



Integrating Sustainable Development Principles in Learning Mathematics to Stimulate Sustainable Skills in Future Generations

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Abstract

This research constitutes a literature review employing a qualitative approach, analyzing scholarly articles, books, and other documents related to sustainable development. This article aims to summarize and analyze previous studies concerning sustainable development in the context of mathematics education, as well as strategies that can be employed to integrate the principles of sustainable education. Integrating the principles of sustainable development into education, including mathematics education, is crucial in fostering a more environmentally responsible society and promoting sustainability across all sectors. However, its implementation remains limited. Educators face various challenges, including a lack of time, resources, and understanding of sustainable education, along with a dearth of supportive teaching materials. The principles of sustainable development can serve as a framework for developing curricula and teaching practices that are more sustainable. Educators can select mathematical problems related to environmental or social issues, discuss relevant mathematical concepts in connection with these problems, and help students comprehend the impact of mathematical decisions on the environment and society. Integrating the principles of sustainable development into mathematics education not only aids in producing a generation with sustainable skills but also motivates students to learn mathematics in more engaging and meaningful ways. A learning approach centered around sustainable development can be an effective way to prepare students for a sustainable future. The article also underscores the necessity for curriculum development, training, and professional advancement for educators.

Keywords: Sustainable Development, Education Sustainable, Sustainable Skills, Learning Mathematics

Abstrak

Penelitian ini merupakan tinjauan pustaka yang menggunakan pendekatan kualitatif, menganalisis artikel ilmiah, buku, dan dokumen lain yang terkait dengan pembangunan berkelanjutan. Artikel ini bertujuan untuk merangkum dan menganalisis penelitian sebelumnya mengenai pembangunan berkelanjutan dalam konteks pendidikan matematika, serta strategi yang dapat digunakan untuk mengintegrasikan prinsip-prinsip pendidikan berkelanjutan. Mengintegrasikan prinsip-prinsip pembangunan berkelanjutan ke dalam pendidikan, termasuk pendidikan matematika, sangat penting dalam membentuk masyarakat yang lebih bertanggung jawab terhadap lingkungan dan mempromosikan keberlanjutan di semua sektor. Namun, implementasinya masih terbatas. Pendidik menghadapi berbagai tantangan, termasuk kurangnya waktu, sumber daya, dan pemahaman tentang pendidikan berkelanjutan, serta kekurangan bahan ajar yang mendukung pendekatan ini. Prinsip-prinsip pembangunan berkelanjutan dapat menjadi kerangka kerja untuk mengembangkan kurikulum dan praktik pengajaran yang lebih berkelanjutan. Pendidik dapat memilih masalah matematika yang terkait dengan isu-isu lingkungan atau sosial, membahas konsep matematika yang relevan dalam kaitannya dengan masalah-masalah ini, dan membantu siswa memahami dampak keputusan matematika terhadap lingkungan dan masyarakat. Mengintegrasikan prinsip-prinsip pembangunan berkelanjutan ke dalam pendidikan matematika tidak hanya membantu menciptakan generasi dengan keterampilan berkelanjutan tetapi juga memotivasi siswa untuk belajar matematika dengan cara yang lebih menarik dan bermakna. Pendekatan pembelajaran yang berpusat pada pembangunan berkelanjutan dapat menjadi cara efektif untuk

mempersiapkan siswa untuk masa depan yang berkelanjutan. Artikel ini juga menekankan pentingnya pengembangan kurikulum, pelatihan, dan pengembangan profesional bagi pendidik.

Kata kunci: Pembangunan Berkelanjutan, Pendidikan Berkelanjutan, Keterampilan Berkelanjutan, Pembelajaran Matematika

Introduction

Sustainable development is a very important concept in facing global challenges in the 21st century. This concept includes policies, practices and behaviors that aim to create healthy environments, inclusive societies and stable economies. Continuing education emphasizes the need to integrate sustainable development principles into educational curricula and practices (Woo et al., 2014). This can help create a more environmentally responsible society and support sustainability in all sectors.

Continuing education must consider three contexts, namely social, economic and environmental (Clarisa et al., 2020; Rahadian, 2016). These three aspects must be integrated with each other to understand the interrelationships between aspects. One way to achieve sustainable development goals is through education, including mathematics education. Mathematics education is chosen as a key strategy to achieve sustainable development goals because mathematics is not just an academic discipline; it is a universal language of science and technology. The ability to comprehend mathematics provides a solid foundation for understanding scientific and technological concepts, serving as a cornerstone for progress across various sectors. Moreover, mathematics learning plays a crucial role in developing critical thinking skills and problem-solving abilities, which are essential in facing the complexities of sustainable development challenges. Through mathematics, individuals can grasp the interconnections between disciplines, apply data analysis for decision-making, and plan actions that are sustainable. Thus, strengthening mathematics education is a strategic investment in shaping a knowledgeable, creative, and competitive society to confront the challenges of sustainable development.

This is in line with Jeong's opinion which states mathematics education for sustainable

development is considered as the main key (Jeong & González-Gómez, 2020). Mathematics education can help increase understanding (Dwijayani, 2019), create critical and analytical thinking (Ismail et al., 2022; Tambunan, 2019). This is an indispensable skill in addressing environmental issues and sustainable development. Mathematics education must be integrated with the principles of sustainable development, so as to stimulate sustainable skills in future generations. In addition, the integration of the principles of sustainable development in learning mathematics can increase students' understanding of the relationship between mathematics and the environment, and encourage them to take concrete actions to support sustainability (Hsiao & Su, 2021). Thus using mathematics in the context of sustainable development can help students develop the skills needed to create sustainable solutions.

However, although there is evidence that the integration of sustainable development principles into mathematics education has significant benefits, its implementation is still limited. Teachers face various challenges when integrating environmental issues into learning mathematics, including a lack of time and resources, as well as a lack of experience and understanding of environmental issues (Darwati & Purana, 2021). Therefore, efforts are needed to support the use of mathematics in the context of sustainable development. This can be done through curriculum development that takes into account the principles of sustainable development and through training and professional development for teachers. The mathematics curriculum based on sustainable development is an attempt to integrate the principles of sustainable development into learning mathematics.

In this curriculum, students are taught to understand and apply mathematical concepts in the context of sustainable development, such as environmental performance measurement, environmental impact calculation, green economy analysis, and so on. In addition, this

curriculum also emphasizes the development of sustainable skills, such as critical thinking, collaboration, innovation, and creativity. By using a mathematics curriculum based on sustainable development, students can increase their understanding of mathematical concepts and develop sustainable skills that are important for their future. They can also gain knowledge about the impact of human actions on the environment and learn how to reduce those impacts.

This article aims to explore the importance of integrating sustainable development principles in mathematics learning to stimulate sustainable skills in future generations. This article will also discuss several strategies that can be used to integrate these principles in teaching mathematics, as well as efforts that must be made to support the implementation of the integration of the principles of sustainable development in learning mathematics.

Methodology

This research is a type of qualitative research with the method used is a library research method. Data collection is done through documentation in the form of scientific articles. The data collected comes from scientific articles or textbooks. There are 13 articles analyzed related to the theory of sustainable development in mathematics education. The data analysis technique used is descriptive analysis that explains and summarizes the characteristics and patterns of existing data. Literature review and literature

rereading is carried out to ensure the accuracy of the assessment and prevent wrong information in data analysis. This method involves analysis, synthesis, and interpretation of literature or other sources that are relevant to the research topic.

Results and Discussions

In this research, an analysis or review of 13 articles related to sustainable development and its impact on mathematics education is conducted. Among these articles, three are from Indonesia, while the remaining ten are from abroad. The publication timeline of these articles ranges from 2014 to 2023.

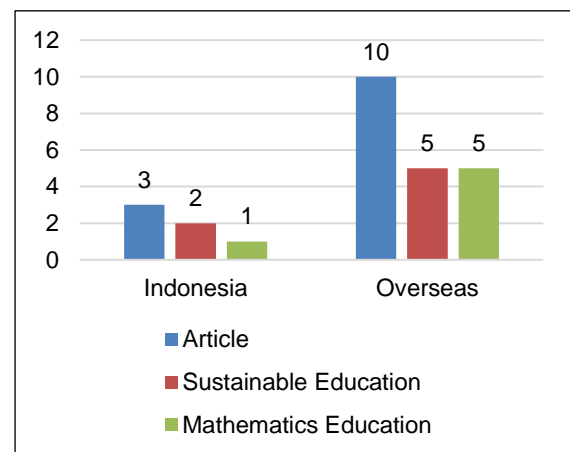


Figure 1. Article graph analyzed

Figure 1 shows the number of articles related to Sustainable Education, which is 7, and there are 6 articles on Mathematics Education. The list of articles is as follows:

Table 1. List of analyzed articles

Code	Article Title	Authors	Year
A1	Education for sustainable development a review aof characteristics of sustainability curriculum.	Woo, Y. L., Mokhtar, M., Komoo, I., & Azman, N	2014
A2	Pathways to Equitable and Sustainable Education Through the Inclusion of Roma Students in Learning	Javier Díez-Palomar, Ainhoa Flecha Fernández de Sanmamed, Rocío García-Carrión, & Silvia Molina-Roldán	2018
A3	A Constructivist Approach to the Teaching of Mathematics to Boost Competences Needed for Sustainable Development.	Anna Vintere	2018
A4	The Development of Mathematics Curriculum to Increase The Higherorder Thinking Skills in The Sustainable Development Goals (SDGs) Era	Anggraeni, Y., Abdulhak, I., & Rusman, R	2019
A5	Sustainability Development in Mathematics Education-A Case Study of What Kind of Meanings Do Prospective Class Teachers Find for The Mathematical Symbol "2/3 "?	Jorma Joutsenlahti, & Päivi Perkkilä	2019

Table 1. (Cont.) List of analyzed articles

Code	Article Title	Authors	Year
A6	Dodo (Domino Ludo); Sarana Pendidikan Karakter Berbasis Pembelajaran Tematik Pada Diri Anak Sekolah Dasar Di Era Sustainable Development Goals	Husnul Khatimah, Reski Dian Utami, & Ira Novia Sari	2019
A7	Penerapan Flipped Classroom dalam Konteks ESD untuk Meningkatkan Kemampuan Kognitif dan Membangun Sustainability Awareness Siswa	Gabriela Clarisa, Agus Danawan, Muslim Muslim, & Agus Fany Chandra Wijaya	2020
A8	Adapting to PSTs' pedagogical changes in sustainable mathematics education through flipped E-Learning: Ranking its criteria with MCDA/F-DEMATEL	Jin Su Jeong, & David González-Gómez	2020
A9	Construction of theoretical model for sustainable development in future mathematical teachers of higher education.	Natalia Pasichnyk, Renat Rizhniak, Inna Krasnoshchok, Yuliia Botuzova, & Kateryna Akbash	2020
A10	Belief system of future teachers on education for sustainable development in math classes	Claudia Vásquez, María José Seckel, & Ángel Alsina	2020
A11	A study on the impact of steam education for sustainable development courses and its effects on student motivation and learning	Peng-Wei Hsiao, & Chung-Ho Su	2021
A12	Mathematics Teachers Facing the Challenges of Global Society: A Study in Primary and Secondary Education in Spain.	Noelia Santamaría-Cárdaba, Cristina Martins, & João Sousa	2021
A13	Environmental Challenges and Sustainable Development	Deepak Kumar Garg	2023

Sustainable development is a concept that emphasizes the importance of maintaining a balance between economic, social, and environmental aspects in every development action undertaken. This concept originated from concerns about the negative impacts of unsustainable development, such as environmental degradation, social injustice, and economic instability. The goal of sustainable development is to create a just, healthy, and sustainable society worldwide. One crucial aspect of sustainable development is meeting human needs sustainably without harming the environment. In other words, sustainable development must consider the long-term impacts of actions taken and ensure that natural resources and the environment remain preserved. This can be achieved by ensuring that every development action is carried out while considering these three aspects and involving all relevant parties, including communities, governments, and the private sector. In practice, the concept of sustainable development encourages the adoption of policies and practices that support sustainable use of natural resources, energy and water conservation, the use of green technologies, and the development of a sustainable economy.

In the implementation of sustainable development, several important principles must be considered, as follows (Garg, 2023):

1. **Community Engagement**
Sustainable development must involve active participation from the community at all levels in decision-making processes related to the environment and development.
2. **Social Justice**
Sustainable development should prioritize social justice and promote equality, reduce disparities, and provide equitable access to resources and benefits from development.
3. **Resource Efficiency**
Sustainable development should achieve efficiency in the use of natural resources and maintain usage levels that can be sustained over the long term.
4. **Biodiversity Conservation**
Sustainable development must focus on the protection and conservation of biodiversity and ecosystems that are essential for the survival of humans and other species.
5. **Environmental Protection**
Sustainable development should prioritize environmental protection and consider the impact of development on the environment, including pollution control and waste reduction.

6. Collaboration and Partnerships

Sustainable development should promote collaboration and partnerships between governments, the private sector, and civil society to effectively and efficiently achieve sustainable development goals.

7. Sustainable Economic Growth

Sustainable development should achieve sustainable and inclusive economic growth, while considering the long-term impacts on society and the environment.

Sustainable development also encourages increased access to education, healthcare, and social justice, while considering human rights and environmental rights. In the context of education, these principles can serve as a framework for developing curricula and teaching practices that are more sustainable. Mathematics is known as a gateway subject in education: students who excel in mathematics tend to achieve higher grades and receive better education compared to those who perform poorly in the subject (Díez-Palomar et al., 2018). Therefore, integrating the principles of sustainable development into mathematics education can help produce a generation with sustainable skills. Mathematics can play a crucial role in sustainable development, as many issues in sustainable development require advanced mathematical analysis. Complex problem-solving, critical thinking, creativity, decision-making, and cognitive flexibility – these are competencies often cited as key elements of sustainable development, and they can be developed through mathematics education (Vintere, 2018).

Sustainable skills that can be developed through mathematics education include: (1) Complex problem-solving is the ability to analyze, understand, and solve problems involving multiple variables, uncertain information, and intricate interactions; (2) Critical thinking is the ability to objectively and rationally analyze, evaluate, and interpret information; (3) Creativity is the ability to generate new, original, and innovative ideas; (4) Decision-making is the process of selecting an action or solution from various available options; (5) Cognitive flexibility refers to the ability to adapt to changes, consider different perspectives, and switch between various ideas or tasks effortlessly.

Its implementation in mathematics learning with the theme of sustainable resource management is as follows:

1. Subtheme Energy Needs Modeling: Students learn to analyze patterns of energy usage in households and develop mathematical models to predict future energy needs. They are challenged to find environmentally friendly and sustainable solutions. (Problem Solving)
2. Subtheme Urban Development Impact: Students conduct research on urban growth and its impact on the environment. They use mathematical concepts to analyze data and identify positive and negative impacts. Students then evaluate sustainable development policies and provide recommendations. (Critical Thinking)
3. Subtheme Eco-Friendly Garden Design: Students work in groups to design environmentally friendly city gardens. They use geometric concepts, comparisons, and area calculations to optimize space usage and minimize ecological footprint. Creative and innovative solutions are emphasized. (Creativity).
4. Subtheme Investment in Renewable Energy: Students study financial concepts such as investment, return on investment, and risk. They then evaluate renewable energy projects as investments and make decisions based on mathematical analysis related to financial benefits and environmental impact. (Decision Making).
5. Subtheme Climate Change and Variability: Students learn about mathematical models used to predict climate change. When presented with new data on climate variability, they are asked to adjust their models and make new predictions. This develops students' ability to think flexibly when faced with new information. (Cognitive Flexibility).

Mathematical knowledge requires an understanding of facts or concepts within a specific field. This means that teachers need to comprehend the structure of mathematics. Teachers should not only know how to define mathematical concepts but also be capable of explaining why a particular mathematical concept is worth knowing and understanding, as well as how it relates to other concepts in

theory and practice. Teachers must possess teaching skills in mathematics so that others can comprehend it, requiring them to employ various alternative approaches. Additionally, teachers are expected to possess the skills and abilities to connect specific mathematical concepts to topics covered in other subjects. Simultaneously, teachers should understand the mathematical topics and problems taught in previous and subsequent years, as well as the curriculum materials that encompass them. In building mathematics teacher training and continuous classroom training, it is understood that content and process play a crucial role for teaching professionals (Joutsenlahti & Perkkilä, 2019).

Integrating sustainable education principles into mathematics teaching can be achieved through various strategies or methods. Here are some methods that can be employed:

1. Case studies: Incorporating sustainable case studies into mathematics learning. Example: Using cases like calculating carbon footprints or cost-benefit analysis of renewable energy investments.
2. Project-based sustainable development: Engaging students in projects that emphasize sustainable solutions. Example: A waste management project in the school where students use mathematical concepts to analyze waste data, design effective waste management solutions, and present sustainable recommendations to the school.
3. Mathematical modeling: Applying mathematical concepts to model sustainable development problems. Example: Creating a mathematical model to predict population growth, considering environmental factors.
4. Use of mathematical software: Using software or applications that encompass sustainable development aspects. Example: GeoGebra, Matlab, SPSS, Mathematica, Maple, SageMath, Maxima, and others.
5. Interdisciplinary collaboration: Integrating mathematics learning with other disciplines related to sustainable development.
6. Open-Ended questions: Providing open-ended questions or problems that require critical thinking and sustainable solutions.
7. Environmental impact analysis: Analyzing data and considering environmental impact in the context of mathematical problems.

Each of these methods offers unique opportunities for students to understand and

apply mathematical concepts in the context of sustainable development, promoting critical thinking and real-world problem-solving skills.

The concepts of sustainable development can be integrated in various ways, such as providing relevant examples that relate to students' contexts so that they understand the significance of sustainable development concepts in their daily lives. Teachers can use real-life case examples and empirical data relevant to students' contexts. Mathematics can be used to analyze data regarding the environmental impacts of human activities, to model natural resources and human consumption patterns, and to estimate the long-term effects of policies and human actions on the environment. Furthermore, teachers can offer positive feedback and motivate students. This can help students understand how crucial sustainable development concepts are in their daily lives and motivate them to apply these concepts in their future lives. Thus, students can comprehend the importance of sustainable development and develop critical thinking skills to solve environment-related problems. This aligns with Anggraeni et al. (2019), who states that Higher Order Thinking Skills (HOTS) are the foundation of SDGs. Abilities found in HOTS include problem-solving, critical thinking, creative thinking, argumentation/reasoning skills, and decision-making, where HOTS problems must be contextual or based on everyday life problems (Lestari, 2019).

Some examples of integrating sustainable development principles into mathematics education are as follows:

1. Using relevant case studies on sustainable development in mathematics education. Integration in the course: In a mathematics class, teachers can choose case studies relevant to sustainable development. For example, students can be tasked with calculating the carbon footprint of daily activities at school, including student transportation, electricity consumption, and waste management. Students can then develop solutions to reduce this carbon footprint, integrating mathematical concepts such as ratios, calculations, and data analysis.
2. Utilizing sustainable development-based mathematics applications. Integration in the course: Teachers can select mathematics software that incorporates sustainable

development principles. For instance, students can use applications that provide an understanding of sustainable performance measurements, environmental value calculations, and projections of the long-term effects of human actions. This provides students with an opportunity to learn mathematical concepts while linking them to environmental impacts.

3. Sustainable tasks and projects assignment. Integration in the course: Within the mathematics curriculum context, teachers can assign tasks or projects that emphasize sustainable development principles. For example, students may be asked to calculate the environmental impact of water consumption in school and propose solutions to optimize water usage. Projects like these involve mathematical modeling, data analysis, and creative thinking to achieve sustainable solutions.
4. Integration of sustainable development concepts into the mathematics curriculum. Integration in the course: Sustainable development principles can be integrated throughout the mathematics curriculum. Concepts such as energy efficiency, carbon calculations, and environmental impact analysis can be incorporated into existing mathematical topics like algebra, statistics, or calculus. This allows students to see the interconnections between mathematics and sustainability issues in a broader context.

Integrating sustainable development principles into mathematics education not only helps produce a generation with sustainable skills but also has the potential to motivate students to learn mathematics in more engaging and meaningful ways. Therefore, an approach focused on sustainable development in teaching can be effective. Teachers should prepare mathematics lessons with a theme of sustainable education. However, currently, there are still teachers who lack understanding and preparation for appropriate teaching methods.

This aligns with the findings of Vásquez et al., (2020), which states that 1% of teachers still do not understand sustainable education, and 25% of teachers are not ready to integrate sustainable education into their subjects. This lack of preparation is compounded by the fact that teachers lack the necessary tools to

integrate sustainable education into mathematics lessons. Furthermore, other studies also indicate that teachers in elementary, middle, and high schools do not pay specific attention to SDGs content in mathematics education (Santamaría-Cárdaba et al., 2021). For example, in thematic learning in elementary schools, teachers struggle to apply thematic learning, especially in mathematics (Khatimah et al., 2019). Therefore, there is a need for socialization of SDGs content related to mathematics education. This shows that teachers have not fully understood how to integrate sustainable education into lessons, resulting in suboptimal preparation.

These deficiencies need to be addressed with teaching methods and media used in mathematics education. According to Pasichnyk et al., (2020), methods for conducting sustainable education include content and methodological elements for integrating skills and disciplines, mathematics, pedagogy, natural sciences, generalization and systematization of knowledge and skills in humanities, and the development of systematic thinking. These methods can be applied to mathematics education combined with sustainable development principles, thus fostering sustainable skills in students. Educational media can clarify the presentation of messages and information in such a way that accelerates and enhances the learning process and outcomes, creates learning motivation, and enables students to learn independently according to their abilities and interests (Widodo & Wiyatmo, 2017). Additionally, educational media can overcome limitations in perception, space, and time.

Studying sustainable education can help students develop more holistic and sustainable mathematical skills. Students can learn how to use mathematics to understand environmental issues and create more sustainable solutions to these problems. Through the development of these skills, students can become more aware and responsible towards the environment and society, and they can take concrete actions to support sustainability in the future. Thus, integrating sustainable development principles into mathematics education can help increase students' awareness of environmental issues. By integrating these principles, students can gain a more comprehensive understanding of

environmental problems and the impact of human actions on the environment. Moreover, students can also learn about ways to reduce the negative impact of human activities on the environment and create more sustainable solutions to environmental issues.

Conclusions

This article highlights the importance of integrating sustainable development principles into mathematics education to promote sustainable skills in future generations. Sustainable development is a crucial concept in addressing global challenges in the 21st century, including creating a healthy environment, inclusive societies, and stable economies. Mathematics education can help enhance critical and analytical thinking abilities, which are essential for addressing environmental issues and sustainable development. However, the integration of sustainable development principles into mathematics education is still limited, and teachers face various challenges.

Some of these challenges include teachers who do not yet understand the connection between sustainable education and school subjects, and teachers lacking the necessary tools and media for effective teaching. Therefore, efforts are needed to support the integration of sustainable development principles into mathematics education, including curriculum development and teacher training. Principles of sustainable development, such as community involvement, social justice, resource efficiency, biodiversity conservation, environmental protection, collaboration and partnerships, as well as sustainable economic growth, can be used as frameworks for developing more sustainable curricula and teaching practices. Integrating these principles into mathematics education not only helps produce a generation with sustainable skills but also motivates students to learn mathematics in more engaging and meaningful ways.

References

Anggraeni, Y., Abdulhak, I., & Rusman, R. (2019). The Development of Mathematics Curriculum to Increase The Higherorder Thinking Skills in The Sustainable Development Goals (SDGs) Era. *WoMELA-*

- GG. <https://doi.org/10.4108/eai.26-1-2019.2282915>
- 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. <https://doi.org/10.24014/jnsi.v3i1.8953>
- Darwati, I. M., & Purana, I. M. (2021). Problem Based Learning (PBL): Suatu Model Pembelajaran Untuk Mengembangkan Cara Berpikir Kritis Peserta Didik. *Widya ACCARYA: Jurnal Kajian Pendidikan FKIP Universitas Dwijendra*, Vol 12 N0(1), 61–69.
- Díez-Palomar, J., de Sanmamed, A. F. F., García-Carrión, R., & Molina-Roldán, S. (2018). Pathways to Equitable and Sustainable Education Through the Inclusion of Roma Students in Learning Mathematics. *Sustainability*, 10(7), 1–16. <https://doi.org/10.3390/su10072191>
- Dwijayani, N. M. (2019). Development of Circle Learning Media to Improve Student Learning Outcomes. *Journal of Physics: Conference Series*, 1321(2). <https://doi.org/10.1088/1742-6596/1321/2/022099>
- Garg, D. K. (2023). Environmental Challenges and Sustainable Development. *Journal Global Values*, XIV(Special Issue), 203–210.
- Hsiao, P. W., & Su, C. H. (2021). A Study on the Impact of STEAM Education for Sustainable Development Courses and Its Effects on Student Motivation and Learning. *Sustainability*, 13(7), 1–24. <https://doi.org/10.3390/su13073772>
- Ismail, S. N., Muhammad, S., Omar, M. N., & Shanmugam, S. K. S. (2022). the Practice of Critical Thinking Skills in Teaching Mathematics: Teachers' Perception and Readiness. *Malaysian Journal of Learning and Instruction*, 19(1), 1–30. <https://doi.org/10.32890/mjli2022.19.1>
- Jeong, J. S., & González-Gómez, D. (2020). Adapting to PSTs' Pedagogical Changes in Sustainable Mathematics Education Through Flipped E-Learning: Ranking Its Criteria with MCDA/F-DEMATEL. *Mathematics* (Vol. 8, Issue 5). <https://doi.org/10.3390/MATH8050858>
- Joutsenlahti, J., & Perkkilä, P. (2019). Sustainability Development in Mathematics

- Education-A Case Study of What Kind of Meanings Do Prospective Class Teachers Find for The Mathematical Symbol " $\frac{2}{3}$ "? *Sustainability*, 11(2), 1–15. <https://doi.org/10.3390/su11020457>
- Khatimah, H., Utami, R. D., & Sari, I. N. (2019). Dodo (Domino Ludo); Sarana Pendidikan Karakter Berbasis Pembelajaran Tematik Pada Diri Anak Sekolah Dasar Di Era Sustainable Development Goals. *Jurnal Pena*, 3(2), 11.
- Lestari, S. A. P. (2019). Pengembangan Instrumen Asesmen Higher Order Thinking Skill (HOTS) pada Materi Himpunan Kelas VII SMP. *JKPM (Jurnal Kajian Pendidikan Matematika)*, 4(2), 111–120. <https://doi.org/10.30998/jkpm.v4i2.3862>
- Pasichnyk, N., Rizhniak, R., Krasnoshchok, I., Botuzova, Y., & Akbash, K. (2020). Construction of Theoretical Model for Sustainable Development in Future Mathematical Teachers of Higher Education. *Universal Journal of Educational Research*, 8(5), 2079–2089. <https://doi.org/10.13189/ujer.2020.080546>
- Rahadian, A. H. (2016). Strategi Pembangunan Berkelanjutan. *Prosiding Seminar STIAM*, III(01).
- Santamaría-Cárdaba, N., Martins, C., & Sousa, J. (2021). Mathematics Teachers Facing the Challenges of Global Society: A Study in Primary and Secondary Education in Spain. *Eurasia Journal of Mathematics, Science and Technology Education*, 17(4), 1–9. <https://doi.org/10.29333/ejmste/10806>
- Tambunan, H. (2019). The Effectiveness of the Problem Solving Strategy and the Scientific Approach to Students' Mathematical Capabilities in High Order Thinking Skills. *International Electronic Journal of Mathematics Education*, 14(2), 293–302. <https://doi.org/10.29333/iejme/5715>
- Vásquez, C., Seckel, M. J., & Alsina, Á. (2020). Belief System of Future Teachers on Education for Sustainable Development in Math Classes. *Uniciencia*, 34(2), 1–30. <https://doi.org/10.15359/RU.34-2.1>
- Vintere, A. (2018). A Constructivist Approach to the Teaching of Mathematics to Boost Competences Needed for Sustainable Development. *Rural Sustainability Research*, 39(334), 1–7. <https://doi.org/10.2478/plua-2018-0001>
- Widodo, A., & Wiyatmo, Y. (2017). Pengembangan Media Pembelajaran Buku Saku Digital Berbasis Android untuk Meningkatkan Minat dan Hasil Belajar Fisika Peserta Didik Kelas XI SMA N 1 Jetis Pada Materi Pokok Keseimbangan Benda Tegar. *Jurnal Pendidikan Fisika*, 6, 148.
- Woo, Y. L., Mokhtar, M., Komoo, I., & Azman, N. (2014). Education for Sustainable Development A Review of Characteristics of Sustainability Curriculum. *OIDA International Journal of Sustainable Development*, 3(8), 33–44. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2031102

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