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EFFECTIVENESS OF USING REAL LABS AND VIRTUAL LABS TO IMPROVE SKILLS 21st CENTURY STUDENTS IN PHYSICS LEARNING

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ABSTRACT

The 21st century requires a person to have various skills, so that the world of education is expected to be able to prepare students and also train various 21st century skills to face and overcome various problems in their future lives. In physics learning, 21st century skills can be trained through laboratory activities. Therefore, to find out more about laboratory activities, this article will present information about laboratory activities to improve 21st century skills. The method used in this article is the literature study method and the analysis is carried out based on previous research literature that is relevant to the discussion of this article. The results obtained from this article are laboratory activities, both real and virtual laboratories can be used to train students' 21st century skills, so that they are expected to improve 21st century skills.

Keywords: 21st century skills, laboratory activities, physics

INTRODUCTION

School laboratories are crucial for improving the quality of student education. The presence of laboratories is expected to facilitate student understanding of the material being studied during practical work (Mukti & Arikunto, 2020). A laboratory is a place, either enclosed or open, for conducting various experiments and research. In learning, laboratories are used as a direct learning tool so that students can study the object of study directly and gain new insights from the results of their investigations (Anwar et al., 2017). In physics learning, the scientific attitude of laboratory activities is reflected in students' curiosity to understand where a concept, law, or formula of physics is derived, and how these concepts, laws, or formulas can be applied in everyday life (Murni et al., 2019).

Laboratory in general is an activity of observation, testing, and experimentation carried out by students. This activity will train four important aspects including (a) skills (using instruments, practicing inquiry skills, following) instructions and communicating results), (b) concepts (opening representative ideas, applying theories to higher levels, and discovering new concepts), (c) the nature of science (understanding). the nature of science, and knowing how scientists work), and (d) attitudes (accuracy, openness, curiosity, objectivity, reality, and cooperativeness) (Utari & Prima, 2020). So to help students solve problems in learning as well as to meet the objectives of physics learning, physics learning cannot be separated from laboratory activities (K. Dunnett, 2020).

The implementation of physics practicums in most schools is still in the low category (Putri et al., 2017) (Rohit et al., 2017) even though direct experiments

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play an important role in physics learning and the method cannot be separated from the scientific method (Riantini et al., 2018) therefore experimental activities cannot be separated from classroom learning (Putri et al., 2019).

Laboratory activities consist of two types, namely real laboratories and virtual laboratories (Malik et al., 2020). A real laboratory is a special place to carry out experiments in physics learning equipped with various equipment and materials and carried out directly (Murni et al., 2019) to understand something that is directly related to skills, observation activities in the form of a real laboratory are needed to encourage students to have direct observation experiences (Hizbi, 2019) meanwhile, a virtual laboratory carries out scientific observations similar to direct experiments but with the advantages of a virtual environment (Paxinou et al., 2020) (Salazar-Escoboza et al., 2020) and can implement the 2013 curriculum through the simulation method using virtual laboratories in the learning process (Wisudawati & Sulistyowati, 2017) through the application of virtual laboratories can also have a positive effect on student attitudes and motivation (Sarı et al., 2019).

Technological skills are one part of the 21st century learning framework and in educational technology is used as a source of information (Putry et al., 2018) because the development of the 21st century is known as a technological development that demands everything that utilizes technology (Lestari & Supahar, 2020) including Physics in everyday life can be delivered more practically with the support of technology (Aji et al., 2020).

Based on this, this article will discuss laboratory activities and their contribution to improving 21st century skills.

METHODS

The research method chosen in this study is a qualitative method with a library research type of material from various scientific disciplines related to the sanitation clinic program which is collaborated with theoretical studies from scientific literature references.(Paul et al., 2021) (Sari, 2021).

The data sources used in this research were obtained from scientific literature relevant to the topic of discussion, such as books, journals or scientific articles related to the chosen topic.(Simarmata et al., 2021).

The data collection technique used in this study is to collect data on good things or variables in the form of articles, journals & materials that are in accordance with scientific principles (Sugiyono, 2015). To ensure continuity in the assessment process and overcome misinformation (human misunderstandings that may occur due to a lack of researcher knowledge or a lack of librarians), data sources from the library were checked and re-read repeatedly.(Sugiyono, 2016).

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RESULT & DISCUSSION

Essentially, in education, laboratories are used as academic support for testing, calibration, and production based on specific scientific methods. A laboratory is a place that can be used to repair something or even create a product

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(Ketut Ima Ismara et al., 2019). Laboratory activities are a series of activities in a laboratory, including the use of real laboratory equipment and computer simulation demonstrations to provide students with learning experiences (Malik. A, 2017).

Laboratories themselves are divided into real laboratories and virtual laboratories (Hermansyah et al., 2017). The implications of real laboratory activities are carried out by providing learning activities that resemble real or actual conditions (Ristanto & Khoiri, 2015). While a virtual laboratory is a series of laboratory tools in the form of interactive multimedia-based computer software, which is operated by a computer and can simulate activities in the laboratory as if the user were in a real laboratory" (Athanasios, 2019) (Zhang et al., 2020). Virtual laboratories have implications for virtual experiences to simulate real laboratory experiments on computers (Lestari, DP, 2020) in other words, virtual laboratories can visualize abstract phenomena or complex experiments carried out in real laboratories (Suhendi et al., 2018). So that virtual laboratories can be developed as an alternative to limited physics experimental equipment and help visualize various abstract concepts in physics (J. Sirait et al., 2017) (KI Ismara & Prianto, 2020). Robeck said in Isjoni (2008), the use of virtual laboratories can accelerate the process of understanding subject matter and strengthen students' evidence of the truth of theories or laws of physics that have been proven by practice using real laboratories (Isjoni et al., 2008).

Expensive laboratory equipment is one of the challenges of using a real laboratory, so alternatives must be sought to continue conducting experiments properly. One such alternative is the use of virtual laboratory activities (McCusker et al., 2018). Virtual laboratory activities involve a number of instructions and procedures, which are carried out using computer software (Ranjan, 2017). The simulation commonly used by students to conduct virtual laboratory activities is the PhET simulation (Suporwoko, 2017) (Admojo, 2018).

The experiences students gain from laboratory activities can guide them throughout their lives to continue developing their knowledge and abilities (Olusola et al., 2018). Furthermore, laboratory activities provide opportunities for students to conduct experiments similar to those conducted by scientists (Shi et al., 2020). This shows that experiments or laboratory activities are an important factor in the educational process (Luan Carlos da Silva Casagranrde et al., 2015). In the learning process, students can be more active and have high motivation to participate in each activity (Sypsas & Kalles, 2018). Laboratory activities have a specific purpose, namely to train students to independently seek and find various answers or problems they face through experiments. Therefore, from these activities, students are trained in scientific thinking (Farhati, 2017) because laboratory activities are used as a place for observation, experimentation, training, and testing of knowledge and technology concepts (Mukti & Arikunto, 2020).

In the 21st century, science and technology play a significant role in developing essential skills and presenting challenges for the future. Therefore, science and technology are inseparable from natural sciences (Rohman et al., 2017). Frequent laboratory activities by students will impact the development of scientific performance and character, both in the process and in the outcome.

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Developing scientific performance and character can support students in acquiring the skills needed in the 21st century (Malik et al., 2020).

Based on previous research conducted by (Hizbi, 2019), there was a significant difference in student achievement in physics. This was due to the influence of the use of real and virtual laboratories. These results indicate that physics achievement in students taught using real laboratories tended to be higher than in the group taught using virtual laboratories.

In addition, according to other research, the application of virtual laboratories in physics learning has a positive impact on increasing concept mastery, problem-solving skills, critical thinking skills, and student activity (Simbolon, 2015).

CONCLUSION

From the presentation of this article, it can be concluded that learning activities with laboratories using both real and virtual laboratories can train students to have 21st century skills so that they can be used to improve 21st century skills.

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