**Journal of Natural Science and Integration**
P-ISSN: 2620-4967|E-ISSN: 2620-5092
Vol. 5, No. 1, April 2022, pp 35-44

**Available online at:**
http://ejournal.uin-suska.ac.id/index.php/JNSI
**DOI: 10.24014/jnsi.v5i1.15342**

# A Literature Review on Education for Sustainable Development (ESD) in Science Learning: What, Why, and How

**Berry Kurnia Vilmala[1*], Ida Kaniawati[2], Andi Suhandi[3], Anna Permanasari[4], Minenhle Khumalo[5]**

*[1,2,3,4] Department of Science Education,Universitas Pendidikan Indonesia, Indonesia*
*[5] University of the Witwatersrand Johannesburg, South Africa*

**Correspondence Author:* berrykurniavilmala@upi.edu

Received: 20 December 2021 Accepted: 26 April 2022 Published: 30 April 2022

**ABSTRACT**
*The idea of Education for Sustainable Development (ESD) is very developed lately. However, many people do not understand what, why and how ESD is. Therefore, the current article discusses obvious issue as an area for attention and related to ESD, why ESD should be, and how ESD is implemented in education, especially in science education, as well as efforts that can be made to make the implementation of ESD successful. This research is included in the parameters of the content analysis theme. This research-based paper uses literature review from various journals, articles and other text books. ESD is a new approach in the world of education. ESD consists of three dimensions, economic, social and environmental. ESD is incredibly important to apply in science learning for the success of the SDGs. There are several notable elements in the implementation of ESD in science in Indonesia, namely the government (P4TK IPA), Professional Associations such as the Indonesian Science Educators Association, Science Subject Teachers' Conferences, and Communities in the midst of society.*

**Keywords**: *education for sustainable development (ESD), sustainable development goals (SDGs)*

## INTRODUCTION

Sustainable Development was first raised in the report of the United Nations (UN) World Environment and Development (WECD) commission. In 1987, at the United Nations general assembly, it was declared that sustainable development meant a principle of organizing human development to meet the needs of life in the long term. In 1992, the United Nations held a conference on environment and development in Rio de Janeiro, Brazil. One of the outcomes of the conference was that education should be directed at sustainable development. A few years later, on December 20, 2002, the United Nations General Assembly adopted a resolution to designate the 2005-2014 decade as the United Nations decade of education for sustainable development. The meeting established UNESCO as the agency tasked with promoting the resolution throughout the world, through recommendations covering the issue of how to integrate it into education policies, strategies and programs in each country (UNESCO, 2003). The resolution of education for sustainable development has the main mission of integrating sustainable development into the system at every level, path, and type of education. To implement sustainability through all levels of education, demands made by various policy initiatives, special attention should be paid to current and future training and education which are expected to act as agents of change. The success of implementing ESD into school curriculum and practice highly depends on how competent and committed teachers are in terms of

sustainability (Barth, 2014;Frisk & Larson, 2011). Sustainable Development is a new concept that has economic and social development benefits. It also has special attention to the environment.

On December 25, 2015 the United Nations through the general assembly in Rio de Jenairo declared the Sustainable Development Goals (SDGs) which were adopted from the 2030 agenda. From 2015, the development and further dissemination of what has been achieved in the United Nations Decade is the stated goal of the Global Program of Action (GAP) "to give everyone the opportunity to acquire the knowledge, skills, values and attitudes that empower them. to contribute to sustainable development" (UNESCO, 2014). The 2030 Agenda sets out 17 sustainable development goals (SDGs). The 17 SDGs have transformational, inclusive and universal characteristics that describe the challenges of sustainable development that are prosperous, peaceful, just and make the earth livable for everyone (United Nations Educational Scientific and Cultural Organization, 2018).

Education for Sustainable Development (ESD) is a tool to achieve the Sustainable Development Goals (SDGs). It can provide the transformation that society needs to achieve a sustainable country (Kioupi & Voulvoulis, 2019). Education is the most strategic way to cultivate and implement sustainable development values. In addition, education is considered as the most strategic in promoting sustainable development and increasing human capacity to be able to overcome environmental and development issues and problems. ESD is a multidisciplinary concept that looks at the concept of development from social, economic and environmental point of view.

ESD has not been widely implemented in Indonesian education, especially in science instruction. Therefore, this study is aimed to discuss in depth about what ESD is, why it should be implemented, how to implement it in science instruction, and what efforts can be made by the authorities in the successful implementation of ESD in classroom instruction.

## METHODOLOGY

This research is a type of the content analysis study. The chosen data and information were received from literature reviews from various journals, articles, and textbooks related to ESD and SDGs. The analysis was carried out on the information and data obtained from these various sources.

The present study also uses a review of the definition of ESD, the importance of ESD, and how to implement ESD in science learning. This study explores what ESD is, why ESD is important, and how to implement ESD in science learning.

The parameter is the content of the article or theme under this study can be seen in the following Table 1.

**Tabel 1. Example of data analysis**

| Parameter | Description |
|---|---|
| Defenition of ESD | Intended to see what is covered in articles or books about ESD |
| The Importance of ESD | To See why ESD is important to be taught |
| How to Implement ESD | To see various ways to implement ESD in science learning |

Sources of data in this study can be seen in the following Table 2.

**Table 2. Data articles/journals/books in this research**

| No | Publication Year | Author | Title | Artikel/Journal/Book |
|---|---|---|---|---|
| 1 | 2011 | Frisk, E., & Larson, K. | Educating for Sustainability: Competencies & Practices for | Journal of Sustainability Education |

| | | | | |
|---|---|---|---|---|
| | | | Transformative Action | |
| 2 | 2014 | Barth, M | Implementing sustainability in higher education: Learning in an age of transformation. | Routledge |
| 3 | 2014 | UNESCO | Roadmap for Implementating the Global Action Programme on ESD | UNESCO |
| 4 | 2015 | ICSU and ISCU | Review of Targets for The Sustainable Development Goals : The Science Review of Targets for the Sustainable Development Goals : The Science Perspective | ICSU and ISCU |
| 5 | 2016 | Wals, A. E. J. and L. . . | Sustainability citizens Collaborative and disruptive social learning | Earthscan |
| 6 | 2018 | Bagoly-Simó, P., Hemmer, I., & Reinke, V. | Training ESD change agents through geography: designing the curriculum of a master's program with emphasis on Education for Sustainable Development (ESD) | Journal of Geography in Higher Education, |
| 7 | 2018 | Bürgener, L., & Barth, M. | Sustainability competencies in teacher education : Making teacher education count in everyday school practice | Journal of Cleaner Production, |
| 8 | 2018 | UNESCO | Issues and trends in Education for Sustainable Development | UNESCO Publishing |
| 9 | 2019 | Bürgener, L., Barth, M., & Redman, A. | Becoming a competent teacher in education for sustainable development. | International Journal of Sustainability in Higher Education © Emerald Publishing Limited |
| 10 | 2019 | Kioupi, V., & Voulvoulis, N. | Education for sustainable development: A systemic framework for connecting the SDGs to educational outcomes | Sustainability |
| 11 | 2019 | Ningsih, S. Y. | Achievement of ESD (Educational for Sustainable Development) through mathematics learning. | Journal of Physics: Conference Series |
| 12 | 2020 | Schina, D | The integration of sustainable development goals in educational robotics: A teacher education experience | Sustainability(Switzerland), |
| 13 | 2020 | Taimur, S., & Sattar, H | Education for Sustainable Development and Critical Thinking Competency | Springer Nature Switzerland AG |
| 14 | 2020 | UNESCO | Guide for the effective dissemination of the asia pacific ESD teacher competency framework | Report Asia-Pacific ESD Teacher Competencies |
| 15 | 2021 | Permanasari, A., Rubini, B., & Nugroho, O. F. | STEM Education in Indonesia: Science Teachers' and Students' Perspectives. | Journal of Innovation in Educational and Cultural Research |

## FINDING AND DISCUSSION

The present study aims to discuss in depth about what ESD is, why it should be implemented, how to implement it in science instruction, and what efforts can be made by the authorities in the successful implementation of ESD in science instruction. In addition, competence is something that must also be trained. What competencies are needed to implement ESD and how teacher education can contribute to supporting the development of these competencies (Bürgener & Barth, 2018). Research on ESD in science instruction is still not widely conducted in Indonesia. This is known from the lack of literature articles or journals in Indonesia

that discuss ESD in science instruction. One of the contributing factors is the unequal distribution of information about ESD in Indonesia, especially in the field of education. Therefore, through this research, it is expected that it will contribute to providing a complete explanation of ESD, especially in science instruction.

## Definition of Education for Sustainable Development (ESD)

Education for Sustainable Development (ESD) is basically a concept that carries a new vision of education, which is to empower people of all ages to take responsibility for creating a sustainable future (UNESCO 2003). ESD is a meaningful education that functions and aims to: (1) building development that can meet the needs of the present generation without harming future generations to meet their needs, (2) improving the quality of life of the community by living within the carrying capacity of the ecosystem, (3) beneficial to all beings now and in the future (Suprastowo, 2010). ESD is an approach that combines behavior change, educational pedagogy and knowledge sustainability where the integration of these three things results in an effective and transformative learning process (Frisk & Larson, 2011). Education for sustainable development ("ESD") is education that empowers students to make informed decisions and take responsible actions for environmental integrity, economic viability and a just society, for present and future generations, while respecting cultural diversity (Taimur & Sattar, 2020).

Education for Sustainable Development (ESD) aims to develop competencies that enable and empower individuals to reflect on their own actions taking into account their current and future social, cultural, economic and environmental impacts from local and global perspectives (United Nations Educational Scientific and Cultural Organization, 2018). It requires groups and individuals to act in complex situations on a sustainable way. ESD also allows students to take part and be responsible for creating a sustainable society. ESD can develop skills, values and attitudes that enable people (including students) to lead healthy lives and can respond to local and global challenges.

## The Importance of Education for Sustainable Development (ESD)

The condition of the earth today is very alarming. Natural disasters, such as floods, landslides, and hurricanes occur frequently. In addition, the earth's temperature is getting hotter due to global warming. Therefore, it is very important for all parties to take part in solving existing problems, including in the field of education.

Education is considered an effective means of solving sustainable problems. The potential of education to change the world cannot be realized unless the education system embraces sustainable development (United Nations Educational Scientific and Cultural Organization 2018). It is expected that we can achieve the sustainable development goals (SDGs) that have been set through education. The correlation between education and the 17 SDGs can be seen in Table 3 below.

**Table 3. The Correlation between Education and the SDGs**

| SDGs | Its correlation to education |
|---|---|
| Goal 1 (No Poverty) | Education is very important to lift people out of poverty |
| Goal 2 (Zero Hunger) | Education plays a key role in helping people move towards more sustainable farming methods, and in understanding nutrition |
| Goal 3 (Good Health and Well-Being) | Education can make an important difference to a wide range of health issues, including premature death, reproductive health, disease spread, healthy lifestyles and well-being |
| Goal 5 (Gender Equality) | Education for women and girls is highly important to achieve basic literacy, improve participatory skills and abilities, and increase life opportunities |
| Goal 6 | Education and training improve skills and capacity to use natural |

| SDGs | Its correlation to education |
|---|---|
| (Clean Water and Sanitation) | resources more sustainably and can improve hygiene |
| Goal 7 (Affordable and Clean Water) | Education programs, particularly non-formal and informal, can promote better energy conservation and absorption of renewable energy sources |
| Goal 8 (Decent Work and Economic Growth) | There is a direct correlation among areas such as economic vitality, entrepreneurship, job market skills, and education level |
| Goal 9 (Industry, Innovation and Infrastructure) | Education is necessary to develop the skills needed to build more resilient infrastructure and more sustainable industrialization |
| Goal 10 (Reduced Inequalities) | Where it is equally accessible, education makes a difference proof to social and economic inequalities |
| Goal 11 (Sustainable Cities and Communities) | Education can give people the skills to participate in shaping and sustaining more sustainable cities, and to achieve resilience in disaster situations |
| Goal 12 (Responsible Consumption and Production) | Education can make an important difference to production patterns (for example with regard to circular economies) and consumer understanding of goods produced more sustainably and waste prevention |
| Goal 13 (Climate Action) | Education is the key to mass understanding of climate change impacts, adaptation and mitigation, particularly at the local level |
| Goal 14 (Life Below Water) | Education is important in developing awareness about the marine environment and building proactive consensus on its wise and sustainable use |
| Goal 15 (Life on Land) | Education and training enhance skills and capacities to support sustainable livelihoods and to conserve natural resources and biodiversity, especially in threatened environments |
| Goal 16 (Peace, Justice and Strong Institutions) | Social learning is essential to facilitate and ensure a participatory, inclusive and equitable society, and social coherence. |
| Goal 17 (Partnerships for the Goals) | Lifelong learning builds capacity to understand and promote sustainable development policies and practices |

Source: (ICSU, 2015).

## Education for Sustainable Development (ESD) Competencies

As the twentieth century draws to a close, everyone shall contribute in establishing a sustainable society. A sustainable society demands that every individual needs to learn how to understand the complex world in which they live, and how to deal with uncertainty, risk, and the high speed of social (global) change, must be able to collaborate, speak, and act positively on changes in the world (Wals, 2016). Therefore, competence is needed to achieve it. The competency approach is based on determining which approaches work best in the real world and then identifying how to encourage the necessary instruction.

The United Nations Educational Scientific and Cultural Organization (2018) has determined that there are eight key ESD competencies, namely; 1) Systems Thinking Competence, 2) Anticipatory Competence, 3) Normative Competence, 4) Strategic Competence, 5) Collaborative Competence, 6) Critical Thinking Competence, 7) Self-Awareness Competence, and 8) Integrated Problem-Solving Competence. Those competencies are critical to sustainability. Each competency has its own qualities and areas of relevance. These competencies depend on each other. That is the reason why integrated problem-solving competence is so important. In addition, basic competencies such as communication skills are very important to face sustainable development. Furthermore, these key sustainability competencies must be developed together with basic competencies (Wiek et al., 2011).

The key ESD competencies can be grouped into three domains, for instance (a) cognitive domain (knowledge and thinking ability), (b) socio-emotional domain (social abilities), and (c) behavioral domain (action competence) (Taimur & Sattar, 2020). The following table shows the grouping of the eight ESD competencies into three domains.

**Table 4. Grouping of ESD competencies in three domains**

| | Congnitive Domain | Socio-emotional Domain | Behavioral Domain |
|---|---|---|---|
| ESD Key Competencies | Systemic thinking | Collaboration | Strategic |
| | Anticipative | | |
| | Normative | Self awareness | Integrated problem solving |
| | Critical thinking | | |

It will be effective when cognitive domain competencies are developed first, followed by the socio-emotional domain and behavioral domain. The cognitive domain forms the basis for the other two domains. Attitudes and actions require a foundation which is provided by knowledge, thinking skills, and social skills.

## Teacher's ESD Competency Framework in Asia-Pacific

There are three domains in the teacher's ESD competency framework in Asia-Pacific, including in Indonesia. The three domains are the domain of facilitating learning, the domain of connecting, collaborating, and engaging, and the domain of continuing to learn and create. An overview of the teacher's ESD competency framework in Asia-Pacific is shown in Figure 1 below.

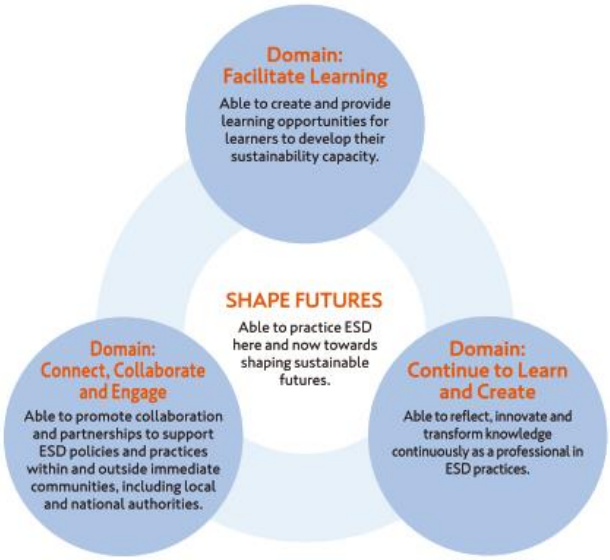


**Figure 1. Teacher's ESD competency framework in Asia-Pacific** (UNESCO, 2020)

Domain of facilitate learning is the ability to create and provide learning opportunities for students to develop their sustainability capacity. This domain consists of 4 aspects, namely; pedagogy, technology, content and culture. Pedagogy is related to how to teach ESD to students, technology is related to what instructional tools will be used in ESD learning, content is related to what material will be taught which consists of learning objectives, issues raised are related to sustainability issues, and involving students in real context.

Domain Continue to Learn and Create is the ability to reflect, be innovative and transform knowledge continuously as a professional in ESD practice. This domain consists of 3 aspects, i.e.

reflecting on ESD learning in the form of critical self-reflection, having socio-cultural awareness in ESD integration, the ability to identify and design plans for continuous improvement of ESD integration, and the ability to monitor and evaluate progress on ESD integration for long-life learning. Innovative means having the ability to develop the quality of sustainable thinking through professional learning, developing multidisciplinary and sectoral involvement for a sustainable future, maximizing ESD work with clear strategies and mechanisms, and being able to come up with creative solutions to solve problems in achieving sustainability. Transformation means the ability to promote ESD, the ability to practice a sustainable way of life, cultivating an ESD attitude for lifelong learning. These three aspects form a circular cycle, it indicates that the process shall be continuous and should not be interrupted in one part.

Connecting, Collaborating and Engaging Domain is the ability to promote and to collaborate with partners to support ESD policies and practices within and outside the community, including local and national authorities. In such obvious domain, the involvement of all parties is highly expected, starting from individuals, schools, and communities to be connected and collaborate together.

## How to Implement ESD in Science Instruction

The implementation of ESD can be performed with various models and learning methods.The implementation of ESD in learning can be done on a project-based basis, one of which is the SLIM project, which must consider the interaction of 3 key components, namely various stakeholders, ways of understanding different or competing situations, legacy conditions and methods that facilitate shared learning and action (Wals, 2016). The implementation of ESD into the curriculum is in the form of training, where the training discusses the SDGs through the Educational Robotics (ER) project. The most notable finding of this research is that this training allows students to work on sustainability across curricular activities and successfully develop ER projects centered on the different SDGs, thereby encouraging teacher education institutions to integrate the SDGs into their curriculum (Schina, 2020).

Actually, ESD strategies in education have been implemented in Indonesia for a long time. It can be seen from the following figure.

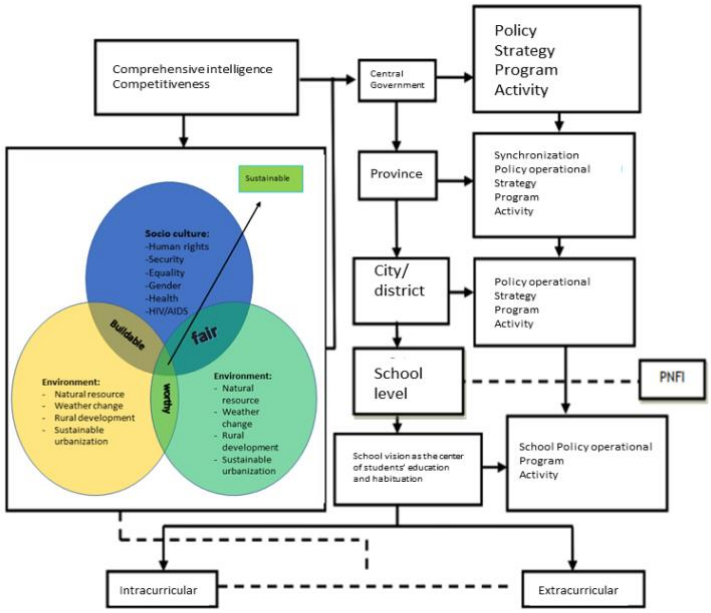


**Figure 2. National strategy model for ESD implementation** (Suprastowo, 2010)

The choice of approach in science instruction is one of the keys to success in achieving the learning objectives that have been formulated. The approach must be developed with reference to the learning outcomes to be addressed. In short, the way of presentation needed in science

instruction is one that can responsibly encourage learners to be able to solve problems in everyday life both individually and in group as a form of concern and contribution in improving the quality of the environment (Permanasari, 2016).

In general, the application of ESD in science instruction can train students to figure out their own problems in the surrounding environment, design and develop solutions, and communicate solutions. Therefore, the application of ESD is definitely suitable to apply in science instruction.

ESD can improve student achievement. This can be seen from the results of research which states that the application of ESD can improve students' academic and non-academic achievements (Ningsih, 2019; Bürgener et al., 2019; Schina, 2020). Therefore, the application of ESD-based science instruction can increase students' knowledge and its application in solving problems in the surrounding environment.

The implementation of ESD in science instruction can be supported by a problem-based learning (PBL) model and a project-based learning (PjBL) model. PBL can provide opportunities for students to apply their knowledge on sustainability issues such as environmental pollution, climate change, etc. (United Nations Educational Scientific and Cultural Organization, 2018) as a form of problem solving. In other words, the use of the PBL model can encourage students to master the knowledge needed to solve the problem. This knowledge can be in various forms, such as information and data that will be used as their consideration in solving problems critically, systematically and logically.

ESD-based science instruction using the PjBL model can also train students to solve the problems given. The PjBL model places more emphasis on the products in solving problems. Products resulting from the use of the PjBL model can be in the form of ideas or devices that can be seen and the resulting product can be a student's contribution to improving the quality of life, economic (Permanasari, 2016), social, and environmental dimensions.

## Improving the Understanding of Science Teachers related to the ESD Concept

Science teachers' understanding of ESD concept implementation in classroom activities is very important. One way that can be done to increase the capacity of science teachers is by participating in various kinds of training on ESD. To achieve a deep and broad implementation of ESD into all forms of education, the capacity of educators and trainers needs to be increased (Bagoly-Simó et al., 2018). Training is one of the many tools that science teachers must use in supporting their professional careers. Investigation of the correlation between professional development activities and specific teaching practices found a correlation between what teachers learn and how teachers teach it (Walpole et al., 2010).

There are four important elements that must be involved in the successful implementation of ESD in classroom instruction. The four elements are as shown in the following figure.

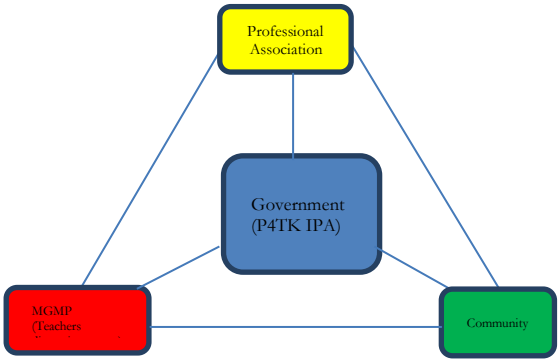


**Figure 3. Networks must be established between the four parties for the successful training and development of science teachers on ESD**. Adapted from: (Permanasari et al., 2021)

Collaboration among these four elements is needed to overcome the challenges of ESD-based science instruction. Science teachers who do not understand ESD implementation in science instruction can invite science educator professional associations, such as the Indonesian Science Educators Association (PPII) or speakers from the government such as P4TK IPA. The training can involve P4TK IPA or professional associations and/or third parties. Technical activities can be in the form of training on making ESD-based lesson plans, training on making ESD-based learning projects and training on learning models for ESD implementation. MGMPs can be involved in the next stage of training through the implementation of the ESD-based or SDGs science lesson plans in actual classroom situations. Throughout this step, the teacher can construct some kind of lesson analysis. They observe the lessons from the model teacher, and then make reflections to find strengths and improvements. In order for the implementation of science instruction to touch the real problems that exist in the community, it can involve various communities. Monitoring and evaluation should be carried out to ensure the effectiveness of the training program.

Research related to ESD and SDGs training that has begun to be carried out, such as training on ER project creation to bring through students to work on sustainability cross-curricular. This training also succeeded in developing an Educational Robotic on different SDGs which prompted teacher education institutions to integrate the SDGs in their curriculum (Schina 2020). The aspect of ESD values is also very important to be owned by the community, including teachers and students. The results showed that 81.34% of respondents stated that relevant ESD aspects or values were taught in elementary schools, especially in lower grades. Other results show that teacher respondents are ready to carry out learning about aspects of ESD in schools. This is indicated by 85.38% of which most of the teachers stated that they had read material on ESD aspects, and 51.38% stated that they had material on ESD aspects (Listiawati 2011). The teacher is able to implement it very well even though the teacher still does not realize that what has been done has led to the competence of ESD-based teachers in the facilitate learning domain (Azzahra and Hamdu 2021). The development of student competencies and the two different learning arrangements support competence dimensions of teacher's different professional action in terms of ESD (Bürgener et al. 2019).

## CONCLUSION

There are many experts and institutions that put forward the definition of ESD, where the essence is education that trains the community (including students) to take part in overcoming sustainability problems (UNESCO, 2018; Kioupi & Voulvoulis, 2019). ESD is important to be implemented into the education curriculum. The community has a role in overcoming various problems that exist in the economic, social, and environmental aspects. ESD is a tool to achieve 17 SDGs (UNESCO, 2018). ESD can be implemented in science learning by using the Project Based Learning model (Wals, 2016;Schina, 2020). This study still has many shortcomings, such as limited reference sources from various indexed journals, therefore it is very possible for other researchers to study more comprehensive about ESD.

## REFERENCES

Bagoly-Simó, P., Hemmer, I., & Reinke, V. (2018). Training ESD Change Agents Through Geography: Designing the Curriculum of A Master's Program with Emphasis on Education for Sustainable Development (ESD). *Journal of Geography in Higher Education*, *42*(2), 174–191.

Barth, M. (2014). Implementing Sustainability in Higher Education: Learning in an Age of Transformation, *January*, 1–201.

Bürgener, L., & Barth, M. (2018). Sustainability Competencies in Teacher Education : Making Teacher Education Count in Everyday School Practice. *Journal of Cleaner Production*, *174*, 821–826.

Bürgener, L., Barth, M., & Redman, A. (2019). *Becoming a Competent Teacher in Education for Sustainable Development*.

Frisk, E., & Larson, K. (2011). Educating for Sustainability: Competencies & Practices for Transformative Action. *Journal of Sustainability Education*, *2*(March), 1–20.

ICSU, I. (2015). *Review of Targets for The Sustainable Development Goals : The Science Review of Targets for the Sustainable Development Goals : The Science Perspective* (Issue February).

Kioupi, V., & Voulvoulis, N. (2019). Education for Sustainable Development: A Systemic Framework for Connecting the SDGS to Educational Outcomes. *Sustainability*, 1–18.

Ningsih, S. Y. (2019). Achievement of ESD (Educational for Sustainable Development) through Mathematics Learning. *Journal of Physics: Conference Series* (Vol. 1157, Issue 4).

Permanasari, A. (2016). STEM Education: Inovasi dalam Pembelajaran Sains. *Seminar Nasional Pendidikan Sains*, 23–34.

Permanasari, A., Rubini, B., & Nugroho, O. F. (2021). STEM Education in Indonesia: Science Teachers' and Students' Perspectives. *Journal of Innovation in Educational and Cultural Research*, *2*(1), 7–16.

Schina, D. (2020). The Integration of Sustainable Development Goals in Educational Robotics: A Teacher Education Experience. *Sustainability (Switzerland)*, *12*(23), 1–15.

Suprastowo, P. (2010). Kebijakan dan Implementasi Pendidikan untuk Pembangunan Berkelanjutan (Education for Sustainable Development/ESD). *Jurnal Penelitian Kebijakan Pendidikan Vol. 9*

Taimur, S., & Sattar, H. (2020). Education for Sustainable Development and Critical Thinking Competency. *Springer Nature Switzerland AG*, 238–248.

UNESCO. (2003). *Conférence générale. December 2002*.

UNESCO. (2014). Roadmap for Implementating the Global Action Programme on ESD. *Education for Sustainable Development*.

UNESCO. (2018). Education for sustainable development and the SDGs: Learning to Act, Learning to Achieve. Policy brief. Advancing ESD Policy. *Advancing ESD Policy*, 6.

UNESCO. (2020). *Guide for the effective dissemination of the asia pacific ESD teacher competency framework*, 3–12

United Nations Educational Scientific and Cultural Organization. (2018). *Issues and Trends in Education for Sustainable Development. UNESCO* Publishing.

Walpole, S., McKenna, M. C., Uribe-Zarain, X., & Lamitina, D. (2010). The Relationships between Coaching and Instruction in the Primary Grades. *Elementary School Journal*, *111*(1), 115–140.

Wals, A. E. J. and L. (2016). *Sustainability Citizens Collaborative and Disruptive Social Learning.pdf* (B. B. B. & A. N. (Eds. . R. Horne, J. Fien (Ed.)). Earthscan.

Wiek, A., Withycombe, L., & Redman, C. L. (2011). Key Competencies in Sustainability: A Reference Framework for Academic Program Development. *Sustainability Science*, *6*(2), 203–218.