



## Integrating SDGs in Climate Change Education: Insights from Pre-Service Physics Teachers

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### ABSTRACT

*To develop a further sustainable world and address the sustainability-related challenges outlined in the SDGs, every individual should be an agent of sustainability. Individuals need understanding, skills, and attitudes that can contribute to the achievement of SDGs and teachers are the key to the development and implementation of SDGs through education. This study aims to measure the knowledge, perception, and attitude of pre-service physics teachers toward the implementation of SDGs. Our research involved 188 students taken from physics education of two different universities in Indonesia. A modified version of a prior study's questionnaire was used to assess students' knowledge, perception, and attitude. The result shows the entire sample had moderate overall knowledge of the SDGs; there were notable variations in the scores gained for the SDGs' personal and professional implications; and there were differences between the perception of the goals, with the different level of SDGs involvement with the climate change courses. Means that pre-service physics teacher still lacks of information and professional education on pedagogies also the instructing abilities essential for teaching them, obstructing the implementation of the SDGs. Pre-service physics teachers must acquire the knowledge and competencies necessary for teaching and promoting the SDGs to stimulate students' interest, curiosity and capability for learning science as well as increasing students' enrolment in science related courses towards the achievement of SDGs.*

**Keyword:** Climate Change, Pre-Service Physics Teacher, Knowledge, Attitude, and Perception, SDGs.

### INTRODUCTION

The Sustainable Development Goals (SDGs) represent a framework aimed at fostering economic prosperity and improving social quality of life, including advancements in the education sector. Education plays a crucial role in supporting the achievement of the SDGs. As a foundational element, education drives progress toward the goals outlined in the SDGs framework. Strengthening Indonesia's education system is essential to achieving the 17 SDGs, particularly by fostering a quality nation through relevant and impactful education (Safitri et al., 2022). Countries worldwide face challenges such as insecurity of property and life,

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increasing poverty rates, extreme violence, hunger, terrorism, inadequate educational standards, limited or nonexistent access to clean water and proper roads, rising inequality, inadequate infrastructure, growing unemployment, natural disasters, and declining quality of life in both land and sea environments (Awodoyin & Ojo, 2021). Indonesia is among the nations committed to implementing the SDGs and has demonstrated this commitment through various programs and strategic measures. These steps include aligning the SDG goals and objectives with national development priorities, mapping the availability of SDG data, and establishing measurement systems for each goal and target, including representative indicators (Widoyono, 2016). According to the SDG Index for Southeast Asia, Indonesia ranked 6th in achieving SDGs in 2021 within the region and 97th globally. The Sustainable Development Report highlights that since the adoption of the SDGs in 2015, Indonesia's SDG implementation index has shown consistent changes in both score and global ranking (Sachs et al., 2021).

The government has implemented several programs aimed at improving the standard and quality of education to support initiatives derived from the United Nations' SDGs, with the goal of achieving these targets by 2030 (Pribadi, 2017). For this plan to succeed, contributions from all sectors—governments, businesses, civil society organizations, and private citizens—are essential (United Nations Educational, 2017). Sustainable human and environmental development is closely linked to the education system. Consequently, higher education plays a pivotal role in addressing current global challenges by producing well-educated graduates who act as agents of change (Jati et al., 2019).

Students, as future decision-makers, also play a crucial role in achieving the SDGs, influencing both the planet's future and key issues facing humanity (Kleespies & Dierkes, 2022). Previous research indicates that students are more motivated to engage in actions aligned with the SDGs when they possess a positive mindset (Afroz & Ilham, 2020). However, it is important to note that awareness of the SDGs may vary among students due to differences in institutional environmental policies. Therefore, it is critical to raise awareness among teachers and students about the risks associated with environmental challenges, how to identify threats, and the actions necessary to prevent these risks from escalating globally. In this context, universities and schools play a crucial role in supporting students by leveraging their expertise (Costa et al., 2023). By fostering sustainable communities and promoting sustainability through education, schools and universities must lead efforts to address global challenges for sustainable development. Enhancing our understanding of sustainability education in higher institutions will enable the development of strategies that address the educational, cultural, economic, environmental, and social dimensions of sustainability (Shah et al., 2022). Recent studies reveal growing interest in Education for Sustainable Development (ESD) within teacher training and education, particularly since 2016. These studies highlight emerging research trends, including perceptions of ESD competencies, evaluations of training programs, and analyses of how ESD is integrated into national teacher education systems (Imara & Altinay, 2021).

Previous studies have explored the implementation of values-based education in Indonesia as a strategy to achieve one of the SDGs, employing content analysis within a library research framework (Anggraini & Nugraheni, 2024). Other research also examines Indonesia's preparedness for achieving the SDGs in education by 2030 and identifies barriers to their implementation in the education sector, also relies on secondary data obtained through library research (Thamrin, 2020). This normative research employs both statutory and conceptual approaches. Numerous studies have highlighted challenges related to teaching practices and curriculum design that hinder the integration of SDGs into Indonesia's education system. However, most of these studies use qualitative methods, revealing a lack of quantitative research on Indonesian students' understanding of the SDGs. This gap presents an opportunity for the author to address it by providing empirical data on pre-service physics teachers' knowledge, perspectives, and attitudes toward the SDGs.

To ensure students understand the interdisciplinary connections within the sustainable development agenda, sustainability education can be integrated into course curricula (Michael et al., 2020). Consequently, school programs must design curricula that incorporate extracurricular, intracurricular, and co-curricular activities (Mulyasari et al., 2021). ESD was developed to balance the need for education with the aspiration for a better future (Ilham et al., 2021). The early goals of ESD aim to instill in individuals—adults, children, and the elderly—a sense of the value of natural resources, economic systems, and social integration, while fostering an appreciation for the environment, economy, and society (da Rocha et al., 2020).

Physics education plays a significant role in shaping future generations. Physics classes help develop analytical skills, critical and creative thinking, and an understanding of natural phenomena. Although physics education in Indonesia requires students to engage in problem-solving as part of science education, physics teacher training programs face challenges in aligning with these goals (Cheng et al., 2022). Additionally, multimedia technology is becoming increasingly relevant in meeting curriculum requirements aligned with the SDGs (Kholiq et al., 2023). Educational institutions are thus compelled to design learning content and outcomes that support the SDGs (Biswas, 2018). Their participation is essential in promoting ESD, as well as fostering research, innovation, and community engagement aligned with SDG objectives (Filho et al., 2024). The complex nature of socio-environmental issues, particularly climate change, stems from the intricate relationships and interactions between these factors (de Rivas et al., 2024). Educating young people about the SDGs will empower them to create a better future. Global climate strikes exemplify youth awareness of the urgent threat posed by climate change and their willingness to act (Marshall & Education, 2019). To build a strong foundation in climate science, educators must emphasize the causal links between everyday actions and their contributions to climate change (Ofori et al., 2023).

Since the learning process requires both intellectual and motor skills, teachers must also act as trainers. Training should account for fundamental skills, available resources, and the unique characteristics of each student and their environment (Rivaldo et al., 2021). Additionally, a comprehensive understanding of students' backgrounds, motivations, and prior

knowledge is essential to designing a competency-based learning process aligned with the SDGs (Zamora-Polo et al., 2019). A survey has indicated that most students are unaware of the environmental impacts of their energy consumption and are largely oblivious to the broader consequences of their actions (Olanipekun & Iyiola, 2020). A well-structured ESD framework equips students with a deeper understanding of environmental integrity, economic viability, and social equity for both present and future generations (United Nations Educational, 2017). Even though this issue is becoming more important, there hasn't been a lot of research that seems to solve the core issue. Showing that it still needs to be explored further so that everyone can play their role and give their best toward the achievement of these goals. Previous educational reports (Delors et al., 1996) have stressed the need for society to be able to cope with new situations in its professional and personal life because evaluation involves a sense of personal responsibility to achieve a common goal. It is imperative that educators receive training on sustainable development challenges and elements prior to taking on their teaching responsibilities. Thus, it is recommended that a study be carried out (Anyolo et al., 2018) the primary teacher education institution in Namibia to learn how it makes sure that educators are taught and equipped to apply ESD in classrooms. The teacher education curriculum can be modified to better prepare teachers for teaching utilizing ESD approaches based on their assessments of their readiness to utilize ESD in the classroom. However, the current perception of SDGs on pre-service physics teacher in Indonesia remain unclear, therefore this study is seeking to answer the following questions:

1. What is the level of knowledge of pre-service physics teachers regarding the SDGs?
2. Which aspects of the SDGs are important for their professional practice?
3. Which aspects of the SDGs influence their daily lives?
4. Which aspects of the SDGs can be integrated into climate change courses in high schools?

## **METHODS**

### **Research Design**

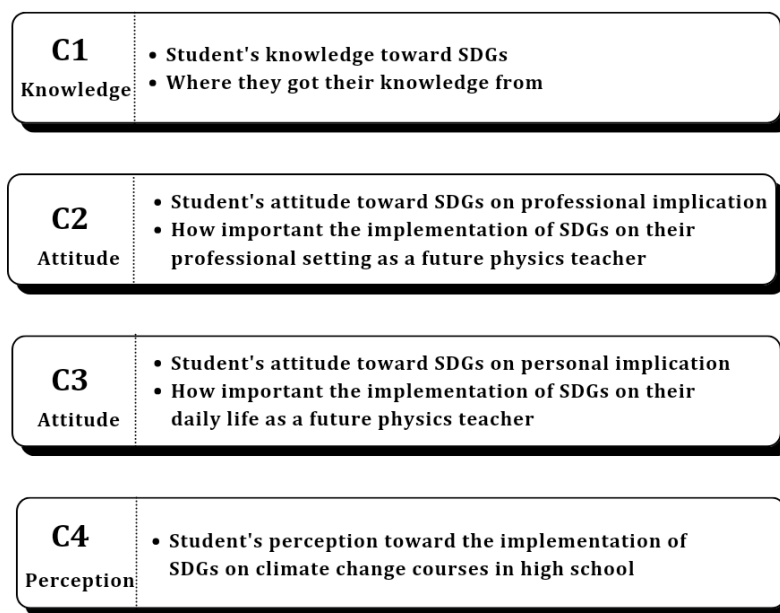
Quantitative research was employed to achieve the objectives of this study. The sample consisted of students from two universities in Indonesia, categorized by their level of study within the physics education program. A survey research design was adopted, with the questionnaire divided into four sections to assess students' knowledge, the implications of SDGs on their personal and professional settings, and their perspectives on the SDGs. Data were collected using a Google Form containing 64 questions distributed across five pages. These pages gathered information on respondents' personal details, knowledge of the SDGs, professional implications, personal implications, and perspectives on the SDGs.

## Participant

This study employs a quantitative approach to collect empirical data on pre-service physics teachers' perceptions of the SDGs. The sample consists of 188 students from two universities in Indonesia, selected from the physics education programs. The first university, University A, is located on Kalimantan Island, while the second, University B, is situated on Sumatra Island. Students from different academic levels specifically from Semesters 2, 4, and 6 were included to provide a comprehensive analysis.

## Instrument

The primary data collection tool is an online survey designed using Google Forms. The questionnaire was adapted from (Zamora-Polo et al., 2019), who developed a reliable and valid instrument to evaluate students' perceptions and knowledge in their respective fields. The modified version was further assessed using SPSS, confirming its reliability and validity for this study. The survey measures four distinct aspects, as illustrated in Figure 1.



**Figure 1.** Infographic for Each Aspect

The first aspect (C1) focuses on students' understanding of the SDGs and the sources from which they acquire their knowledge. The second aspect (C2) analyzes the connection between the SDGs and their vocational training as future physics teachers. The third aspect (C3) examines the application of the SDGs in students' personal lives. Finally, the fourth aspect (C4) explores the integration of SDGs into climate change courses.

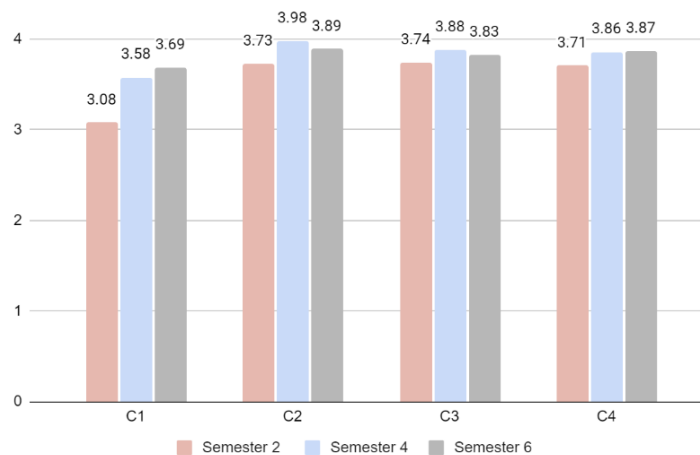
## Data Analysis

Responses were recorded using a Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree") (Ortega-Sánchez & María Gómez-Trigueros, 2019). The data were analyzed using SPSS and visualized with Microsoft Excel to facilitate understanding. The average values for each aspect were categorized as follows: 1 (Very Low), 2 (Low), 3 (Moderate), 4 (High), and 5 (Very High) (Harpe, 2015). Graphs were generated for each aspect and presented according to students' levels of study. The data were subjected to normality and homogeneity tests using SPSS, followed by a Pearson correlation test to assess the relationship between pre-service physics teachers' personal and professional implications of the SDGs.

## RESULTS AND DISCUSSION

### Results

As demonstrated, the analysis links the outcomes of the four constructs (C1-C4) to students' levels of study. Figure 2 presents the significance of each construct based on the students' academic progression.



**Figure 2.** Value of Mean of the Four Construct

Construct 1 (C1) reflects pre-service teachers' understanding of the SDGs and their sources of knowledge. Notably, third-year students (Semester 6) achieved the highest score (3.69 out of 5), indicating a moderate understanding. However, first-year pre-service teachers (Semester 2) recorded the lowest score (3.08 out of 5), highlighting a concerning knowledge gap. Despite some improvement across study levels, the overall average remains moderate, underscoring the need for increased emphasis on SDG awareness. Construct 2 (C2) evaluates students' perceptions of the relevance of the SDGs to their future teaching profession. This construct recorded the highest mean scores, particularly among second-year students, suggesting a greater awareness of how the SDGs align with their vocational roles as educators. Construct 3 (C3) examines the personal application of the SDGs. The mean scores across all study levels were relatively consistent, indicating that pre-service teachers perceive a similar degree of personal relevance of the SDGs, regardless of their academic progression. Construct

4 (C4) assesses the potential integration of the SDGs into climate change courses in high schools. The findings reveal comparable score across all levels of study, suggesting a shared understanding among pre-service teachers of how the SDGs can be promoted through climate education. This construct highlights the importance of educating students about climate change, its causes, and its impact on achieving the SDGs. Pre-service teachers can play a critical role by emphasizing the need for action and fostering student awareness of the interconnections between climate change and sustainable development goals.

**Table 1.** Pearson Correlation of Professional and Personal Implication

<b>Correlation</b>	<b>Professional Implication</b>	<b>Personal Implication</b>
Pearson Correlation	.637**	.637**
Sig. (2-Tailed)	.006	.006
N	17	17

The second step involved assessing the statistical relevance of the relationship between personal and professional implications of the SDGs using Pearson's correlation analysis. Table 1 presents the results, indicating a significant positive correlation between these two constructs. The Pearson correlation coefficient was 0.637, suggesting a moderate to strong positive relationship. This implies that as pre-service physics teachers' professional engagement with the SDGs increases, their personal commitment is likely to rise correspondingly. Furthermore, the significance value for both implications was  $p < 0.05$  (Patar Tamba & Sitompul, 2022), confirming a statistically significant relationship between personal and professional implications of the SDGs among pre-service teachers.

## Discussion

The knowledge of SDGs among pre-service physics teacher is very limited and consist with the low promotion of SDGs, comparing to other studies. Based on prior research, 89.5% of students are aware of the SDGs, and 62.5% have a good level of awareness about them (Jati et al., 2019). We discovered that students' awareness is connected to both the accessibility of information and their everyday lives, and that students' knowledge is impacted by the availability of the source of information. Participation in the organization by students has little effect on awareness or knowledge. However, some studies indicate a marginally negative association between University of Malaya students' knowledge and implementation of the SDGs. (Nusrat Afroz & Zul Ilham, 2020).

Other studies have warned that students play a crucial role in the achievement of the SDGs, impacting the planet's future as well as the major issues facing humanity as future decision-makers (Rivaldo et al., 2021). One needs to have a solid understanding of the SDGs with the aim to map a learning approach for them that is based on competences. As can be seen from pre-service teacher's responses on C1 where pre-service teacher knowledge was measured, less than half of them have received information of SDGs from broadcast media

such as television which the most direct way to teach them, while most of them receive the knowledge of SDGs from university or the higher education institution. It is worth pointing out that the higher the education levels the more developed is their knowledge about SDGs while other graphs don't show the same improvement, because education is taking part in raising student awareness of SDGs. Previous research suggests that the first obstacle to achieving sustainable energy use in postsecondary institutions and society at large are awareness and understanding (Olanipekun & Iyiola, 2020). The knowledge that the students gain in class might enable students to reflect their personal and professional domains, it also helps to produce more responsible human beings. Recently, teachers have been able to continue instructing and avoid learning loss because of their ability to adapt. These abilities will be crucial in the future when conditions shift. (Chaaban et al., 2023). Therefore, education is important and essential for sustainable development. Even though the effects are not immediately felt, it is hoped that adopting a sustainable or ongoing approach will lessen harmful effects on the planet, like global warming, and reduced oxygen levels by mass planting of trees and other greenery that will be cared for until it can benefit the planet. besides giving off oxygen, preserving groundwater, and preserving the environment on earth.

The implication of pre-service physics teacher on SDGs toward their personal life is needed the improvement since education is necessary to encourage such individual changes as well as the necessity of public engagement and action and vice versa. It is necessary to implement policies and programs as well as strategies to incorporate the SDGs into the personal action of individuals. The pre-service teacher shows a high response on SDGs goals number 6 means they have a high contribution toward the accessible to clean water. This could be a good move for future educators to participate in the achievement of SDGs while impacting the planet's future as well as other major issues. While SDGs goals number 10 to reduce inequalities receive the lowest responses among pre-service physics teacher, means that they show less interest toward these goals on their personal life. Apart from creating environmental awareness, according to (Anyolo et al., 2018), ESD recognized that all parts were critical for sustainable development and taught about both social and economic sides of it.

The perception of pre-service physics teacher on the importance of SDGs is needed to be point out, Academic staff members require additional training and development for them to effectively advocate for sustainability and sustainable development within their respective professions. Their confidence in teaching and learning activities will increase as a result (Malavoloneque & Costa, 2022). Pre-service physics teachers have a low response to the SDGs goals number 2 which to hunger reduction. Means that most of the pre-service teachers think that they barely can contribute toward this goal which is just wrong because physics also learns about the technologies to create food out of electricity that may be associated with other nature studies. Another topic that can be related is to teach students on how to compose and decompose such waste to increase agriculture to practice farming. Their responses toward SDGs goals number 4 are receive the highest number, means that they could contribute to a greater involvement and play a critical part in resolving these global issues.



Climate change should be discussed by various environmental student clubs, and in cases where there aren't any now, starting one should be encouraged. Organizations that deal with climate change are also urged to get more involved in the public, particularly in schools. Collaboration between different public and private stakeholders, including ministry of education, non-governmental organizations, universities, researchers, and community groups, should be a part of community education. One of the physics materials that are being taught in school is global warming that can be one of thousands way for future physics teacher to spread knowledge through instruction and learning. ESD was developed to create a balance between the necessity for education and the hope for a better future. Additionally, ESD gives people the ability to act and think forward. It makes it possible for every person to comprehend how their activities affect the world and to make moral decisions. (Müller et al., 2021). The responses of SDGs implication toward climate change courses have shown the highest value toward SDGs goals number 6 means that they have high interest to relating access to clean water into climate change courses. While ending poverty as a world issue receives the lowest value means that they need more training in how to correlate this topic into climate change courses. Pre-service physics teachers need to improve their knowledge toward the application of physics concepts to help to end poverty in countries or families.

Lastly is to understand the correlation between the personal and professional implication of pre-service physics teacher which can be seen on Table 1 that there is a strong correlation between these two variables. This means that the pre-service physics teacher should have been implied their daily life toward the SDGs and efforts should be made to boost awareness among all parties concerned, including their future students, to optimize the achievement of the SDGs. To do this, a carefully considered and implemented communication plan is a useful instrument for putting all 17 SDGs goals into action. According to one study, teachers' own convictions can have a favorable impact on their ESD decisions. This can help universities and other educational institutions create professional development courses and training programs that will allow pre-service and in-service teachers to experience sustainable growth firsthand and indirectly. (Kwee, 2021).

The results of this study offer valuable insights for educators to achieve their teaching objectives by equipping students with relevant skills and values as global citizens. However, the study has methodological limitations. The number of our participants was relatively small, which limited the ability to capture all possible perspectives and information. Despite this, we followed recommended a wider sample size to gain a broader and more nuanced understanding of pre-service science teachers' perceptions of the SDGs in Indonesia. Additionally, this study provides a well-defined technique that may be applied to future research in Indonesia including larger and more varied participant groups, which will enhance the educational applications of ongoing studies on the SDGs. Future studies may, for instance, examine the motivation of other science subject instructors worldwide to support the development of the SDGs in various educational situations. This study is among the few that address physics teachers' motivation for SDGs, challenging the common assumption that

physics teachers lack interest and motivation in implementing SDGs. Policymakers and school administrators can use these observations to help create methods that will motivate instructors who frequently consider sustainable development to be outside of their subject areas. Furthermore, by using the findings as a guide, academic institutions and universities can create training programs and professional development courses for pre-service and in-service teachers that will assist them become directly and indirectly exposed to sustainable development.

## CONCLUSION

The research findings indicate that pre-service physics teachers have an average level of knowledge about the SDGs. The results also reveal a correlation between their understanding of the SDGs and the implications for both their professional and personal setting. Moreover, the higher value observed in the integration of the 17 SDGs goals into climate change courses suggests that all 17 SDGs should be effectively incorporated into classroom learning. To teach and promote the SDGs, pre-service physics teachers must develop the necessary competencies through appropriate methods and instructional strategies, which should be evaluated to improve the teaching-learning process for the SDGs. Furthermore, the study advocates for an interdisciplinary and comprehensive approach to curriculum reorientation for SDGs implementation, suggesting broader implications for potentially influencing not just the general school culture but also the motivation of teachers.

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## REFERENCES

- Afroz, N., & Ilham, Z. (2020). Assessment of Knowledge, Attitude and Practice of University Students towards Sustainable Development Goals (SDGs). *JISDeP-The Journal of Indonesia Sustainable Development Planning*, *1*(1), 31–44. <http://journal.pusbindiklatren.bappenas.go.id/>
- Anggraini, Dewi., & Nugraheni, S. (2024). Menuju Pendidikan Berkelanjutan: Implementasi Tujuan Pembangunan Berkelanjutan (SDGS) dalam Mewujudkan Pendidikan Berkualitas di Indonesia [Towards Sustainable Education: Implementation of Sustainable Development Goals (SDGS) in Realizing Quality Education in Indonesia]. *Jurnal Penelitian Pendidikan Indonesia*, *1*, 189–197. <https://jurnalisticomah.org/index.php/jppi/article/view/1028>
- Anyolo, E. O., Kärkkäinen, S., & Keinonen, T. (2018). Implementing Education for Sustainable

- Development in Namibia: School Teachers' Perceptions and Teaching Practices. *Journal of Teacher Education for Sustainability*, 20(1), 64–81. <https://doi.org/10.2478/jtes-2018-0004>
- Awodoyin, A. F., & Ojo, O. (2021). Sustainable Development Goals Attainment: Examining Librarians Awareness and Perception in Selected University Libraries in Ogun State, Nigeria. In *SAMARU JOURNAL OF INFORMATION STUDIES* (Vol. 21, Issue 1). <https://www.ajol.info/index.php/sjis/article/view/217869/205477>
- Biswas, G. (2018). Awareness on Sustainable Development among Secondary School students in Papumpare District, Arunachal Pradesh. In *International Journal of Interdisciplinary Research and Innovations* (Vol. 6). [www.researchpublish.com](http://www.researchpublish.com)
- Chaaban, Y., Du, X., Lundberg, A., & Abu-Tineh, A. (2023). Education Stakeholders' Viewpoints about an ESD Competency Framework: Q Methodology Research. *Sustainability (Switzerland)*, 15(3). <https://doi.org/10.3390/su15031787>
- Cheng, M. M. H., Buntting, C., & Jones, A. (2022). Concepts and Practices of STEM Education in Asia. In *Concepts and Practices of STEM Education in Asia*. Springer Nature. <https://doi.org/10.1007/978-981-19-2596-2>
- Costa, M. C., Ferreira, C. A. F., & Pinho, H. J. O. (2023). Physics of Sound to Raise Awareness for Sustainable Development Goals in the Context of STEM Hands-On Activities. *Sustainability (Switzerland)*, 15(4). <https://doi.org/10.3390/su15043676>
- da Rocha, V. T., Brandli, L. L., Mazutti, J., Moro, L. D., Gasperina, L. D., & Kalil, R. M. L. (2020). Teacher's Approach on Climate Change Education a Case Study. In *World Sustainability Series* (pp. 617–642). Springer. [https://doi.org/10.1007/978-3-030-30306-8\\_37](https://doi.org/10.1007/978-3-030-30306-8_37)
- de Rivas, R., Vilches, A., & Mayoral, O. (2024). Secondary School Students' Perceptions and Concerns on Sustainability and Climate Change. *Climate*, 12(2). <https://doi.org/10.3390/cli12020017>
- Delors, J., Cameiro Fay Chung Broni, R., Geremek William Gorham Aleksandra Komhauser Michael Manley Marisela Padron Quero Marie-Angelique Savane Karan Singh Rodolfo Stavenhagen Myong Won, law, & Zhou, uhr N. (1996). *LEARNING: THE Members of the Commission*. <https://unesdoc.unesco.org/ark:/48223/pf0000102734>
- Filho, W. L., Trevisan, L. V., Dinis, M. A. P., Ulmer, N., Paço, A., Borsari, B., Sierra, J., & Salvia, A. (2024). Fostering students' participation in the implementation of the sustainable development goals at higher education institutions. *Discover Sustainability*, 5(1). <https://doi.org/10.1007/s43621-024-00204-7>
- Harpe, S. E. (2015). How to analyze Likert and other rating scale data. In *Currents in Pharmacy Teaching and Learning* (Vol. 7, Issue 6, pp. 836–850). Elsevier Inc. <https://doi.org/10.1016/j.cptl.2015.08.001>
- Imara, K., & Altinay, F. (2021). Integrating education for sustainable development competencies in teacher education. *Sustainability (Switzerland)*, 13(22). <https://doi.org/10.3390/su132212555>
- Jati, H. F., Darsono, S. N. A. C., Hermawan, D. T., Yudhi, W. A. S., & Rahman, F. F. (2019a). Awareness and Knowledge Assessment of Sustainable Development Goals Among University Students. *Jurnal Ekonomi & Studi Pembangunan*, 20(2). <https://doi.org/10.18196/jesp.20.2.5022>
- Kholiq, A., Sucahyo, I., Anggaryani, M., Satriawan, M., & Habibulloh, M. (2023). Analysis of the pre-service physics teacher's ability to develop SDGs-oriented multimedia. *E3S Web of Conferences*, 450. <https://doi.org/10.1051/e3sconf/202345001008>
- Kleespies, M. W., & Dierkes, P. W. (2022). The importance of the Sustainable Development Goals

- to students of environmental and sustainability studies—a global survey in 41 countries. *Humanities and Social Sciences Communications*, 9(1). <https://doi.org/10.1057/s41599-022-01242-0>
- Kwee, C. T. T. (2021). I want to teach sustainable development in my english classroom: A case study of incorporating sustainable development goals in english teaching. *Sustainability (Switzerland)*, 13(8). <https://doi.org/10.3390/su13084195>
- Malavoloneque, G., & Costa, N. (2022). Physics Education and Sustainable Development: A Study of Energy in a Glocal Perspective in an Angolan Initial Teacher Education School. *Frontiers in Education*, 6. <https://doi.org/10.3389/feduc.2021.639388>
- Marshall, H., & Education, O. (2019). *The Sustainable Development Goals: A Guide for Teachers*. <https://oxfamilibrary.openrepository.com/bitstream/10546/620842/4/edu-sustainable-development-guide-15072019-en.pdf>
- Michael, F. L., Sumilan, H., Bandar, N. F. A., Hamidi, H. A. N. A., Jonathan, V., & Nor, N. N. M. (2020). Sustainable Development Concept Awareness Among Students in Higher Education: A Preliminary Study. *Journal of Sustainability Science and Management*, 15(7), 113–122. <https://doi.org/10.46754/jssm.2020.10.011>
- Müller, U., Hancock, D. R., Stricker, T., & Wang, C. (2021). Implementing esd in schools: Perspectives of principals in germany, macau, and the usa. *Sustainability (Switzerland)*, 13(17). <https://doi.org/10.3390/su13179823>
- Mulyasari, E., Ali, M., & Sukirman, D. (2021). Building Student's Character in Primary School Through Sustainable Development Goals (SDGs) of School Program. *Indonesian Scholars Scientific Summit Taiwan Proceeding*, 3, 30–35. <https://doi.org/10.52162/3.2021109>
- Nusrat Afroz, & Zul Ilham. (2020). Assessment of Knowledge, Attitude and Practice of University Students towards Sustainable Development Goals (SDGs). *The Journal of Indonesia Sustainable Development Planning*, 1(1), 31–44. <https://doi.org/10.46456/jisdep.v1i1.12>
- Ofori, B. Y., Ameade, E. P. K., Ohemeng, F., Musah, Y., Quartey, J. K., & Owusu, E. H. (2023). Climate change knowledge, attitude and perception of undergraduate students in Ghana. *PLOS Climate*, 2(6), e0000215. <https://doi.org/10.1371/journal.pclm.0000215>
- Olanipekun, E. A., & Iyiola, C. O. (2020). A Study of Awareness and Electricity Use Behaviour of On-campus Residence Students in Nigeria. *International Journal of Sciences: Basic and Applied Research (IJSBAR) International Journal of Sciences: Basic and Applied Research*, 54(2), 19–43. <http://gssrr.org/index.php?journal=JournalOfBasicAndApplied>
- Ortega-Sánchez, D., & María Gómez-Trigueros, I. (2019). *Massive Open Online Courses in the Initial Training of Social Science Teachers: Experiences, Methodological Conceptions, and Technological Use for Sustainable Development*. <https://doi.org/10.3390/su11020578>
- Patar Tamba, K., & Sitompul, H. (2022). Pre-Service Secondary Mathematics and Physics Teachers' Perceptions on Educational Research. *Jurnal Pendidikan MIPA*, 23(4), 1635–1643. <https://doi.org/10.23960/jpmipa/v23i4.pp1635-1643>
- Pribadi, R. E. (2017). *Implementasi Sustainable Development Goals (SDGs) dalam Meningkatkan Kualitas Pendidikan di Papua [Implementation of Sustainable Development Goals (SDGs) in Improving the Quality of Education in Papua]*. 5(3), 917–932. <https://www.academia.edu/6612667>
- Rivaldo, A., Stie, S., & Bandung, T. (2021). The Role of Teachers in Building Student Character at Sindangsari 02 State Elementary School. *JURNAL PAPATUNG*, 4(3), 48. <https://ejournal.goacademica.com/index.php/japp/article/download/537/502/>
- Sachs, J., Schmidt-Traub, G., Kroll, C., Lafortune, G., & Fuller, G. (2021). Sustainable Development

- Report 2020. In *Sustainable Development Report 2020*. Cambridge University Press. <https://doi.org/10.1017/9781108992411>
- Safitri, A. O., Yuniarti, V. D., & Rostika, D. (2022). Upaya Peningkatan Pendidikan Berkualitas di Indonesia: Analisis Pencapaian Sustainable Development Goals (SDGs) [Efforts to Improve Quality Education in Indonesia: Analysis of Sustainable Development Goals (SDGs) Achievement]. *Jurnal Basicedu*, 6(4), 7096–7106. <https://doi.org/10.31004/basicedu.v6i4.3296>
- Shah, Z., Kennedy-Clark, S., Xie, Y., Rahim, M. S., Mahdavi, M., & Levula, A. (2022). Teacher Views on Teaching Sustainability in Higher Education Institutes in Australia. *Sustainability (Switzerland)*, 14(14). <https://doi.org/10.3390/su14148431>
- Thamrin, Husni. (2020). Educational Aspects in Efforts to Realize SDGs in Indonesia. *Journal of Advances in Education and Philosophy*, 4(11), 473–477. <https://doi.org/10.36348/jaep.2020.v04i11.007>
- United Nations Educational, S. and C. O. (2017). *UNESCO Education for Sustainable Development Goals : Learning Objectives*. [https://stairwaytosdg.eu/images/UNESCO\\_Education\\_for\\_Sustainable\\_Development\\_Goals\\_ENG.pdf](https://stairwaytosdg.eu/images/UNESCO_Education_for_Sustainable_Development_Goals_ENG.pdf)
- Widoyono, S. B. (2016). *Potret Awal Tujuan Pembangunan Berkelanjutan (Sustainable Development Goals) di Indonesia [Early Portrait of Sustainable Development Goals in Indonesia]*. <https://filantropi.or.id/pubs/uploads/files/3%20BPS%20Potret%20Awal%20TPB%20di%20Indonesia.pdf>
- Zamora-Polo, F., Sánchez-Martín, J., Corrales-Serrano, M., & Espejo-Antúnez, L. (2019). What do university students know about sustainable development goals? A realistic approach to the reception of this UN program amongst the youth population. *Sustainability (Switzerland)*, 11(13). <https://doi.org/10.3390/su11133533>
- Zul Ilham, Kamal, A., Imad Wan-Mohtar, W. A. A. Q., & Ainurzaman Jamaludin, A. (2021). Youth Awareness Level towards Sustainable Development Goals (SDGs) in Greater Kuala Lumpur. *The Journal of Indonesia Sustainable Development Planning*, 2(3), 217–233. <https://doi.org/10.46456/jisdep.v2i3.173>