# Learning Based on Education for Sustainable Development (ESD) as a Solution to Global Environmental Problems

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**Abstract**
Environmental problems are still a significant global issue and challenge that is not only limited to the national or regional level. This problem is closely related to economic and social development which is often triggered by human activities that are not environmentally friendly. In overcoming this problem, the concept of sustainable development was coined with three main dimensions, namely economic, social and environmental. Education has an important role in supporting sustainable development through the application of Education for Sustainable Development (ESD) in learning. This research aims to describe the implementation of ESD-based learning in schools as a solution to global environmental problems. The method used in this research is a literature study, which includes six stages: determining the topic, searching for related literature, developing arguments, conducting a survey of relevant literature, criticizing the literature, and writing a review. The research results show that ESD-based learning in schools can be implemented using appropriate learning models and supported by various ESD-based learning resources. This implementation has proven effective in increasing students' awareness and knowledge of environmental issues and encouraging more environmentally friendly actions.

**Article History:**

**Keywords:**
ESD,
Global Environment,
Learning.

## 1. Introduction

Environmental problems include aspects such as climate change, air and water pollution, deforestation, loss of biodiversity and land degradation. All of these problems are closely related to economic and social development which is often triggered by human activities that are not environmentally friendly. Activities such as excessive use of fossil fuels, deforestation for agricultural land and settlements, as well as pollution from industry and transportation, are some clear examples that contribute to environmental damage (Hamidah & Surtikanti, 2023).

To overcome this problem, the concept of sustainable development was coined. Sustainable development is a development approach that seeks to meet the needs of the present without compromising the ability of future generations to meet their own needs. This concept is based on three main dimensions, namely economic, social and environmental. The economic dimension emphasizes inclusive and sustainable economic growth, the social dimension emphasizes social welfare and reducing inequality, while the environmental dimension emphasizes preserving natural resources and environmental protection (Haryanti & Kaswinarni, 2021; Rahman et al., 2019).

Sustainable development in the field of education is often called Education for Sustainable Development (ESD). ESD is a dynamic concept in education that prioritizes noble values to achieve a sustainable future. This concept focuses on three main perspectives, namely socio-cultural, environmental and economic. ESD aims to integrate the principles, values and practices of sustainable

development into all aspects of education and learning. Thus, ESD does not only focus on knowledge about environmental issues, but also on developing critical thinking skills, problem solving, and responsible decision making (Firmaningsih & Wasikin, 2021).

Indonesia is one of the developing countries that continues to strive to accelerate development, including in the fields of economy, infrastructure and transportation, to prepare itself to face the challenges of the industrial revolution 4.0 (Karmana, 2022). However, these activities have a significant impact on the environment. Environmental issues are one of the global megatrends that affect various sectors, including education in Indonesia. Therefore, wise and sustainability-oriented education is very necessary. It is important to apply this sustainability mindset to students to help them choose and sort things that will have an impact on future conditions (Nofriyandi et al., 2021). With this background, this research aims to describe the implementation of ESD-based learning in schools as a solution to global environmental problems. Through this research, it is hoped that a deeper understanding can be gained regarding how ESD can be applied in the context of formal education and how this application can contribute to increasing students' awareness and knowledge of environmental issues and encouraging more environmentally friendly actions.

## 2. Method

This study employs qualitative research with a descriptive analysis method and a literature review approach. The literature review method involves collecting data by understanding and studying theories from various literatures related to the research (Ridwan, et al., 2021). This literature review includes reviews and analyses of various previously published literatures.

The process of compiling the literature review itself includes six important stages that must be followed sequentially: determining the topic, searching for related literature, developing arguments, conducting a survey of related literature, criticizing the literature, and writing the review (Mahanum, 2021). The data sources for this research are previous studies that have been published in journals. The data obtained are then analyzed.

The steps of this research begin with data collection, data analysis, data interpretation, and reporting of research results. Data is collected from various literature sources such as journal articles, books, research reports, and other academic sources. The researcher uses academic databases such as Google Scholar and ScienceDirect to search for relevant literature. The collected data is analyzed using content analysis methods. The researcher identifies the main themes, categorizes the information, and evaluates the findings from various literature sources. The results of the data analysis are interpreted to answer the research questions and achieve the research objectives. The researcher links the findings from the literature to the main arguments developed in the previous stages. Finally, the research results are reported in the form of a comprehensive literature review. This report includes a summary of findings, critical analysis of the literature, and recommendations for the implementation of ESD-based learning in schools.

To ensure the validity and reliability of the research, the researcher ensures several things: selecting literature from credible and reliable sources; using systematic and transparent analysis methods; performing data triangulation by comparing findings from various sources; involving co-researchers in the analysis process to reduce bias and enhance objectivity.

## 3. Results and Discussion

### 3.1 Results

Education today must be able to create individuals who are oriented towards sustainability, acting with consideration for their impact on the future of the planet to ensure the well-being of future generations. It is undeniable that the pursuit of economic development often results in significant damage and serious threats to both humans and the environment. In response to these challenges, sustainable development has been formulated as a global paradigm by the United Nations (UN). Sustainable development is defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Maulana et al., 2024; Vioreza et.al., 2023).

Achieving sustainability in human life requires various processes, methods, and efforts. One way to achieve this is through sustainable development. Among the most crucial aspects of sustainable development is the field of education, known as Education for Sustainable Development (ESD).

Indonesia is one of the countries committed to integrating the values of sustainable development into its education system. This commitment is outlined in the 2020-2024 Strategic Master Plan of the Southeast Asian Ministers of Education Organization (SEAMEO) Center Indonesia. In point seven about the adoption of the 21st-century curriculum, it is targeted that by 2030, all learners must possess knowledge and skills that support sustainable development, including Education for Sustainable Development (ESD). The indicators of achieving this target specify that all member countries must integrate 5C, ESD, and GCED into their national curricula (Southeast Asian Ministers of Education Organization, 2020). ESD-based learning is also reflected in the roadmap for Indonesia's education in 2025-2045 published by Bappenas.

ESD is believed to be capable of forming individuals who are knowledgeable, skilled, and possess values and attitudes that can be empowered to contribute to sustainable development (Purwadi & Hamdu, 2021; Vioreza et.al., 2023). The core competencies of ESD that should be developed in learners include knowledge, skills, attitudes, values, motivation, and commitment (Lee, 2012). The outcomes of ESD learning are categorized into three domains: cognitive, socio-emotional, and behavioral (UNESCO, 2017). The domains of ESD learning outcomes can be seen in Table 1.

Table 1.
Domains of ESD Learning Outcomes

| Domain | Deskripsi |
|---|---|
| Cognitive | This domain consists of the knowledge and thinking skills needed to understand SDGs |
| Socio-emotional | This domain includes the social skills needed to collaborate and cooperate to promote SDGs, as well as emotional skills, attitudes, values, and motivation to develop sustainability |
| Behavioral | This domain involves the attitudes and actions to be responsible in sustainable development |

Vilmala et al. (2022) categorized eight sustainability competencies into three domains of learning outcomes, which can be seen in Table 2.

Table 2
Categorization of Sustainability Competencies into Learning Outcome Domains

| | Cognitive Domain | Socio-emotional Domain | Behavioral Domain |
|---|---|---|---|
| **Sustainability Competency** | Systems Thinking Competency | Collaborative Competency | Strategic Competency |
| | Anticipatory Competency | | |
| | Normative Competency | elf-awareness Competency | Integrated Problem-Solving Competency |
| | Critical Thinking Competency | | |

The implementation of ESD learning can be integrated into learning models. A learning model is a design or pattern that can be utilized to develop curricula (long-term learning plans), design learning materials, and direct the learning process in the classroom or other environments (Maulana, 2023; Khoerunnisa & Aqwal, 2020). These learning models include problem-based learning (PBL) (Purnamasari et al., 2022; Firmaningsih & Wasikin, 2021; Kurniahtunnisa et al., 2023; Zulfah, Purnamasari, & Abdurrahman, 2024; Hasna, 2024), project-based learning (PjBL) (Latifah, Hayat, & Khoiri, 2023; Purnamasari et al., 2022; Nihayati, 2024; Laela, Khoiri, & Sugiyanto, 2024), STEM (Widarti & Roshayanti, 2021; Widarti, Khoiri, & Roshayanti, 2023; Riyanto, Nuroso, & Roshayanti, 2024; Muntamah, Roshayanti, & Hayat, 2024; Kurniawan, Abdurrahman, & Rosidin, 2024), flipped

classroom (Clarisa et al., 2020; Jamaludin, 2022), and predict, observe, and explain (POE) (Fatimah et al., 2023).

ESD learning can be implemented through various learning resources. Learning resources are various or all sources, whether in the form of data, people, methods, media, or places where learning occurs, used by learners to facilitate learning (Samsinar, 2020; Anilia, Heryanto, & Sunedi, 2023; Hilyati, et.al., 2023). Learning resources used in education include learning modules (Jamaludin, 2022; Fatimah et al., 2023; Mahdiann et al., 2022; Purnamasari et al., 2022), PPT (Purnamasari et al., 2022), videos (Purnamasari et al., 2022; Firmaningsih & Wasikin, 2021), worksheets (Purnamasari et al., 2022; Fauziah & Hamdu, 2022; Wahyuni, Khoiri, & Novita, 2024), games on Android-based devices (Purnamasari et al., 2022; Fibonacci, Azizati, & Wahyudi, 2020), textbooks (Purnamasari et al., 2022), interactive electronic textbooks (Sihombing, Muslim, & Agustin, 2024), e-encyclopedias (Azizah, Lathifah, & Hidayat, 2021), and virtual field trips (Adwiah et al., 2023).

The Problem-Based Learning (PBL) model is an innovative approach that requires learners to be actively involved in the learning process, allowing them to apply the knowledge gained to real-life situations (Hasna, 2024). The use of this model can also stimulate learners' thinking by breaking down problems as a way to solve those problems or issues. The implementation of the PBL model has successfully improved learners' skills in interpreting problems. However, combining PBL with Education for Sustainable Development (ESD) can broaden the scope of discussion, encompassing various social, economic, and environmental issues. The stages of the learning flow using the ESD-based PBL model consist of five phases (Hasna, 2024; Zulfah, Purnamasari, & Abdurrahman, 2024):

Phase 1: Orienting learners to the problem
Phase 2: Organizing learners for learning
Phase 3: Guiding independent or group investigations
Phase 4: Developing and presenting artifacts and exhibits
Phase 5: Analyzing and evaluating the problem-solving process

In Firmaningsih & Wasikin's (2021) study, the implementation of PBL was assisted by videos. The learning videos in this study contained ESD (Education for Sustainable Development) content, which would later present a problem to be tested on the learners.

Project-Based Learning (PjBL) is a learning approach that encourages learners to actively explore knowledge, solve problems, and develop skills through engaging and meaningful real-world projects. The implementation of the ESD-based PjBL model involves several stages: (1) project planning, (2) project launch, (3) guided inquiry and product creation, and (4) project conclusion (Nihayati, 2024).

STEAM learning is an educational approach that emphasizes the connection between Science, Technology, Engineering, Art, and Mathematics (STEAM) knowledge and skills to address problems (Riyanto, Nuroso, & Roshayanti, 2024). The STEAM approach helps students develop problem-solving skills, critical thinking, and collaboration to understand various phenomena in their environment. This encourages curiosity, an understanding of the causes and impacts of a phenomenon, and efforts to find solutions to address it (Muntamah, Roshayanti, & Hayat, 2024). ESD-oriented STEAM learning can be applied in project-based learning (Riyanto, Nuroso, & Roshayanti, 2024).

One technology-supported learning method is the Flipped Classroom. ESD-based contextual learning can help students develop problem-solving skills, which in turn can enhance their interest and academic performance. By integrating the context of ESD into the Flipped Classroom model, it is expected that students' cognitive abilities will improve, while also fostering their awareness of sustainability values. The steps in Flipped Classroom learning consist of the preliminary stage (brainstorming), the learning culture stage, presenting conceptual content, analyzing and evaluating the learning process, and the conclusion (Clarisa et al., 2020). In Jamaludin's (2022) study, the implementation of the Flipped Classroom was supported by the use of e-modules. The e-modules in this learning method facilitate students' independent learning.

## 3.2 Discussion

Education for Sustainable Development (ESD) plays a vital role in creating individuals who not only possess knowledge but also have the skills and attitudes to contribute to sustainable development.

Global commitments, including those undertaken by Indonesia, to integrate ESD into the national curriculum require an evaluation of its effectiveness in changing students' perspectives and behaviors towards sustainability issues (Taylor, J. 2014; Sinakou, E., 2019). Learning models such as Problem-Based Learning (PBL), Project-Based Learning (PjBL), STEAM, and the Flipped Classroom play crucial roles in supporting the achievement of ESD competencies. PBL and PjBL, for instance, encourage students to actively engage in solving real-world problems related to social, economic, and environmental issues, while STEAM integrates various disciplines to develop critical thinking and collaboration skills in facing sustainability challenges. The Flipped Classroom provides students with opportunities to access material independently, allowing more time for discussions and the application of concepts in real-world contexts, as well as the development of practical skills in addressing sustainability issues.

Moreover, the use of learning resources such as videos, electronic modules, and technology-based applications further enriches the ESD learning experience, enabling students to learn in a more interactive and contextual manner (Vioreza, 2022; Supriani, Y. 2016). Videos and digital learning modules, as well as Android-based game applications, provide opportunities for students to understand sustainability issues practically and deeply (Wibowo, H. S., 2023; Vioreza, 2023). However, challenges in the implementation of ESD, from curriculum aspects, teacher training, and community involvement, remain. As highlighted by Tilbury (2011), a more inclusive curriculum adaptation and empowering teachers through more in-depth training are essential to realize sustainability-based education. Additionally, community involvement is a crucial aspect of the sustainable education process.

As a step to strengthen the implementation of ESD in Indonesia, it is important to develop a more integrative curriculum, provide in-depth teacher training on ESD principles, and maximize the use of technology to support sustainability-based learning. With the right approach, ESD-based education can have a positive impact in preparing future generations to face increasingly complex global challenges (UNESCO, 2017).

## 4. Conclusion

This research demonstrates that the implementation of Education for Sustainable Development (ESD) has significant potential as a solution to global environmental problems. Through the integration of sustainability concepts into the education curriculum, students not only gain knowledge about environmental issues but also develop the attitudes and skills necessary to take positive action in their daily lives. The study found that comprehensively implemented ESD teaching methods can increase students' environmental awareness, enhance their critical and analytical abilities in addressing environmental challenges, and encourage their active participation in environmental conservation activities. Furthermore, ESD helps shape a more responsible and committed generation towards sustainability, ultimately contributing to long-term solutions to various global environmental issues. Thus, the integration of ESD into the education system is a strategic step that needs to be promoted and prioritized by policymakers and education practitioners worldwide. Through education focused on sustainable development, we can create a society that is more aware and concerned about the environment, capable of facing global challenges with innovative and sustainable solutions.

## 5. References

Adwiah, R., Hamdu, G., Nuryadin, A., & Hadiana, D. (2023). Aplikasi VFT Hidroponik Berbasis Education for Sustainable Development Sebagai Media Pembelajaran Mandiri. Naturalistic: Jurnal Kajian dan Penelitian Pendidikan dan Pembelajaran, 8(1), 31-41. https://doi.org/10.35568/naturalistic.v8i1.2349

Anilia, R., Heryanto, H., & Sunedi, S. (2023). Analisis Sikap Peduli Lingkungan Sebagai Sumber Belajar Siswa Kelas III SD Negeri 11 Tanjung Sakti Pumu. *Innovative: Journal Of Social Science Research*, *3*(2), 11939-11948. https://doi.org/10.31004/innovative.v3i2

Azizah, Y. N., Lathifah, S. S., & Hidayat, N. (2021). Pengembangan E-Ensiklopedia Keanekaragaman Talas di Kabupaten Bogor Berbasis ESD untuk Meningkatkan Literasi Digital Siswa. Pedagogia: Jurnal Ilmiah Pendidikan, 13(2), 52-56.

Clarisa, G., Danawan, A., Muslim, M., & Wijaya, A. F. C. (2020). Penerapan Flipped Classroom dalam Konteks ESD untuk Meningkatkan Kemampuan Kognitif dan Membangun Sustainability Awareness Siswa. *Journal of Natural Science and Integration*, *3*(1), 13-25.

Fatimah, F. N. U., Siswanto, J., Nuroso, H., & Hayat, M. S. (2023). Implementation of the education for sustainable development (ESD) based predict, observe, and explain (POE) learning module to improve critical thinking skills. *Practice of The Science of Teaching Journal: Jurnal Praktisi Pendidikan*, *2*(2), 52-63.

Fibonacci, A., Azizati, Z., & Wahyudi, T. (2020). Development of Education for Sustainable Development (Esd) Based Chemsdro Mobile Based Learning for Indonesian Junior High School: Rate of Reaction. *JTK (Jurnal Tadris Kimiya)*, *5*(1), 26–34. https://doi.org/10.15575/jtk.v5i1.5908

Firmaningsih, F., & Wasikin, E. H. (2021). Efektivitas Video Pembelajaran Berbasis Sustainability dalam Model Problem Based Learning terhadap Minat dan Hasil Belajar Kognitif Siswa pada Materi Ekosistem. In Seminar Nasional Sains & Entrepreneurship (Vol. 1, No. 1).

Fauziah, N. N., & Hamdu, G. (2022). Elektronik-lembar kerja peserta didik berbasis ESD di sekolah dasar. *Attadib: Journal of Elementary Education*, *6*(1), 63-78. *https://www.jurnalfai-uikabogor.org/attadib*

Hamidah, N., & Surtikanti, H. K. (2023). Implementasi education for sustainable development (ESD) pada universitas lintas negara terhadap tingkat pengetahuan dan perilaku kesadaran lingkungan mahasiswa. Asian Journal Collaboration of Social Environmental and Education, 1(1).

Haryanti, E. H. W., & Kaswinarni, F. (2021). Penerapan Pembelajaran Bermuatan Sustainability di Sekolah Program Adiwiyata untuk Mendukung Sustainable Development. Jurnal Inovasi Hasil Pengabdian Masyarakat (JIPEMAS), 4(2), 1-10.

Hasna, B. A. (2024). Integrasi Problem Based Learning Berbasis Education For Sustainable Development untuk Meningkatkan Keterampilan Interpretasi Masalah. In *Proceeding Seminar Nasional IPA* (pp. 233-244).

Hilyati, W., Yudha, C. B., & Vioreza, N. (2023). The Implementation of Education for Sustainable for Development (ESD) in Shaping Students' Green Behavior. In *Proceeding of International Conference on Education* (Vol. 2, pp. 31-40).

Jamaludin, Z. Z. (2022). E-Modul Keanekaragaman Hayati Berbasis Education For Sustanable Development Untuk Mendukung Implementasi Flipped Learning. *Jurnal Cakrawala Pendas*, *8*(4), 1550-1570. http://dx.doi.org/10.31949/jcp.v8i2.3090

Karmana, I. W. (2022). Review Literatur : Studi Tingkat Pemahaman Education Sustainable Development (ESD) pada Siswa SMA. Biocaster: Jurnal Kajian Biologi, 2(3), 123-127. https://doi.org/10.36312/bjkb.v2i3.89

Khoerunnisa, P., & Aqwal, S. M. (2020). ANALISIS Model-model pembelajaran. *Fondatia*: Jurnal Pendidikan Dasar, *4*(1), 1-27.

Kurniahtunnisa, K., Fitrianingrum, A. M., & Manuel, M. Y. (2023). Analisis Kemampuan Komunikasi dan Kolaborasi Mahasiswa Pada Pembelajaran Problem Based Learning berbasis ESD Materi Metode Ilmiah. *SCIENING: Science Learning Journal*, *4*(2), 120-127. https://doi.org/10.53682/slj.v4i2.8303

Kurniawan, T., Abdurrahman, A., & Rosidin, U. (2024). Implementasi Pembelajaran STEM Berbasis Education for Sustainable Development pada Topik Energi Terbarukan untuk Meningkatkan Kemampuan Berpikir Sistem. *Journal of Teaching and Learning Physics*, *9*(1), 12-22. http://dx.doi.org/10.15575/jotalp.v9i1.28763

Laela, F. N., Khoiri, A., & Sugiyanto, B. (2024). Efektivitas Penerapan Education for Sustainable Development Melalui Pembelajaran Berbasis Proyek Terhadap Sustainablity Consciousness Siswa Kelas 4 MI Ma'arif Kliwonan Wonosobo Pada Mata Pelajaran IPAS Tahun Pelajaran 2023/2024. Jurnal Intelek Dan Cendikiawan Nusantara, 1(2), 2968-2972.

Latifah, N., Hayat, M. S., & Khoiri, N. (2023). Potensi Implementasi Pembelajaran Berdiferensiasi Berorientasi ESD dalam Projek IPAS Aspek Zat dan Perubahannya. *Jurnal Penelitian Pembelajaran Fisika*, *14*(2), 261-268. https://doi.org/10.26877/jp2f.v14i2.16955

Lee, J. C. K. (2012). Education for sustainable Development SOURCEBOOK. In UNESCO (Vol. 43). https://doi.org/10.2753/CED1061-1932430207

Mahanum, M. (2021). Tinjauan Kepustakaan. *ALACRITY: Journal of Education*, 1-12. https://doi.org/10.52121/alacrity.v1i2.20

Mahdiannur, M. A., Erman, E., Martini, M., Nurita, T., Rosdiana, L., & Qosyim, A. (2022). Pendampingan Pengembangan Modul Ajar Berdiferensiasi untuk Guru Mata Pelajaran IPA SMP/Sederajat Berorientasi ESD. *BERNAS: Jurnal Pengabdian Kepada Masyarakat*, *3*(4), 801-808. https://doi.org/10.31949/jb.v3i4.3409

Maulana, A. (2023). *Strategi Pembelajaran Bahasa Arab*. Bumi Aksara.

Maulana, L., Mumtahaen, I., Nugraha, A. W., & Ramdhani, A. (2024). Implementasi Prinsip-Prinsip Ekonomi Syariah Dalam Kebijakan Pembangunan Berkelanjutan. Jurnal Ekonomi dan Bisnis, 4(2), 213-218.

Muntamah, M., Roshayanti, F., & Hayat, M. S. (2024). Keterampilan Berpikir Kritis Siswa SMK Pada Pembelajaran Projek IPAS Berorientasi ESD dan Pendekatan STEAM. *Jurnal Penelitian Pembelajaran Fisika*, *15*(1), 80-87. https://doi.org/10.26877/jp2f.v15i1.17981

Nihayati, F. (2024, August). UPAYA MENINGKATKAN KEMAMPUAN BERPIKIR KREATIF PESERTA DIDIK MENGGUNAKAN MODEL PROJECT BASED LEARNING (PjBL) BERMUATAN ESD. In *Proceeding Seminar Nasional IPA* (pp. 273-280

Nofriyandi., Andrian, D., Effendi, L. A., Firdaus., Ariawan, R., Qudsi, R., Wahyuni, R., Sthepani, A., & Indriani, M. (2021). Peningkatan Kemampuan Desain Media Pembelajaran Matematika Berbasis Education for Sustainable Development Guru. Community Education Engagement Journal, 2(2), 1-6. https://doi.org/10.25299/ceej.v2i2.6682

Purnamasari, S., Suhendi, F. A. F., & Zulfah, N. L. N. (2022). Implementasi Education for Sustainable Development (ESD) dalam Pembelajaran IPA di Kabupaten Garut. Jurnal Kajian Pendidikan IPA, 2(1), 1-6. http://dx.doi.org/10.52434/jkpi.v2i1.1573

Purwadi, J., & Hamdu, G. (2021). Implementasi Kompetensi Guru Berbasis ESD: Connect, Collaborate, and Engage Di SD. *Jurnal Fundadikdas (Fundamental Pendidikan Dasar)*, *4*(2), 156–171. https://doi.org/10.12928/fundadikdas.v4i2.4190

Rahman, A., Heryanti, L. M., & Ekanara, B. (2019). Pengembangan Modul Berbasis Education for Sustainable Development pada Konsep Ekologi untuk Siswa Kelas X SMA. Jurnal Eksakta Pendidikan (JEP), 3(1), 1-8. https://doi.org/10.24036/jep/vol3-iss1/273

Riyanto, A., Nuroso, H., & Roshayanti, F. (2024). Potensi Implementasi STEAM Berorientasi ESD dalam Pembelajaran Zat dan Perubahannya. *Jurnal Penelitian Pembelajaran Fisika*, *15*(1), 88-94. https://doi.org/10.26877/jp2f.v15i1.17345

Ridwan, M., Suhar, A. M., Ulum, B., & Muhammad, F. (2021). Pentingnya penerapan literature review pada penelitian ilmiah. *Jurnal Masohi*, *2*(1), 42-51.

Samsinar, S. (2020). Urgensi learning resources (sumber belajar) dalam meningkatkan kualitas pembelajaran. *Didaktika: Jurnal Kependidikan*, *13*(2), 194-205. https://doi.org/10.30863/didaktika.v13i2

Sihombing, R. A., Muslim, M., & Agustin, M. (2024). Pemanfaatan Buku Ajar Elektronik Interaktif Untuk Pembagunan Berkelanjutan Sebagai Solusi Dalam Meningkatkan Kesadaran Berkelanjutan Siswa SMP. *Jurnal Penelitian Sains dan Pendidikan (JPSP)*, *4*(2), 134-147.

Sinakou, E., Boeve-de Pauw, J., & Van Petegem, P. (2019). Exploring the concept of sustainable development within education for sustainable development: implications for ESD research and practice. *Environment, development and sustainability*, *21*(1), 1-10.

Supriani, Y. (2016). Quipper School sebagai Media Pembelajaran Berbasis Teknologi Informasi. *Jurnal Ilmu Pendidikan (JIP) STKIP Kusuma Negara*, *7*(2), 59-66.

Taylor, J. (2014). Shaping the GAP: Ideas for the UNESCO Post-2014 ESD agenda. *Journal of Education for Sustainable Development*, *8*(2), 133-141https://e-journal.iain-palangkaraya.ac.id/index.php/mipa/

UNESCO. (2017). Education for Sustainable Development Goals: Learning Objectives. UNESCO.

Vilmala, B. K., Karniawati, I., Suhandi, A., Permanasari, A., & Khumalo, M. (2022). A Literature Review of Education for Sustainable Development (ESD) in Science Learning: What, Why, and How. Journal of Natural Science and Integration, 5(1), 35. https://doi.org/10.24014/jnsi.v5i1.15342

Vioreza, N., Hilyati, W., & Lasminingsih, M. (2023). Education for Sustainable Development: Bagaimana Urgensi dan Peluang Penerapannya pada Kurikulum Merdeka?. *PUSAKA: Journal of Educational Review*, *1*(1), 34-48. https://doi.org/10.56773/pjer.v1i1.11

Vioreza, N. ., Supriatna, N. ., & Hakam, K. A. . (2023). The effect of utilizing Betawi local food in the implementation of Pancasila student profile strengthening project on increasing ecoliteracy of elementary school students. *Kasetsart Journal of Social Sciences*, *44*(4), 1115–1126. Retrieved from https://so04.tci-thaijo.org/index.php/kjss/article/view/268987

Vioreza, N., Supriatna, N., & Hakam, K. A. (2022). Development of Digital Teaching Materials Based on Betawi Local Food to Increase Ecoliteracy in Elementary School Students. *Al Ibtida: Jurnal Pendidikan Guru MI*, *9*(2), 402-416.

Wahyuni, S., Khoiri, N., & Novita, M. (2024). Validasi LKPD Konsep Energi Berorientasi ESD dengan Pendekatan Pembelajaran Berdiferensiasi. *Jurnal Penelitian Pembelajaran Fisika*, *15*(1), 95-104. https://doi.org/10.26877/jp2f.v15i1.17471

Wibowo, H. S. (2023). *Pengembangan Teknologi Media Pembelajaran: Merancang Pengalaman Pembelajaran yang Inovatif dan Efektif*. Tiram Media.

Widarti, R., Khoiri, N., & Roshayanti, F. (2023). Validitas Perangkat Pembelajaran Konsep Fluida Berbasis Science Technology Engineering Art Mathematic (STEAM) Berorientasi Education For Sustainable Development (ESD) . Jurnal Inovasi Pembelajaran Di Sekolah, 4(1), 128-136. https://doi.org/10.51874/jips.v4i1.67

Widarti, R., & Roshayanti, F. (2021). Potensi Implementasi STEAM (Science, Technology, Engineering, Art and Mathematic) berorientasi ESD (Education for Sustainable Development) dalam Pembelajaran Fluida. UPEJ Unnes Physics Education Journal, 10(3), 290-295.

Zulfah, N. L. N., Purnamasari, S., & Abdurrahman, D. (2024). Implementasi problem based learning (PBL) terintegrasi education for sustainable development (ESD) terhadap literasi lingkungan siswa pada topik energi. Jurnal Kajian Pendidikan IPA, 4(1), 299-304.