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# IMPLEMENTATION OF VIRTUAL LABORATORYORIENTED EDUCATION FOR SUSTAINABLEDEVELOPMENT (ESD) IN SCIENCE LEARNING

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**ABSTRACT**

Education for Sustainable Development (ESD) is a method that can be applied in order to achieve Sustainable Development Goals (SDGs). Science subjects can contribute to ESD through integrating ESD competencies in science topics. This research aims to determine the implementation of an ESD-oriented virtual laboratory in science learning at junior high school level in Pidie Regency. The instrument used in this research was a questionnaire distributed directly to juniorhigh school science teachers. Based on the questionnaire, the percentage of ESD implementation using virtual laboratories in science learning carried out by teachers is 25%. The implementation of ESD-oriented virtual laboratories in science learning is mostly integrated into the topics of temperature and heat. One of the factorsinhibiting the implementation of ESD in science learning is teachers' limited understanding of virtual laboratories, ESD and SDGs

Volume 4, No.1, June 2024, Pages : 8-15

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## INTRODUCTION

Nowadays, education for sustainable development (PuPB) or what is often called Education for Sustainable Development (ESD) has been going on for a long time. ESD has been known since 1992 when Johannesburg at "The World Summit on Sustainable Development" initiated the creation of ESD (Salsabila, 2020). Education for Sustainable Development (ESD) has become an important issue which has 17 goals to realize the goals that occur in society in facing global changes that arise due to environmental changes. To realize this goal, contributions can be made from various aspects, one of which is education. Irina Bokova, Director General of UNESCO stated that education is the key (UNESCO, 2015). Education for Sustainable Development (ESD) through education has an important role in preparing everyone to face and respond to the challenges of the 21st century, as well as fostering the right values and skills that will lead to sustainable development. ESD has a framework that aims to increase the role and contribution of the education sector in building a fairer society and a sustainable world. ESD not only supports the integration of sustainable development and SDGs into education and learning, but also ensures the integration of education and learning into every activity that supports sustainable development and SDGs (Purnamasari, 2021; UNESCO, 2020).

ESD is an innovation that has great potential in the implementation and development of education in Indonesia with the hope of being able to process and filter information as well as being able to make decisions and be responsible regarding economic sustainability, ecosystem continuity and community continuity (Hariyono, 2018; Klarin 2018; Novidsa, 2020; UNESCO , 2017). Sustainable development becomes more feasible if it is applied to the world's education system, especially the Indonesian education system, both formal education, non-formal education and special education which have a very important role (Timm, 2020). An appropriate sustainability strategy in making improvements in the educational process towards quality education with the role of all school stakeholders, especially teachers, which cannot be ignored, where teachers have a very important role with the relevant competencies they have (Timm, 2020; Brandt, 2020).

Education for Sustainable Development (ESD) can be integrated into the curriculum at all levels of education, from primary education, secondary education to higher education. ESD is also interdisciplinary and transdisciplinary in nature (Sund, 2020). Starting from this idea, to make this happen requires the role of students as objects in implementing the concept of ESD-oriented education. One form of implementation of the ESD concept that can be done is through virtual laboratory learning activities combined with Education for Sustainable Development (ESD).

Virtual Laboratory can be defined as a series of laboratory tools in the form of interactive multimedia-based computer software in the form of simulations, experiments and/or animations both locally and remotely via the internet to simulate activities like in a real laboratory (Fujayanto, 2017). Virtual laboratories can make the learning process more interesting, as if students can go on a real journey but virtually.

Based on this, a learning device is needed as a learning tool or means for students. The learning device can be an application which contains an ESD integrated Virtual Laboratory. However, based on a literature review, there are not many ESD-based Virtual Laboratories learning tools as learning tools for elementary school students. Many previous researchers developed ESD-

Volume 4, No.1, June 2024, Pages: 8-15
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based learning tools at the school level, including research from Fitria and Hamdu who developed ESD-based science learning tools specifically for teachers which included lesson plans, worksheets, modules, media guides, evaluation questions and learning performance assessment rubrics in elementary schools (Melinda , 2017). Then, Melinda, VA, Nyoman, SD & Dedi, K developed Virtual Field Trip (VFT) based social studies learning video media in Class V SDNU Kratonkencong (Majumdar, 2019)

Based on the results of researchers' observations on the Play Store, there is no Android application that providesa complete ESD integrated virtual laboratory learning device for junior high school students consisting of LKPD, modules, test questions and virtual laboratory videos. At this observation stage, the researcher only found an ESD- oriented Android-based learning application called ESDPedia which was created as a reference for teachers and prospective teachers in preparing ESD-based learning, especially in elementary schools.

In addition, the learning tools in this research were created with a focus on the fifteenth goal of the Sustainable Development Goals (SDGs), namely protecting, restoring and supporting sustainable use of terrestrial ecosystems, sustainably managing forests, combating desertification, and preventing and reversing soil degradation and inhibitingthe loss of biodiversity. This is adapted to the basic competencies of class VII junior high school which refers to the independent learning curriculum. This topic was chosen because the education sector is still underutilized as a sourcethat can be used to introduce students to basic knowledge about temperature and heat found in everyday life. Knowledge about temperature and heat in the ESD context requires increasing students' understanding and readiness in the learning process. So, the ESD concept needs to be implemented at the school level at various levels. ESD implemented at the school level is seen as effective in providing awareness to the current generation so that they are able to respect the environment for future generations.

With the presence of technology, it can now be used as a solution to achieve goals and improve the quality of skills in the learning context (Melinda, 2017). One way is to use smartphones to support today's modern learning activities. So, researchers took the initiative to use smartphones to develop virtual laboratories as a means of ESD- based learning tools. Based on the explanation above, this research aims to implement a complete ESD integrated virtual laboratory for junior high school students consisting of LKPD, modules, test questions, and virtual laboratory videos. This was developed based on the consideration that this virtual laboratory learning tool can facilitate studentsin learning and can be accessed without time limits, anytime and anywhere.

## METHOD

The type of research used by researchers is descriptive qualitative. The aim of this research is to determine theimplementation of ESD in a virtual laboratory in science learning at junior high school level in Pidie Regency. The subjects of this research were 30 science subject teachers at junior high school level who were members of MGMP IPA Rayon III Mutiara, Pidie Regency, Aceh. Data collection was carried out using a response questionnaire instrument which was given online via Google form for each subject which was arranged with four alternative answers, namely strongly agree, agree, disagree and strongly disagree. In analyzing the data, the technique used is to convert qualitative data into quantitative using a Likert Scale.

Volume 4, No.1, June 2024, Pages: 8-15
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http://internationaljournal.unigha.ac.id/

To obtain a clear picture of the research, data analysis was used using statistical techniques with a percentage formulalike the equation below:

$$P = f/n \times 100\%$$

Information :
P = percentage of Questionnaires
f = the number of answers that appearn = number of zstudents
100% = constant
value Source:
Purnamasari
(2021)

## RESULTS AND DISCUSSION

Sustainable development education or known as Education of Sustainable Development (ESD) is the main foundation in implementing the concept of sustainable development. In the process of implementing ESD, it guides students that education can direct students to pay attention to sustainable living for now and in the future (Fitri, 2021). ESD can create new innovations in science learning, such as virtual laboratories which can direct students to become literate in technology. Globally, ESD is increasingly recognized as a key element for quality education. This is clearly seen in the involvement of ESD as part of the 2030 Agenda for Sustainable Development which was agreed to by 195 countries (Majumdar, 2019). As a science teacher who has professional competence, you must be able to integrate sciencelearning by implementing learning innovations, applying approaches, methods and learning strategies which are then integrated into ESD competencies.

In research conducted through a survey to see the implementation of virtual laboratories in integrating ESD competencies in science learning. The information obtained from this implementation is used to determine the implementation of virtual laboratories on science topics as a means of studying ESD learning in science learning. Based on a questionnaire given to teachers at MGMP Science Rayon III Mutiara, Pidie Regency, information was obtained that75% of teachers had never implemented learning media in the form of virtual laboratories and integrated ESD learning

(graph 1). This shows that out of 30 teachers, only 5 teachers have implemented virtual labs and integration in ESD. From further investigation, 5 teachers have implemented this due to the online learning process during the COVID-19 pandemic and have implemented the Virtual Laboratory approach. Meanwhile, 25 other teachers have never done so. Based on observations made through a questionnaire distributed by 25 teachers, they did not understand how virtual laboratory learning works and they also did not understand ESD, in fact there were 10 teachers who still implemented conventionallearning.

Volume 4, No.1, June 2024, Pages: 8-15
ISSN 2775-4928 (Print) ISSN 2775-8893 (Online)
http://internationaljournal.unigha.ac.id/

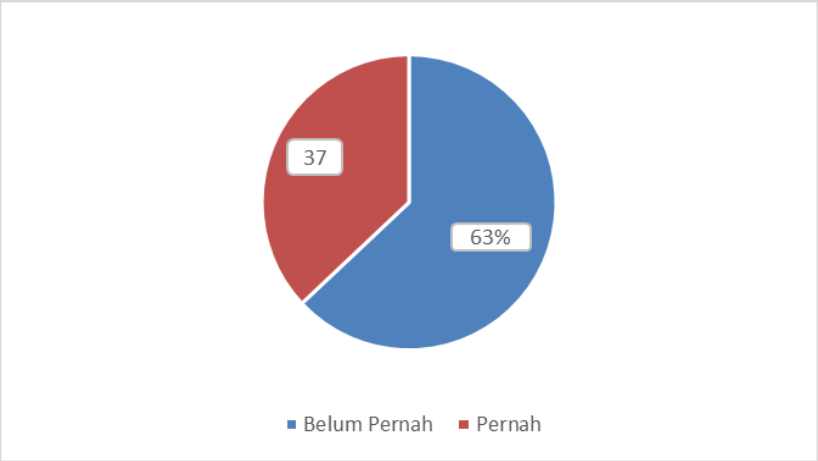


Figure 1. Percentage Diagram Before Implementing an ESD-Oriented Virtual Laboratory in Science Learning

Based on the questionnaire, information was obtained that not all teachers knew about virtual laboratories, especially ESD. There are only 5 teachers who can explain virtual laboratories and ESD. Meanwhile, 25 other teachers gave various answers. Based on the questionnaire before the implementation of STEM-oriented virtual laboratories, it was also discovered that teachers were not yet able to differentiate virtual laboratories from real practicums and how to apply technology-based learning in sustainable development (ESD). This is one of the obstacles or obstacles for teachers in implementing ESD-oriented virtual laboratories. Therefore, in implementing an ESD-oriented virtual laboratory in learning, science teachers are required to understand that ESD competencies can be integrated into learning and provide insight into comprehensive sustainable development. (Jegstad & Sinnes, 2015; Karaarslan & Teksöz, 2016; UNESCO, 2020).

In Table 2, data is presented regarding teacher responses after implementing ESD-oriented virtual laboratories in science learning carried out by each teacher. After implementation, the teacher presents his findings and can finally conclude. This is proven by the teacher response questionnaire given.

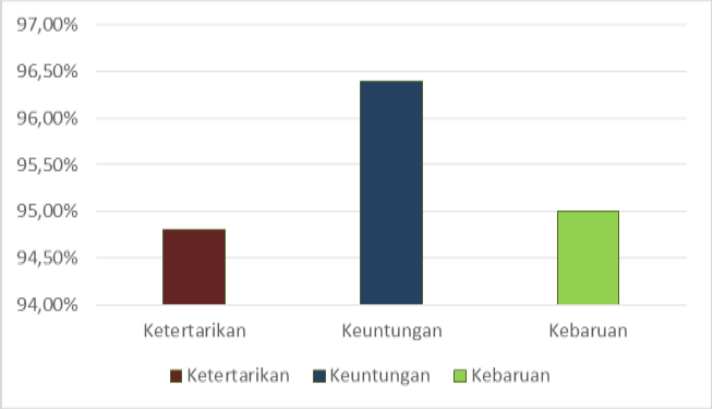


Figure 2. Percentage Diagram After Implementing ESD-Oriented Virtual Labs in Science Learning

Volume 4, No.1, June 2024, Pages: 8-15
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http://internationaljournal.unigha.ac.id/

Figure 2 shows that the teacher's response to the implementation of the ESD-oriented Virtual Lab in science learning was extraordinary. The teacher answered that with the help of technology it was easier for them to apply practicums, and made the learning process easier and more interesting for students, so that students were more enthusiastic and not bored in the learning process, and also the subjects displayed were more attractive with simple illustrations with life students' daily lives. Learning using illustrations has been proven to increase interest and motivate students to be more interested and enthusiastic in learning [17]. The choice of science topics in the virtual lab is considered very suitable for integration with ESD competencies, because science topics involve techniques or technology that can be used to fulfill the needs or interests of humanity, both now and in the future (Purnamasri, 2021 ).

The science teachers also stated that they were ready to implement ESD-oriented virtual labs in science learning in the classroom. Most teachers agree that implementing ESD-oriented virtual labs in learning is something they feel is important. For this reason, teachers try to enrich their knowledge and understanding regarding virtual labs and ESD through various sources, such as the latest research articles in journals, ESD-related website pages, and ESD modules that are circulating and can be accessed via the internet. Most of them will also try to design science learning that will be integrated with ESD competencies on certain science topics

## CONCLUSION

Based on the research results, all teacher questionnaire statements in the implementation of ESD-oriented virtual labs have a positive influence on the science learning process. This is proven by the teacher's response who feels interestedand provides many benefits when learning using an ESD-oriented virtual lab, so that the learning process is more meaningful. To see how the ability of science teachers to implement ESD and the quality of the implementation of ESD- oriented virtual labs in science learning needs to be studied further so that it can be applied to several other materials, especially science material.

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