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Awakening Student Awareness as Pioneers Toward Sustainable Energy

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Abstract

This research aims to determine the increase in student awareness of sustainable energy. The method used in this research is literature review. The results of this research are descriptive and related to First, the initial level of awareness of students towards sustainable energy. Second, students are pioneers of sustainable energy. Third, some factors influence students' awareness of sustainable energy. Fourth, strategies to increase student awareness of sustainable energy. And fifth, various sustainable energy education programs for student awareness. The conclusion of this research is that students' initial awareness of sustainable energy is generally still at a basic stage, with varying understanding depending on educational background and individual experience. The integration of sustainable energy topics in the academic curriculum, practical experience through field projects and internships, and effective awareness campaigns have proven to be key strategies in increasing students' understanding and involvement in sustainable energy issues.

Keywords: awareness, curriculum, education, students, sustainability.

Introduction

In an era of globalization marked by various environmental challenges, energy sustainability becomes a crucial issue that must be addressed immediately due to its broad implications. Firstly, the excessive use of fossil fuels results in greenhouse gas emissions, triggering global warming and leading to extreme climate change. This includes rising global temperatures, melting polar ice caps, and increased frequency and intensity of natural disasters such as storms, floods, and droughts. Thus, sustainable energy with low emission levels is key to reducing carbon footprints and the negative impacts of climate change. Secondly, the depletion of fossil fuel reserves is caused by frequent exploitation in large quantities. However, sustainable energy sources such as biomass, solar, and wind offer renewable supplies in abundance, providing a stable energy supply for future generations. Thirdly, technological innovations are emerging to improve energy efficiency, energy storage, and the development of new energy sources. Sustainable energy technologies have the potential to reduce long-term energy costs, thereby enhancing the stability of energy supply (Rahmandani & Dewi, 2023). Consequently, the current global energy crisis also affects national security. High dependence on imported fossil fuels makes countries vulnerable to price and supply fluctuations. By raising awareness about sustainable energy, students can contribute to reducing this dependence through the development and use of safer and more stable renewable energy.

Sustainable energy is a crucial issue that must be addressed immediately to ensure a secure, healthy, and sustainable future. Immediate and coordinated action is required to tackle these challenges and seize the opportunities offered by the sustainable energy transition. Sustainable energy aims to meet current energy needs without compromising the ability of future generations to meet their needs. According to Chinelo et al. (2024), "Sustainable energy refers to the provision and use of energy in a way that meets the needs of the present without compromising the ability of future generations to meet their own needs." This definition points to various practices and technologies aimed at producing, distributing, and consuming energy in an environmentally responsible,

economically viable, and socially just manner. Apriliyanti & Rizki (2023) describe the transition from fossil fuels to renewable energy as an achievement of long-term sustainability. Kadang & Sinaga (2021) define sustainable energy as energy obtained and used sustainably over a long period without the risk of environmental damage, rapid resource depletion, or social issues. Based on these definitions, it can be concluded that sustainable energy should be efficient, environmentally friendly, and accessible to everyone. They also highlight the importance of technological innovation, carbon emission reduction, and the integration of renewable energy into the global energy system.

The transition to renewable energy and increased awareness of sustainable energy are becoming increasingly urgent. This situation demands heightened awareness from various parties, including students, to ensure the efficient and environmentally friendly use of energy. As the next generation, students have a strategic role in adopting and disseminating sustainable energy practices (Erma et al., 2023). Therefore, higher education institutions have a responsibility to help shape students' mindsets and behaviors to understand the importance of sustainable energy awareness. Students, as agents of change, have great potential to be pioneers in the sustainable energy campaign. The knowledge they gain in college, supported by practical experience, can lead to innovations beneficial to the wider community. High awareness of the importance of sustainable energy among students is also expected to influence future energy policies (Pambudi et al., 2024). This study aims to understand students as pioneers of sustainable energy, the factors influencing students' awareness of sustainable energy, and strategies to enhance students' awareness of sustainable energy.

Methods

This study utilizes the literature review method, which is a systematic and structured approach to collecting, analyzing, and synthesizing previous research relevant to the current study. According to experts such as Yun & Tom (2024), literature reviews should be conducted using a systematic and reproducible method to ensure validity and reliability. Puspita, Indarti, & Nurhayati (2023) state that the function of a literature review is to provide contextual explanations by identifying patterns in previous research, which then informs the current study. Meanwhile, Teguh et al. (2023) explain that a literature review involves a theoretical discussion of research findings, discoveries, and materials from previous studies to assist new researchers. Thus, it can be concluded that a literature review is a systematic, explicit, and reproducible method for identifying, evaluating, and synthesizing existing research and practitioners' work. The literature review method involves a time-consuming process due to the need to determine the quality of the research being reviewed. However, when used as a method in developing new research, it offers several benefits:

1. A literature review provides in-depth knowledge in the chosen field of study, as researchers need to analyze various sources of references relevant to their field.
2. It offers insights into the relevance of previous research.
3. Researchers gain continuously evolving knowledge from reviewing a variety of prior studies.
4. It provides detailed explanations of the issues being investigated.
5. Researchers obtain up-to-date information sources for resolving issues in their research.

Based on this, the literature review method is a review, summary, and evaluation of previous authors' work, resulting in new and developing research (Maldague, 2023).

Results and Discussion

The results of the literature review conducted by the researcher consist of a summary of the main findings from studies related to students' awareness of sustainable energy. Below are the results and discussion of the study.

a. Initial Awareness of Students Towards Sustainable Energy

The initial awareness of students towards sustainable energy shows significant variation depending on their educational background and individual experiences. Generally, many students have a basic understanding of sustainable energy, such as recognizing that renewable energy is a more environmentally friendly alternative to fossil fuels. This knowledge is often acquired through mass media, environmental campaigns, or introductory education addressing general environmental issues. However, a deeper understanding of technical concepts or energy policies is often lacking without additional education or experience (Alnavis, Wirawan, Solihah, & Nugroho, 2024).

Curricula in many institutions often provide only a general overview of sustainable energy without delving into the latest technologies, policies, and challenges faced (Tatsar, Rohman, & Salamah, 2022). This results in students' basic knowledge being limited to surface-level information. If institutions do not offer specialized courses or programs

focused on sustainable energy, students may not gain adequate understanding to address more complex issues. Practical experience and involvement in extracurricular activities play a crucial role in enhancing students' awareness. Students who participate in practical projects, research, or clubs focusing on energy sustainability tend to have a deeper understanding. Direct experience with renewable energy technologies and environmental policies provides clearer insights into real-world applications and related challenges, differing from mere theoretical knowledge (Reimers, 2024).

Media exposure and environmental campaigns also contribute to the initial level of student awareness. (Dindin et al., 2023) Mass media actively discussing sustainable energy issues can influence general understanding and raise awareness. Environmental campaigns conducted by organizations or communities can also disseminate important information, although the impact may vary depending on the reach and engagement of these campaigns. Social environment and support from friends and family can affect students' awareness of sustainable energy. Students in supportive environments that motivate them to learn more about sustainability tend to have better knowledge. Conversely, without social support or encouragement to deepen their understanding of sustainable energy, students may only have basic knowledge or lack information.

b. Students as Pioneers of Sustainable Energy

Students are an integral part of the academic community and play various important roles in social, economic, and environmental contexts. Moosavian et al. (2024) describe several key roles of students as pioneers in sustainable energy: (1) Agents of Change: Actively participating in movements that lead to social, political, and environmental reforms. (2) Innovators: Developing new technologies, research methods, and creative solutions to challenges, particularly in the context of sustainable energy, and engaging in research and development of renewable energy technologies. (3) Contributors to Curriculum Development: Playing a role in shaping curricula and teaching methods. (4) Community and Volunteer Engagement: Frequently involved in community organizations and volunteer activities outside of campus. (5) Researchers and Academics: Acting as researchers and scholars. (6) Catalysts in Local and Global Economies: Serving as catalysts in both local and global economies. (7) Advocates for Sustainability: Often being the primary advocates for sustainability and environmental protection. (8) Role Models and Mentors: Functioning as role models and mentors for their peers and the next generation. (9) Drivers of Technology: Being movers and shakers in technological advancements. (10) Preservers and Developers of Culture and Values: Contributing to the preservation and development of cultural and societal values.

The explanation above highlights the significant potential of students from various perspectives. They have multifaceted roles in society, not only as recipients of education but also as agents of change, innovators, community leaders, researchers, and advocates. Their roles in various aspects of life demonstrate their substantial contributions to social, economic, and environmental progress.

c. Factors Affecting Students' Awareness of Sustainable Energy

Students' awareness of sustainable energy is influenced by various factors, contributing to their understanding of the importance of sustainable energy use and its impact on the environment. The main factors influencing students' awareness of sustainable energy are (Valeria Andreoni, 2023):

a) Formal Education and Academic Curriculum: The inclusion of sustainable energy topics in academic programs. Programs that integrate courses on sustainable energy enhance students' understanding of current issues. Additionally, students can deepen their knowledge through involvement in related research and projects.
b) Campus Projects, Internships, or Industry Collaborations: Practical experiences through projects involving renewable energy systems, waste management, or energy efficiency programs provide direct experience that affects their understanding and engagement in sustainability issues.
c) Participation in Extracurricular Activities and Student Organizations: Opportunities to learn more about sustainable energy and contribute to promoting environmentally friendly practices.
d) Social Media, Blogs, and Digital Platforms: Platforms for increasing awareness of sustainable energy as they provide access to various literature, scientific articles, seminars, and online resources about sustainable energy.
e) Supportive Social Environment: Environments that support sustainable practices and advocacy can strengthen students' awareness and commitment to these issues.

Influences from friends, family, and the social environment contribute to students' awareness. Discussions and experiences shared among friends or family can impact students' views on sustainable energy.

f) Personal Experiences: Experiencing the impacts of climate change or participating in environmental initiatives can increase awareness. Personal motivation from concerns about the environment, health, or social justice often affects their commitment to sustainable energy.
g) Institutional Policies and Campus Support: Institutions implementing sustainability policies, such as reducing carbon footprints or managing resources efficiently, provide direct examples and motivate students to engage in sustainable practices.
h) Involvement in Public Activities and Advocacy: Participation in environmental campaigns or community meetings can enhance students' awareness. These experiences allow students to understand challenges and solutions in a broader context and contribute to collective efforts for sustainability.
i) Skills and Knowledge about Energy Technology: Students' understanding of energy technology, sustainability principles, and environmental impacts. Additional education, training, and certification in renewable energy or sustainability can deepen their understanding and increase awareness.
j) Challenges and Barriers: Issues such as lack of access to technology or resources, costs, and lack of support can affect students' awareness. Addressing these challenges, such as providing facilities that support sustainable energy projects and access to educational resources, can help improve their awareness and engagement.

In conclusion, students' awareness of sustainable energy is influenced by a combination of educational factors, practical experiences, social influences, access to information, and individual motivation. By understanding and managing these factors, educational institutions, student organizations, and communities can be more effective in enhancing students' awareness and involvement in sustainable energy practices and solutions.

d. Strategies to Increase Students' Awareness of Sustainable Energy

Here are some effective strategies to enhance students' awareness of sustainable energy (Mareta et al., 2024):

a) Curriculum Development: Institutions can collaborate with faculties and departments to design and offer relevant courses. Additionally, sustainable energy topics can be integrated into broader courses such as environmental science, economics, or engineering.
b) Campus Projects and Internships: Institutions can organize projects involving solar panel installations, campus energy audits, or participation in local sustainability initiatives. Internships with companies or organizations focused on sustainable energy can also provide valuable experience.
c) Events and Workshops: Institutions can host regular events featuring guest speakers, interactive workshops, and leverage social media to spread information. Campaigns could also include competitions, such as sustainable energy innovation contests, to encourage student engagement.
d) Partnerships: Institutions can partner with organizations focused on sustainability to conduct joint activities, such as campaigns, training, and community projects. Internships and volunteer programs with these partners can further increase student involvement.
e) Digital Content and Platforms: Institutions can create and promote digital content, including videos, infographics, and articles on sustainable energy. Using educational apps and online platforms to engage students in interactive courses or simulation games related to sustainability can also broaden their understanding.
f) Support for Environmental Clubs: Institutions can support the formation and activities of environmental clubs by providing facilities, funding, and guidance. These clubs can organize events like seminars, training, and community projects related to sustainable energy.
g) Sustainability Training Programs: Institutions can offer training programs covering topics such as energy audits, renewable energy system design, and sustainability management. Certifications and advanced courses can also be provided for students seeking to deepen their knowledge.

h) Institutional Policies: Institutions can implement policies to reduce their carbon footprint and increase the use of renewable energy. These policies can include developing sustainability initiatives that involve students in planning and implementation.
i) Certification Programs: Institutions can offer certification programs that include courses on renewable energy technology, energy policy, and sustainability management. These certifications can be recognized by industry and serve as tools to promote student interest and knowledge.
j) Funding for Research Projects: Institutions can provide funding and support for student research projects focused on sustainable energy. Publishing research results in academic journals or conferences can also increase the visibility and impact of students' contributions to sustainable energy advancements.

e. Structured Education Programs on Sustainable Energy

Well-structured education programs have a positive impact on increasing students' awareness. Significant improvements in knowledge scores before and after the program indicate the effectiveness of these educational approaches. Programs that involve active learning methods, such as group discussions, simulations, and practical projects, are more successful in educating students compared to traditional teaching methods. This suggests that teaching methods that engage students actively and apply practical applications can deepen their understanding of sustainable energy. Rismawati & Rachman (2023) identify five programs to enhance students' awareness of sustainable energy:

a) Specialized Courses: Courses specifically about sustainable energy in the academic curriculum. These courses might cover topics such as renewable energy technology, energy management, energy policy, and the environmental impacts of various energy sources. For example, institutions can develop courses like "Renewable Energy Technology," "Energy Policies and Regulations," and "Sustainable Energy Systems" as part of engineering, environmental science, or management programs (Rima et al., 2024).
b) Internships or Practicums: Programs with companies or organizations focused on sustainable energy. These programs provide students with direct experience in applying renewable energy technologies and energy management. Students gain practical experience, industry insights, and develop professional skills relevant to the field. Implementation examples include partnerships with renewable energy companies, government agencies, or NGOs focusing on sustainability to offer internships involving real projects and challenges in sustainable energy.
c) Workshops and Training Programs: Focused on various aspects of sustainable energy, such as solar panel installation, energy audits, and energy efficiency techniques. These workshops provide practical skills and technical knowledge that can be applied in the field. Students learn about the latest technologies and best practices in sustainable energy. Implementation examples include inviting industry experts for training on renewable energy technologies or energy efficiency, and conducting hands-on sessions in laboratories or campus facilities.
d) Research and Innovation Projects: Programs involving research on new technologies, development of renewable energy solutions, or energy policy analysis. Students can engage in in-depth research, develop innovative solutions, and contribute to advancing knowledge in sustainable energy. This also offers opportunities to publish research results and collaborate with academics and practitioners. Implementation examples include offering research scholarships or grants for projects focusing on renewable energy innovations and hosting energy innovation competitions on campus.
e) Awareness and Environmental Campaigns: Campus-wide programs focusing on sustainable energy. These can include seminars, exhibitions, social media campaigns, and educational activities involving students in discussions about sustainable energy. Such programs enhance general knowledge, motivate students to adopt sustainable practices, and create a community supporting environmental initiatives. Implementation examples include hosting events like "Sustainable Energy Day" with seminars, renewable energy technology exhibitions, and panel discussions with speakers from various sectors of sustainable energy (Hassan et al., 2024).

By implementing these educational programs, educational institutions can effectively increase students' awareness of sustainable energy and prepare them to actively contribute to sustainability efforts in the future.

Conclusion

Based on the literature review findings on increasing students' awareness of sustainable energy, it can be concluded that students' initial awareness of this issue varies, with many possessing basic knowledge but lacking a deep understanding. Integrated educational programs within the curriculum, practical experiences, and involvement in extracurricular activities play a crucial role in enhancing their understanding. With various educational and training programs available, students can gain more in-depth and practical knowledge about sustainable energy.

This research suggests that educational institutions should be more proactive in incorporating sustainable energy topics into the academic curriculum. Students should engage in various extracurricular activities or practical projects to gain diverse experiences related to sustainable energy. Future researchers can use this study as a reference for research relevant to enhancing students' awareness of sustainable energy.

The researcher recommends that educational institutions focus on curriculum development, provide experiential facilities for students, enhance awareness campaign programs, build strategic partnerships, and develop certification programs. Students are highly encouraged to actively participate in activities that increase their awareness of sustainable energy. Future researchers are advised to consult additional references to broaden their understanding of sustainable energy.

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