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Article

Literature Study of The E-book based on Education for Sustainable Development (ESD) as The Main Solution to Improving Sustainability Awareness

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ABSTRACT

This study underscores the significance of E-books centered on Education for Sustainable Development (ESD) for junior high school students, highlighting the value of interactive and multidirectional learning resources to foster sustainability awareness. The research objectives are to (1) find out the necessity of ESD-based E-books for enhancing sustainability awareness among students, 2) to prove the advantages and disadvantages of ESD-based learning compared to traditional learning, and (3) compare ESD-based learning with traditional methods. Using interviews, and literature study, the study finds traditional printed science textbooks insufficient in engaging students, often reducing their enthusiasm for learning. Interviews reveal that conventional textbooks are the primary learning medium, but students find them uninspiring. E-books, however, show promise in boosting student engagement through features like accessibility, searchability, and interactivity. Challenges exist in integrating ESD into the curriculum, primarily due to educators' limited understanding of sustainability concepts. Nonetheless, ESD-based E-books are seen as effective tools for developing a sustainable culture and enhancing students' awareness of sustainability issues. The literature study indicates a clear need for ESD-based E-books for students, emphasizing their role in preparing the next generation for sustainable development. The study recommends rigorous testing and comparative analysis of STEM-ESD E-books versus traditional resources to evaluate their effectiveness in raising sustainability awareness among junior high school students. The ultimate aim is to promote self-directed learning and greater awareness of sustainability.

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INTRODUCTION

Science education facilitates an interactive learning process, emphasizing the understanding rather than mere memorization of concepts (Manurung et al., 2021). Referred to as natural science, it encompasses a vast pool of knowledge derived from observations and investigations, elucidating the intricacies, causes, and workings behind various phenomena (David et al., 2020; Panggabean et al., 2023). The incorporation of robust science education

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aligns with the United Nations' Sustainable Development Goal (SDG) 4, which aims to ensure inclusive and quality education for all, fostering a deeper understanding of scientific principles crucial for sustainable development across diverse communities. Moreover, a well-grounded grasp of science contributes to various other SDGs, including SDG 3 (Good Health and Well-being), SDG 6 (Clean Water and Sanitation), and SDG 7 (Affordable and Clean Energy), among others, underscoring its pervasive role in addressing global challenges and promoting sustainable practices.

The Sustainable Development Goals (SDGs), also known as sustainable development, are part of the United Nations (UN) agenda. Their primary aims involve socio-economic development within the environment and addressing global challenges such as climate change and biodiversity loss (Sebestyén et al., 2020; Coscieme et al., 2020). Referring to Sustainable Development Goal (SDG) number 4, which emphasizes quality education, it can be explained that this target aims to ensure inclusive, equitable, and lifelong learning opportunities for all members of society. The overarching goal of quality education, as outlined by Rieckmann (2017), aligns with the concept of Education for Sustainable Development (ESD) proposed by the UN in 2005 as a comprehensive paradigm for global societal living. ESD aims to lay the foundation for sustainable development, with its fundamental concept emphasizing meeting human needs without compromising the ability of future generations (Biase et al., 2021). ESD can be understood as education that empowers individuals to understand and address issues that may threaten life on Earth (Cars & West, 2014; Zowada & Belova, 2021; Zidny et al., 2021). Individuals experiencing positive and negative feelings related to the environment may be prompted to demonstrate affection for it by safeguarding and conserving it. Currently, human interaction with the environment has led to substantial environmental damage such as heightened waste production, air pollution, deforestation, and subsequent issues like flooding (Septian et al., 2016; Mufidah et al., 2023). One strategy to enhance environmental quality involves incorporating sustainability awareness into the learning process.

Sustainability awareness is a continuous form of consciousness related to the environment, involving attitudes of care and appreciation towards it. Attitudes, as expressions of behavior and tendencies towards specific actions, can be cultivated through personal experiences that play a pivotal role in shaping an individual's perspective of particular subjects (Albarracin & Shavitt, 2018; Abun et al., 2023). Sustainability awareness represents an individual's actions that demonstrate how to appreciate environmental issues and other aspects of life (Isaias et al., 2020; Fang et al., 2022). Establishing this awareness early on is considered crucial to support sustainable development, reflecting an innovative approach in environmental education.

As per the 2017 Environmental Quality Index (Indeks Kualitas Lingkungan Hidup/ IKLH) and the Indonesian Environmental Status (Status Lingkungan Hidup Indonesia/SLHI) report released by the Indonesian Ministry of Environment, approximately 30% of Indonesia's water has been reported as contaminated. Similarly, the deterioration of air quality has been attributed to the reduction in green spaces, increased air pollution, and the accumulation of more waste. These findings indicate a notably low level of environmentally friendly practices in Indonesia (Sugiarto & Gabriella, 2020).

Sustainability awareness is a crucial prerequisite for transforming mindsets and behaviors to preserve the environment (Alsaati et al., 2020). The lack of environmental awareness among students, stemming from their limited understanding of their surroundings, poses a challenge for educators to enhance students' sustainability consciousness. Vosniadou (2019) and Pristianti & Prahani (2023) emphasizes the necessity of scientific reasoning among students to link concepts with everyday phenomena. One of the contributing factors to students' low sustainability awareness is the absence of teaching materials that can shape their understanding. Many available teaching materials solely focus on content, lacking contextual relevance, appearing monotonous, and often lacking scientific knowledge to address problems

within the materials (Nurhasnah & Sari, 2020). Moreover, the predominant use of conventional print media in teaching materials leads to a lack of student engagement, creativity, and the absence of materials fostering a favorable attitude towards the environment (Aswirna et al., 2022). Ecocentric education can helps elucidate the complex factors such as national and institutional contexts, ideology, ethics (like ecocentric orientation), and pedagogical skills (such as didactic qualities) that contribute to ensuring a sustainable future (Molina-Moltos, 2019; Kopnina, 2020). The contributors explore how various educational programs have shaped students' worldviews and highlighted moral issues concerning the environment and our collective future. Unlike the predominant approaches of environmental education and education for sustainable development (ESD), ecocentric education focuses on the teachings of environmentalism and addresses the underlying power structures within society. A key objective of ecocentric education is to foster a connection with nature, benefiting both future learners and the planet (Pedersen, 2019; Spannring, 2019).

According to Ardan's research (2016), teachers tend to rely more on printed books or conventional teaching materials to interpret and understand the subject matter, resulting in limited and narrowly focused content. Engaging teaching materials create enthusiasm among learners in acquiring knowledge or information (Rahmani et al., 2021). The current weakness in the learning process not only stems from insufficient teacher competence but also from the lack of innovative learning resources/materials, hindering students' comprehensive mastery of the subject matter (Farhana et al., 2021). Educators' ability to enhance student involvement while curbing disruptive conduct is crucial for fostering a secure and productive learning atmosphere (Febriansyah et al., 2021; Octavia et al., 2022). The inventiveness exhibited by teachers significantly contributes to accomplishing educational objectives (Sihombing et al., 2022; Simatupang et al., 2023). Employing suitable teaching tools is a viable strategy for educators to elucidate complex scientific ideas (Fitriah & Irawan, 2021; Sihombing et al., 2023). Utilizing technological resources in education, specifically through e-book, has been identified as an effective teaching material aiding students' comprehension of subjects (Haleem et al., 2022). An example of this technological integration is the e-book, which represents a digital transformation of traditional books, accessible via computer screens, laptops, e-readers, PDAs, and even smartphones, offering students convenience in seeking information (Santoso et al., 2018). E-books enable direct reading and enjoyment on screens, replacing paper as a medium. They surpass printed books with features such as search options, page flipping, location markers, bookmarks, and annotations (Possatti et al., 2018). Leveraging information and communication technology (ICT) in educational innovation can be achieved by creating innovative teaching materials that integrate Sustainable Development Goals (SDGs) (Aswirna et al., 2022).

In response to these challenges, the government has implemented the Kurikulum Merdeka planning in accordance with the Kurikulum Merdeka Process Standards based on Regulation No. 16 of 2022 by the Minister of Education and Culture of the Republic of Indonesia. This curriculum emphasizes a multidirectional learning pattern involving interactions among teachers, students, the community, the environment, and various learning resources or media. This shift aims to transform the learning paradigm from a passive approach to one that is active, critical, and innovative (Retnaningrum et al., 2023; Hadi et al., 2023). Considering these issues, a study of literature was conducted to explore suitable learning media as a solution to enhance the sustainability awareness of junior high school students.

The novelty of this study lies in its holistic approach to integrating ESD principles into an interactive and multidirectional STEM-ESD e-book, with a focus on addressing specific environmental challenges in Indonesia. The comparative analysis with conventional learning resources adds an evaluative dimension, contributing to the understanding of the potential impact of innovative educational materials on sustainability awareness among junior high school students. Furthermore, this literature study has the potential to yield insights into the

effectiveness of implementing Education for Sustainable Development (ESD)-based learning in elevating sustainability awareness among junior high school students, particularly in the realm of science education. Research questions from this study include:

1. How does the literature support the concept of the need for ESD-based E-books as the primary solution to enhance sustainable awareness among junior high school students?
2. What are the advantages and disadvantages of ESD-based learning compared to traditional learning, especially in the context of enhancing sustainable awareness among junior high school students?
3. What are the differences between ESD-based learning and traditional learning for junior high school students?

METHODS

The research methods employed in this study primarily comprised with two aims: (1) to find out the necessity of ESD-based E-books for enhancing sustainability awareness among students, (2) to prove the advantages and disadvantages of ESD-based learning compared to traditional learning, and (3) compare ESD-based learning with traditional methods. The objective was to improve students' sustainability awareness by investigating their needs and challenges. The research tools used included teacher interview tests, and observation sheets to assess the specific requirements of students in a Junior High School setting. The data collected from these sources were analyzed to identify prevalent issues, their root causes, and potential solutions based on the insights derived from the literature study.

The study, focused on learning using E-book based on ESD and its impact on students sustainability awareness, conducted a literature study using secondary data from journals from national and international scale (Popenoe et al., 2021; Kraus et al., 2022; Libório et al., 2023; Pristianti & Prahani., 2023) sourced from Google Scholar and Scopus. Justified by Scopus' comprehensive multidisciplinary coverage (Bordignon, 2019; Martin-Martin et al., 2021), data collection spanned from 2019 to 2023. Employing a qualitative methodology, specifically descriptive qualitative analysis (Busetto et al., 2020; Rosairo, 2023), the study adapted Miles et al., (2014) stages of data analysis, outlined in Figure 1. The analysis aimed to identify prevalent issues, their root causes, and potential solutions, presenting results based on insights derived from the literature study. The findings reflect the majority opinions of participants involved in the research.

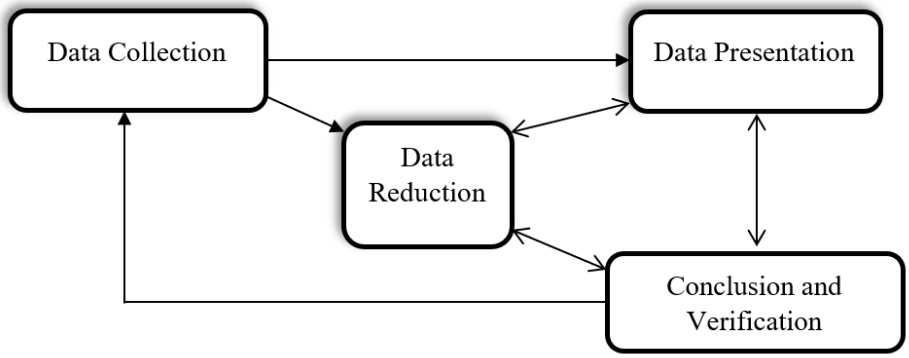

Figure 1. Qualitative Data Analysis Chart

The analysis of qualitative data encompasses four key phases, namely:

1. Data Collection: The initial phase in qualitative data analysis involves gathering the necessary information from diverse sources, including both journal studies and trials. This step is crucial for achieving the research goals.

2. Data Reduction: In this phase, researchers summarize and select key elements from the collected data. The objective is to simplify the dataset, focusing on crucial elements and making it more accessible for subsequent analysis.

3. Data Presentation: The most frequently employed form of presenting qualitative data involves using narrative text. This can take the form of succinct descriptions, charts, and the exploration of relationships between individuals. This phase aims to convey a clear picture of the findings.
4. Verification and Conclusion: The final phase centers on verifying and drawing conclusions from the data. It specifically addresses novel discoveries that contribute new insights to the existing body of knowledge, marking the culmination of the qualitative analysis process.

RESULTS AND DISCUSSION

The first results are based on the observations in several Junior High School, according to researchers' observations at a Junior High School, the current teaching method still utilizes a direct instruction system, focusing predominantly on teacher-centered learning. In contrast, the Implementation of the Kurikulum Merdeka, guided by Regulation No. 16 of 2022 from the Minister of Education and Culture of Indonesia, emphasizes a multidirectional learning pattern involving interactions among teachers, students, the community, the environment, and various learning resources. Despite the importance of this multidirectional approach in fostering sustainability awareness, some Junior High Schools have yet to effectively implement it. The lack of this approach might impede the holistic development of students' sustainability awareness, which thrives on interactions among teachers, students, the community, the environment, and diverse learning resources.

ESD is an approach that engages holistic and interdisciplinary characteristics, critical thinking, participation in decision-making, application, local relevance, pedagogical pluralism, and nurturing values that support sustainable development. The primary goal of ESD is social empowerment and building personal capacities with forward-thinking orientations and actions (Firth & Smith, 2018). The significance of education on sustainable development aims to safeguard the Earth from pollution and destruction while responding to recurring natural disasters as part of the global commitment towards sustainable development (Mardiyevna & Ugli, 2023; Javanmardi & Xie, 2023).

Based on interviews to some of students, findings reveal that the predominant learning media utilized are conventional science textbooks. Students expressed that the use of printed book media tends to dull their enthusiasm for learning, indicating a necessity for more interactive learning resources. This requirement becomes more pertinent amid the Covid-19 pandemic restrictions, limiting face-to-face learning interactions, hence emphasizing the demand for suitable mediums to facilitate the implementation of the ESD approach, benefiting both teachers and students. To facilitate an effective learning environment, educators are tasked with establishing favorable conditions that cultivate enthusiasm among learners, as highlighted by Aswirna (2018); Aswirna et al., (2022). This involves the use of teaching materials that not only capture the interest of students but also promote independent learning. The objective is to shift the focus from a traditional teacher-centered approach to a more student-centered one, as advocated by Nurhasnah et al., (2020). By employing engaging and stimulating instructional materials, educators can encourage a shift in the learning process, placing learners at the center and fostering a more interactive and participatory educational experience (Sihombing et al., 2023). An effective solution found within this context is the implementation of E-books. E-books are designed as educational tools with comprehensive materials and evaluation components, enabling independent study (Kusumayuni, 2021). The evolution of the digital era

has significantly empowered technology's role in education, enhancing the learning process's appeal for students. Sun & Pan (2021) regard E-books as interactive electronic teaching materials distinct from printed materials. They have become increasingly popular learning resources, particularly among students, facilitated by the widespread adoption of mobile reader devices in the early 21st century (Sihombing & Hasruddin, 2023).

Several advantages of E-books, such as easy accessibility, eliminating the need to visit libraries, simplified topic searches, availability anytime and anywhere, enhanced display, cost-effectiveness, and space efficiency (Santoso et al., 2018). Almunawaroh (2020) added to these benefits by emphasizing that E-books serve as effective tools to captivate students' interest, assist in motivating them to complete assignments, and offer engaging features that enhance literacy skills and leisure reading experiences. E-books excel over printed books due to features like search capabilities, page flipping, bookmarking, and annotations (Possatti et al., 2018). Innovative learning through Information and Communication Technology (ICT) can be achieved by creating innovative teaching materials integrated with SDGs (Aswirna et al., 2022; Kiswanda et al., 2022). The implementation of Education for Sustainable Development (ESD) aligns with its characteristics, encompassing pedagogical innovation, interactive teaching, student-centered approaches, and supporting experiential learning. ESD aims to enhance students' knowledge, skills, values, and attitudes to foster individuals with sustainable and fair cultures. In this context, innovative teaching materials based on E-book and ESD can serve as a solution. These instructional materials can facilitate active interaction with the content, enhance comprehension, and engage students in problem-solving and the development of scientific skills.

By integrating aspects of ESD focusing on the environment into the school learning process, it is anticipated that the learning will acquire deeper significance and encourage students to become more aware of sustainable values (sustainability awareness). Previous research by Michael et al., (2020) and Kaur & Kaur (2022) affirms that students engaged in ESD-based learning experience an increase in sustainability awareness, encompassing sustainability practice awareness, behavioral and attitude awareness, as well as emotional awareness. These findings are supported by other studies (Kemper, 2021; Rahmayanti et al., 2021), stating that the effective utilization of ESD-based learning tools helps students comprehend subject matter and enhances their awareness of the importance of environmental conservation.

Incorporating ESD programs into the curriculum with the aim of application within the learning process is undeniably a challenging and demanding task. Presently, many educators in schools still possess inadequate understanding of the concept of "sustainability" (Wilhelm et al., 2019). Most educators tend to focus more on local and national environmental issues but pay less attention to ongoing global problems such as climate change, waste management, depletion of energy resources, and other related issues. Table 1 presents a comparison between the ESD approach and the conventional approach in the context of the learning process, referring to the studies conducted by Otieno (2007), UNESCO (2008), and Lipin et al. (2021).

Table 1. Differences Between ESD and Conventional Approaches/Traditional Education

Criteria	Education For Sustainable Development	Conventional Approaches/Traditional Education
Essence	Social wellbeing	Market service
Function	Education as life	Education as training for economic activity
Aim	Enhancement of the complete human subjective experience	Creation of an expert in a specific field or discipline
Method of Implementation	Adjustment of individuals to the conditions and demands of the world.	Adjustment of humans to meet the present demands and needs of their surroundings.
Thinking	Rational thinking	Instrumental thinking
Goal-setting	Creating strategic goals	Choice of effective means
Knowledge	Culture of "ignorance"	Ready to use "useful" knowledge/information
Time	Involvement in the past, present and future	Involvement in the "tyranny of the moment"
Area	Heterotopia	Dystopia
Creativity	Imagination	Arbitrary fantasy
Worldview	Viewing the world from the perspective of the human race	Observing the world from an individual's perspective based on their personal interests.
Sustainability	Fundamental education centered on providing knowledge, skills, values, and viewpoints aimed at enabling individuals to lead sustainable lifestyles.	Practical and theoretical education aimed at fundamental survival skills and their integration with diverse facets of progress and growth.
Values	Incorporates lifelong learning of principles, skills, perspectives, and values concerning sustainability across social, environmental, and economic domains.	Learning based on values, highlighting sustainability principles across all aspects of life, facilitated by community elders to foster harmonious living.
Information	Well-informed populace and communities with extensive knowledge	Dissemination of relevant information to communities through village council gatherings, musical expressions, dancing, and interactive role-playing.
Skills	Educating every sector of the workforce to equip them with the essential knowledge and skills required to conduct their tasks in a manner that promotes sustainability.	Apprenticeship programs designed to improve expertise and abilities in various vocations like masonry, carpentry, and traditional medicine.
Cultural	Addressing various social, economic, and environmental circumstances in ways that are relevant and culturally suitable, considering indigenous cultures and their knowledge systems.	Deeply embedded in the tested and longstanding indigenous knowledge systems, yet adaptable and responsive to accommodate emerging challenges and developments.

The traditional education system was holistic, offering both practical and theoretical training. In this context, education and culture were closely connected, focusing on creating, transmitting, and preserving the knowledge, skills, and values of various societies. Cultural practices heavily influenced child-rearing, resulting in different views on quality childcare across cultures (Otieno, 2007; Sharma, 2020; Ogbo & Ndubisi, 2021). This education system prioritized practical skills and theoretical knowledge crucial for survival and harmonious development. Community elders played a significant role in value-based learning, teaching principles of sustainability to foster harmonious living. Learning was integrated into daily life through village meetings, songs, dances, and role-plays. Apprenticeships were also common, helping individuals acquire skills in trades like masonry, carpentry, and traditional medicine. Rooted in indigenous knowledge, this system was both time-tested and adaptable to new challenges.

In contrast, Education for Sustainable Development (ESD) focuses on providing knowledge, skills, values, and perspectives that encourage sustainable living. ESD integrates

principles related to sustainability across social, environmental, and economic domains, promoting lifelong learning. It aims to develop informed citizens and communities capable of addressing diverse challenges in culturally relevant ways (Lipin et al., 2021; Perwitasari et al., 2023). ESD also emphasizes the need to train the workforce to perform their duties sustainably, respecting indigenous cultures and knowledge (Nousheen et al., 2020; Druker-Ibáñez & Cáceres-Jensen, 2022).

ESD's features-being interdisciplinary, holistic, values-driven, problem-solving, multi-method, participatory, and locally relevant-mirror the principles of traditional education shaped by culture. This suggests that ESD is essentially a return to foundational educational practices, validating the effectiveness of traditional methods in addressing current sustainability challenges.This broad approach to education highlights the importance of combining cultural values and indigenous knowledge with modern educational methods to promote sustainable development and ensure the comprehensive growth of all society members.

Through an analysis of the needs of both students and teachers in the science field at a Junior High School, it becomes evident that a diverse array of reading materials is crucial to facilitate independent study and foster an increased awareness of sustainability. The development of an E-book emerges as a pivotal solution, offering an interactive and captivating reading resource for students, actively engaging them in the learning process. This interactive involvement encompasses various elements like video observations, reading texts linked to everyday occurrences, problem-solving worksheets, accessible online quizzes via smartphones, and the submission of assignments through online platforms. These engaging features collectively contribute to a more dynamic and immersive learning experience for students. Aswrina et al., (2022) corroborates the efficacy of the STEM SDGs science E-module, highlighting its positive influence on students' scientific literacy and environmental attitudes, and based on Simatupang et al., (2022) research, that said that STEM teaching books and e-learning content were very suitable to be used in classes. This resource not only aids in advancing scientific literacy skills but also plays a crucial role in cultivating environmentally conscious attitudes among students, aligning with the goals of sustainable development.

CONCLUSION

Given the challenges outlined earlier, there is a necessity for students to have access to educational materials in the form of e-books that align with Education for Sustainable Development (ESD). These e-books should focus on illustrating the relationship between living organisms and their environment, connecting these concepts with real-life examples relevant to the students' daily experiences. The content should be presented in an engaging, adaptable, and multidirectional format, aimed at fostering independent learning among students. This approach is anticipated to not only enhance students' understanding but also contribute to the elevation of their sustainability awareness. The researcher recommends not only creating an e-book centered around Education for Sustainable Development (ESD) but also advocating for its integration with STEM, resulting in an innovative learning resource known as STEM-ESD e-book. It is essential for this e-book to undergo rigorous testing to assess its effectiveness in enhancing the educational process. Comparisons should be made between the outcomes of using this new e-book and the utilization of conventional learning resources or media currently employed in Junior High Schools. This evaluation aims to gauge the potential advantages and impact of integrating STEM and ESD in educational materials for students.

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REFERENCES

Abun, D., Antonio, G. J., Alipio, C. D., & A, L. (2023). The Effect of Students' Attitude toward Research on the Intention to Conduct Research. *Divine Word International Journal of Management and Humanities, 2*(2), 268-287.

Albarracin, D., & Shavitt, S. (2018). Attitudes and Attitude Change. *Annual Review of Psychology, 69*, 299–327.

Alsaati, T., El-Nakla, S., & El-Nakla, D. (2020). Level of Sustainability Awareness Among University Students in the Eastern Province of Saudi Arabia. *Sustainability (Switzerland), 12*(8), 1–15.

Ardan, A. S. (2016). The Development of Biology Teaching Material Based on the Local Wisdom of Timorese to Improve Students Knowledge and Attitude of Environment in Caring the Persevation of Environment. *International Journal of Higher Education, 5*(3), 190-200.

Aswirna, P. (2018). Penerapan Model Pembelajaran Kooperatif Tipe Talking Stick Terhadap Pemahaman Konsep Fisika Siswa di MTsN Piladang Kabupaten Lima Puluh Kota. *Natural Science: Jurnal Penelitian Bidang IPA Dan Pendidikan IPA*, *4*(1), 503–515.

Aswirna, P., & Ritonga, A. M. (2020). Development of Discovery Learning – Based E-Book Teaching Based on Kvisoft Flipbook Maker on Science Literation In MAN 2 Padang Pariam. *Jurnal Hunafa: Studia Islamika*, *17*(2), 1-19.

Aswirna, P., Aldila, E., Nurhasnah., & Fahmi, R. (2022). STEM-Based Global Warming E-Book in Sustainable Development Based on Gender View. *Indonesian Journal of Science and Mathematics Education*, *05*(2), 169-181.

Aswirna, P., Fahmi, R., Samad, D., & Tamala, N. (2022). Pengembangan E-Modul Fisika Berbasis Model Trait Treatment Interaction Terhadap Keterampilan Berpikir Kritis. *Natural Science: Jurnal Penelitian Bidang IPA dan Pendidikan IPA, 8*(1), 40-49.

Aswirna, P., Kiswanda, V., Nurhasnah., & Fahmi, R. (2022). Implementation of STEM E-Module with SDGs Principle to Improve Science Literacy and Environment-friendly Attitudes in Terms of Gender. *JTK: Jurnal Tadris Kimia*, *7*(1), 64-77.

Aswirna, P., Roza, M., & Zainia, M. (2023). Integrated Science E-Module assisted by the Flip PDF Professional Application to Integrate Character Education Values in Science Learning for Junior High Schools. *Journal of Natural Science and Integration*, *6*(1), 14-27.

Aswirna, P., Sabri, A., & Tusa'diah. (2020). Development of Interactive Module Based on Trait Treatment Interaction (TTI) Using Adobe Flash on Critical Thinking Skills of Students. *Global Conferences Series: Social Sciences, Education and Humanities (GCSSSEH)*, *6*, 192-203.

Aswirna, P., Samad, D., Devi, I., Fahmi, R., & Jannah, R. (2022). STEM-Based E-Module Integrated Local Wisdom of Rice Stem Fertilizers on Students' Critical and Creative Thinking. *Al-Ta lim Journal*, *29*(1), 15-23.

Biase, R. D, Malatesta, S., & Friedberg, M. S. D. (2022). Promoting Education for Sustainable Development in the Maldives: Exploring the Link Between Theory and Practice. *PROSPECTS*, *52*(3), 529-544.

Bordignon, F. (2019). Tracking Content Updates in Scopus (2011-2018): A Quantitative Analysis of Journals Per Subject Category and Subject Categories Per Journal. *17th International Conference on Scientometrics & Informetrics*, 1630-1640. https://enpc.hal.science/hal-02281351

Busetto, L., Wick, W. & Gumbinger, C. (2020). How To Use and Assess Qualitative Research Methods. *Neurol. Res. Pract, 2(*14), 1-10. https://doi.org/10.1186/s42466-020-00059-z

Cars, M., & West, E. E. (2015). Education For Sustainable Society: Attainments and Good Practices In Sweden During The United Nations Decade For Education For Sustainable Development (UNDESD). *Environment, Development and Sustainability*, *17*(1), 1–21.

Coscieme, L., Mortensen, L. F., Anderson, S., Ward, J., Donohue, I., & Sutton, P. C. (2020). Going Beyond Gross Domestic Product as an Indicator to Bring Coherence to the Sustainable Development Goals. *Journal of Cleaner Production*, *248*, 1-8.

David, M., Susanti, D., & Kurniasih, R. (2020). Pedagogical Use of Dramatic Performance Through Science Subject for Peace Education in Paraguay. *Insecta: Integrative Science Education and Teaching Activity Journal*, *1*(2), 110-120.

Druker-Ibáñez, S., & Cáceres-Jensen, L. (2022). Integration of Indigenous and Local Knowledge into Sustainability Education: A Systematic Literature Review. *Environmental Education Research*, 1-28. DOI: https://doi.org/10.1080/13504622.2022.2083081

Fang, W., Hassan, A., & LePage, B. A. (2022). *The Living Environmental Education*. Singapore: Springer Nature Singapore.

Farhana, F., Suryadi, A., & Wicaksono, D. (2021). Pengembangan Bahan Ajar Berbasis Digital Pada Mata Pelajaran Bahasa Inggris di SMK Atlantis Plus Depok. *Jurnal Instruksional*, *3*(1), 1-17.

Febriansyah, F., Herlina, K., Nyeneng, I. D. P., & Abdurrahman. (2021). Developing Electronic Student Worksheet (E-Worksheet) Based Project Using Fliphtml5 to Stimulate Science Process Skills During the Covid-19 Pandemic. *Insecta: Integrative Science Education and Teaching Activity Journal*, *2*(1), 59-73.

Firth, R., & Smith, M. (2018). *Education for Sustainable Development: What was achieved in the DESD?* Melbourne: Routledge.

Fitriah, I. R., & Irawan, E. (2021). Development of Electronic Teaching Materials Based on Smart Application Creator (SAC) to Improve Contextual Thinking Ability of VIII Junior High SchoolStudents on Vibration and Wave Materials. *Insecta: Integrative Science Education and Teaching Activity Journal*, *2*(1), 105-116.

Hadi, A., Ngindana, R., Kurdi, M. S., Kurdi, M. S., Fauziah. (2023). New Paradigm of Merdeka Belajar Curriculum in Schools. *Al-Ishlah: Jurnal Pendidikan*, *15*(2), 1497-1510.

Isaias, P., Sampson, D. & Ifenthaler, D. (2020). *Online Teaching and Learning in Higher Education*. Cham: Springer.

Javanmardi, E., Liu, S., & Xie, N. (2023). Exploring the Challenges to Sustainable Development from the Perspective of Grey Systems Theory. *Systems*, *11*(2), 1-35.

Kaur, J., & Kaur, K. (2022). Developing Awareness and Attitude Towards Sustainability Through an Activity-Based Intervention. *Journal on Efficiency and Responsibility in Education and Science*, *15*(4), 212–220.

Kemper, J. (2021). Stimulating Collective Transformative Learning Experiences with an ESD Whole-School Assessment Tool. *Glocality*, *4*(1), 1–20.

Kiswanda, V., Aswirna, P., & Nurhasnah. (2022). Pengembangan E-Modul Fisika Berbasis STEM Dengan Prinsip Pembangunan Berkelanjutan Terhadap Literasi Sains Siswa Kelas XI. *Journal Cerdas Mahasiswa*, *4*(1), 62-75.

Kopnina, H. (2019). Ecocentric Education: Introduction to A Special Collection of Essays. *Education Sciences*, *10*(217), 1-6.

Kraus, S., Breier, M., Lim, W. M., Dabić, M., Kumar, S., Kanbach, D., Mukherjee, D., Corvello, V., Piñeiro-Chousa, J., Liguori, E., Palacios-Marqués, D., Schiavone, F., Ferraris, A., Fernandes, C., & Ferreira, J. J. (2022). Literature Reviews as Independent Studies: Guidelines For Academic Practice. *Review of Managerial Science*, *16*(8), 2577-2595. https://doi.org/10.1007/s11846-022-00588-8

Kusumayuni, P. N., Agung, A, A, A. (2021). E-Book with A Scientific Approach on Natural Science Lesson For Fifth Grade Students of Elementary School. *Jurnal Ilmiah Sekolah Dasar*, 5(1), 177-185.

Libório, M. P., Martins, C. A. P. S., Laudares, S., & Ekel, P. I. (2023). Method of Preparing An International and National Literature Review For Novice Researchers. *MethodsX*, *10*, 102165. https://doi.org/10.1016/j.mex.2023.102165

Lipin, M., Husieva, N., & Krasilnikov, O. (2021). Education For Sustainable Development in The Perspectives of "Information Society". *SHS Web of Conferences*, *111*(01012). https://doi.org/10.1051/shsconf/202111101012

Lipin, M., Husieva, N., & Krasilnikova, O. (2021). Education For Sustainable Development in The Perspectives Of "Information Society". *SHS Web of Conferences*, *111*(01012), 1-12.

Manurung, G. A., Simanjuntak, L.A., & Sihombing, R. A. (2021). Misconceptions on The Concept of Photosythesis and Plant Respiration for Class VIII at SMP Negeri 27 Medan in Science Learning. *Indonesian Science Education Research (ISER)*, *3*(2), 12-19.

Mardiyevna, S. G., & Ugli, T. O. U. (2023). Importance of Sustainable Development In The Modern World. *International Scientific-practical Conference*.

Martín-Martín, A., Thelwall, M., Orduna-Malea, E., & López-Cózar, E. D. (2021). Google Scholar, Microsoft Academic, Scopus, Dimensions, Web of Science, and OpenCitations' COCI: A Multidisciplinary Comparison of Coverage Via Citations. *Scientometrics*, *126*, 871–906. https://doi.org/10.1007/s11192-020-03690-4

Michael, F. L., Sumilan, H., Bandar, N. U. R. F. A., Jonathan, V., & Nor, N. I. K. N. (2020). Sustainable Development Concept Awareness Among Students In Higher Education: A Preliminary Study. *Journal of Sustainability Science and Management*, *15*(7), 113-122.

Miles, M. B., Huberman, A. M., & Saldana, J. (2014). Q*ualitative Data Analysis, A Methods Sourcebook, Edition 3*. USA: Sage Publications. Terjemahan Tjetjep Rohindi Rohidi, UI-Press.

Molina-Motos, D. (2019). Ecophilosophical Principles for An Ecocentric Environmental Education. *Education Sciences*, *9*(1), 1-15. https://doi.org/10.3390/educsci9010037

Mufidah, A., Agustina, W. L., & Ekapti, R. F. (2023). DE-ASIGION (Digital Plotagon Animation Video)as aMiddle Science Learning Media Towards SDGs 2030. *Insecta: Integrative Science Education and Teaching Activity Journal*, *4*(1), 64-74.

Nousheen, A., Zai, S. A. Y., Waseem, M., & Khan, S. A. (2020). Education For Sustainable Development (ESD): Effects of Sustainability Education on Pre-Service Teachers' Attitude Towards Sustainable Development (SD). *Journal of Cleaner Production*, *250*(119537), 1-12. https://doi.org/10.1016/j.jclepro.2019.119537

Nurhasnah, N., & Sari, L. A. (2020). E-Modul Fisika Berbasis Contextual Teaching and Learning Menggunakan Aplikasi Kvisoft Flipbook Maker Untuk Meningkatkan Literasi Sains Peserta Didik SMA/MA Kelas XI. *Natural Science: Jurnal Penelitian Bidang IPA dan Pendidikan IPA*, *6*(1), 29– 40.

Nurhasnah, N., Kasmita, W., Aswirna, P., Abshary, F. I., (2020). Developing Physics EModule Using "Construct 2" to Support Students' Independent Learning Skills. *Thabiea: Journal of Natural Science Teaching*, *3*(2), 79-94.

Octavia, S. C., Sihombing, R.A., Destine, K. T., & Hutagalung, J. F. (2022). Analysis of Obstacles on Limited Face-To-Face Learning During the Covid-19 Pandemic Junior High School in Medan. *Tarbiyah: Jurnal Ilmiah Kependidikan*, *11*(1), 18-28.

Ogbo, C. V., & Ndubisi, E. J. O. (2021). African Indigenous Education in Contemporary Society. *Journal of African Studies and Sustainable Development*, 1-19.

Otieno, L. (2007). *Cultural Considerations in Early Childhood Education for Sustainable Development*. UNESCO: Paris.

Panggabean, F. T. M., Simanjuntak, L. A., Sihombing, R. A., Octavia, S. C., Tambunan, J. B. (2023). Analysis of 7th-Grade Students' Misconceptions of Acid-Base. *J-PEK (Jurnal Pembelajaran Kimia)*, *8*(1), 1-7.

Pedersen, H. (2019). The Contested Space of Animals in Education: A Response to the "Animal Turn" in Education for Sustainable Development. *Education Sciences*, *9*(3), 1-11. https://doi.org/10.3390/educsci9030211

Perwitasari, S. I., Hariyono, E., & Susantini, E. (2023). Implementation of ESD (Education for Sustainable Development) In Climate Change Learning: A Literature Review. *IJORER: International Journal of Recent Educational Research*, 4(4), 399-415. https://journal.ia-education.com/index.php/ijorer

Popenoe, R., Langius-Eklöf, A., Stenwall, E., Jervaeus, A. A. (2021). Practical Guide to Data Analysis in General Literature Reviews. *Nordic Journal of Nursing Research*, *41*(4):175-186. https://doi:10.1177/2057158521991949

Possatti, G. M., Silva, R. P., & Perry, G. T. (2018). Guidelines for Ebook Design. *Brazilian Journal of Information Design*, *15*(2), 197-213.

Pristianti, M. C., & Prahani, B. K. (2023). Literature Review on The Use of Problem Based Learning Models in Improving Physics Learning Outcomes. *Insecta: Integrative Science Education and Teaching Activity Journal*, *4*(1), 91-103.

Rahmani, R., Mustadi, A., Maulidar, M., & Senen, A. (2021). The Development of Teaching Materials Based on Context and Creativity to Increase Students Scientific Literacy. *Jurnal Ilmiah Peuradeun*, *9*(2), 345-364.

Rahmayanti, E., Hendayana, S., & Riandi, R. (2021). Project Based Learning in Pandemic Covid-19: The Implementation of ESD to Develop Students' Critical Thinking Skills. *UNNES Science Education Journal*, *10*(3), 137-144.

Retnaningrum, E., Widyatiningtyas, R., Sari, A. R., Sapulete, H., Solissa, E. M., & Sujana, I. G. (2023). Teacher's Paradigm in Interpreting the Birth of the Merdeka Curriculum Policy. *Journal of Education Research*, *4*(2), 435-442.

Rieckmann, M. (2017). *Education for Sustainable Development Goals: Learning Objectives*. UNESCO Publishing.

Santoso, T. N. B., Siswandari., & Sawiji, H. (2018). The Effectiveness of Ebook Versus Printed Books in The Rural Schools in Indonesia at The Modern Learning Era. *International Journal of Educational Research Review*, *3*(4), 77-84.

Santoso, T. N. B., Siswandari., & Sawiji, H. (2018). The Effectiveness of Ebook Versus Printed Books in The Rural Schools in Indonesia at The Modern Learning Era. *International Journal of Educational Research Review*, *3*(4), 77-84.

Sebestyén, V., Domokos, E., & Abonyi, J. (2020). Focal Points for Sustainable Development Strategies—Text Mining based Comparative Analysis of Voluntary National Reviews. *Journal of Environmental Management*, *263*, 1-12.

Septian, Y., Ruhimat, M., & Somantri, L. (2016). Perilaku Ramah Lingkungan Peserta Didik SMA di Kota Bandung. *SOSIO DIDAKTIKA: Social Science Education Journal*, *3*(2), 109-201.

Sihombing, R. A., & Hasruddin, H. (2023). Development of E-Book STEM-Based on Human Digestive System Material Based on Scientific Literacy. *Jurnal Pendidikan Matematika dan IPA*, *15*(2), 182-197.

Sihombing, R. A., Manurung, G. A., & Simanjuntak, L. A. (2022). Analysis Implementation of Technological Pedagogical Content Knowledge by Science Teachers Through Distance Learning at Junior High School In Medan. *Jurnal Pendidikan Matematika dan IPA*, *13*(2), 214-230.

Sihombing, R. A., Muslim., & Rahman, T. (2023). Effective Classroom Management During the Limited Face-To-Face Learning Period in Junior High School Medan. J*urnal Manajemen Pendidikan: Jurnal Ilmiah Administrasi, Manajemen dan Kepemimpinan Pendidikan, 5*(2), 1-16

Sihombing, R. A., Muslim., & Rahman, T. (2023). The Development of Interactive Audio-Visual-Based Media Using VideoScribe to Reduce Misconceptions Electrical Potential and ECG Material. Tarbiyah: Jurnal Ilmiah Kependidikan, *12*(2), 69-80.

Simatupang, H., Hardinata, A., Ningsih, W., Bukhari, I., & Sihombing, R. A. (2022). Validation of Teaching Books and STEM Subjects E-Learning Content. *AIP Conference Proceedings*, *2659*, 1-5.

Simatupang, H., Siregar, E. H., Sihombing, R. A., & Tanjung, M. Y. (2023). Profile of Technology Pedagogical Content Knowledge-21 (TPACK21) on Pre-Service Science Teacher in Microteaching Course. *Sciendo*, 2022, 764-771.

Spannring, R. (2019). Ecological Citizenship Education and The Consumption of Animal Subjectivity. *Education Sciences*, *9*(1), 1-20. https://doi.org/10.3390/educsci9010041

Sugiarto, A., & Gabriella, D. A. (2020). Kesadaran Dan Perilaku Ramah Lingkungan Mahasiswa di kampus. *Jurnal Ilmu Sosial dan Humaniora*, *9*(2), 260– 275.

Sun, L., & Pan, C. E. (2021). Effects of the Application of Information Technology to E-Book Learning on Learning Motivation and Effectiveness. *Frontiers in Psychology*, *12*(September), 1–5.

UNESCO. (2008). *The Contribution of Early Childhood Education to a Sustainable Society*. Paris.

Vosniadou, S. (2019). The Development of Students' Understanding of Science. *Frontiers in Education*, *4*(April), 1–6.

Wilhelm, S., Förster, R., & Zimmermann, A. B. (2019). Implementing Competence Orientation: Towards Constructively Aligned Education for Sustainable Development in University-Level. *Sustainability*, *11*(1891), 122.

Zidny, R., Sjöström, J., Eilks, I. (2021). A Multi-Perspective Reflection on How Indigenous Knowledge and Related Ideas Can Improve Science Education for Sustainability. *Science & Education*, *29*, 145-185.

Zowada, C., Belova, N., & Eilks, I. (2021). Enhancing Education for Sustainable Development Through Geographical Perspectives in Chemistry Teaching. *International Journal of Science and Mathematics Education*, *19*(1), 87–109.