use the VIRAL lab. However, many teachers need the VIRAL lab for 87.8% in physics learning in the hope of improving student learning outcomes.

4. CONCLUSION

Based on research results, more than 80% of physics teachers in Aceh require hands-on and virtual laboratories for online and offline learning. Then 97% of physics teachers in Aceh still need a virtual lab design from the results of researchers' studies. Is mean VIRAL still not needed urgently because teachers really need a virtual lab. Then only 39.3% of teachers have combined the VIRAL lab in one physics subject, however as many as 87.8% of physics teachers in Aceh still expect the VIRAL lab in physics learning.

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References

[1] Hofstein A, Lunetta VN. The laboratory in science education: foundations for the twenty-first century. Sci Educ. 2004;88(1):28–54.

[2] Jonathan O, Justin D. Good practice in science teaching. what research has to say. 2nd ed. Mc Graw Hill: Open University Press; 2010.

[3] Gunawan G, Harjono A, Sahidu H, Herayanti I. Virtual laboratory to improve students' problem-solving skills on electricity concept. Jurnal Pendidikan IPA Indonesia. 2017;6(2):257–64.

[4] Wang T, Tseng YK. The comparative effectiveness of physical, virtual, and virtual-physical manipulatives on third-grade students' science achievement and conceptual understanding of evaporation and condensation. Int J Sci Math Educ. 2018;16(2):203–13.

[5] Zacharia ZC, de Jong T. The effects on students' conceptual understanding of electric circuits of introducing virtual manipulatives within a physical manipulatives-oriented curriculum. Cogn Instr. 2014;32(2):101–58.

[6] Chanthala C, Santiboon T, Ponkham K. Instructional designing the stem education model for fostering creative thinking abilities in physics laboratory environment classes. AIP Conference Proceedings. 2018. pp. 1–12.

[7] Oktiani I. Kreativitas guru dalam meningkatkan motivasi belajar peserta didik. Jurnal Kependidikan. 2017;5(2):216–32.

[8] M. Serungke, Muhibbuddin, and Suhrawardi, "Implementation of problem-based learning (pbl) with virtual laboratory to improve students' critical thinking and achievement,". J Phys Conf Ser. 2020;1460(1):1–6.

[9] Admoko S, Yantidewi M, Oktafia R. The implementation of guided discovery learning using virtual lab simulation to reduce students' misconception on mechanical wave. J Phys Conf Ser. 2019;1417(1):1–7.

[10] Arista FS, Kuswanto H. Virtual physics laboratory application based on the android smartphone to improve learning independence and conceptual understanding. Int J Instr. 2018;11(1):1–16.

[11] Aşiksoy G, Islek D. The impact of the virtual laboratory on students' attitudes in a general physics laboratory. International Journal of Online Engineering. 2017;13(4):20–8.

[12] Kapici HO, Akcay H, de Jong T. Using hands-on and virtual laboratories alone or together—which works better for acquiring knowledge and skills? J Sci Educ Technol. 2019;28(3):231–50.

[13] Putri KL, Suhandi A, Samsudin A, Surtiana Y. The development of virtual conceptual change laboratory (vcclab) for conception reconstruction through lab virtual activity. J Phys Conf Ser. 2021;1806(1):1–7.

[14] Faour MA, Ayoubi Z, Faour Z. Malak Abou; Ayoubi, "The effect of using virtual laboratory on grade 10 students' conceptual understanding and their attitudes towards physics,". J Educ Environ Sci Health. 2018;4(1):54–68.

[15] Husnaini SJ, Chen S. Effects of guided inquiry virtual and physical laboratories on conceptual understanding, inquiry performance, scientific inquiry self-efficacy, and enjoyment. Phys Rev Phys Educ Res. 2019;15(1):10119–29.

[16] Ranjan A, Black MJ. "Optical flow estimation using a spatial pyramid network.," In: Proceedings of the IEEE conference on computer vision and pattern recognition. pp. 4161–4170 (2017).

[17] Gunawan G, Harjono A, Sahidu H, Herayanti I, Suranti S, Yahya F. “Using virtual laboratory to improve pre-service physics teachers’ creativity and problem-solving skills on thermodynamics concept,” ournal of Physics. Conference Series. 2019;1280:1–7.

[18] Sapriadil S, Setiawan A, Suhandi A, Malik A, Safitri D, Lisdiani S A S, et al. Effect of higher order thinking virtual laboratory (hotvl) in electric circuit on students’ creative thinking skills. J Phys Conf Ser. 2019;1204(1):1–7.

[19] Sari RP, Mauliza M, Nazar M, Nahadi N. The implementation of performance assessment through virtual laboratory to college students’ creative thinking skills. Jurnal Penelitian Pendidikan IPA. 2020;7(1):5–10.

[20] Ismail I, Permanasari A, Setiawan W. Stem virtual lab: an alternative practical media to enhance student’s scientific literacy. Jurnal Pendidikan IPA Indonesia. 2016;5(2):239–46.

[21] Arieska Putri L, Permanasari A, Winarno N, Ahmad NJ. Enhancing students’ scientific literacy using virtual lab activity with inquiry-based learning. J.Sci.Learn. 2021;2021(2):173–84.

[22] Pyatt K, Sims R. Virtual and physical experimentation in inquiry-based science labs: attitudes, performance and access. J Sci Educ Technol. 2008;21(1):133–47.

[23] Mutlu A, Acar B. Comparison of inquiry-based instruction in real and virtual laboratory environments: prospective science teachers’ attitudes. International Journal of Curriculum and Instruction. 2020;12(2):600–17.

[24] Yusuf I, Widyaningsih SW. Implementing e-learning-based virtual laboratory media to students’ metacognitive skills. Int J Emerg Technol Learn. 2020;15(5):63–74.

[25] Sypsas A, Paxinou E, Kalles D. “Using virtual laboratory environment for science education in different educational settings.,” In: EDEN Conference Proceedings. pp. 475–485 (2021).

[26] Hamed G, Aljanazrah A. The effectiveness if using virtual experiments on students’ learning in the general physics lab. J Inf Technol Educ. 2020;19:977–96.

[27] M. Miles, M. Huberman, and J. Saldaña, Qualitative data analysis: a methods sourcebook., 2013.

[28] Sanggara PW, Doyan A, Verawati NN. The effect of process oriented guided inquiry learning model based on virtual laboraory toward problem solving abilities of physics student. Jurnal Penelitian Pendidikan IPA. 2018;5(1):1–5.

[29] Price CB, Price-Mohr R. PhysLab: a 3d virtual physics laboratory of simulated experiments for advanced physics learning. Phys Educ. 2019;54(3):1–9.