# American Journal of Environment and Climate (AJEC)

ISSN: 2832-403X (ONLINE)

VOLUME 5 ISSUE 2 (2026)

PUBLISHED BY
E-PALLI PUBLISHERS, DELAWARE, USA

American Journal of Environment and Climate (AJEC)

Volume 5 Issue 2, Year 2026
ISSN: 2832-403X (Online)
DOI: https://doi.org/10.54536/ajec.v5i2.7218
https://journals.e-palli.com/home/index.php/ajec

# Insights of Pre-Service Teachers in Renewable Energy Sources on Environmental Science Course

Jericho D. Parami[1], Richelle S. Libot[1], Sola Mae Y. Alarcon[1], Mercy Joy R. Mendez[1*]

**Article Information**

**Received:** January 02, 2026
**Accepted:** March 08, 2026
**Published:** July 17, 2026

**Keywords**

*Environmental Science Education, Pre-Service Teachers, Renewable Energy Sources*

## ABSTRACT

This study explores the insights of pre-service teachers regarding renewable energy concepts and their integration into the Environmental Science course at a selected university in Mindanao, Philippines. Using in-depth interviews and focus group discussions with 10 purposively selected participants, the research identifies varying levels of awareness among pre-service teachers, with most knowledge limited to theoretical discussions. While students recognized the environmental and economic benefits of renewable energy, particularly solar energy, many expressed concerns over the lack of practical applications and hands-on learning within the course. Thematic analysis revealed three major themes: awareness of renewable energy concepts, perspectives on the potential adoption of solar energy in the university, and overall insights of renewable energy sources. Participants expressed strong support for integrating renewable energy solutions in campus infrastructure but identified barriers such as high initial investment, technical challenges, and limited institutional support. The findings emphasize the importance of revising educational approaches to include experiential learning and institutional policy development that supports sustainable energy practices. This study contributes to the discourse on environmental education and positions higher education institutions as key agents in advancing climate action and the Sustainable Development Goals (SDGs).

## INTRODUCTION

Excessive dependence on fossil fuels contributes to environmental issues, including climate change, carbon emissions, and erratic weather (Kavari *et al.*, 2019). Natural resources are being depleted due to the overuse of conventional fuels (Irfan, 2020; Jabeen, 2020). As a result, it is necessary to create a new energy structure (Elavarasan *et al.*, 2020). This new energy structure would make use of alternative energy sources, including wind, solar, and biomass, which can both lower the cost of oil imports and lessen climate-related issues (Rezaee *et al.*, 2019).

Accordingly, universities are major contributors to energy consumption and carbon emissions since they use a lot more energy (Alghamdi *et al.*, 2020). Universities utilize 60% more energy than commercial offices and three to five times as much as schools (Munaro *et al.*, 2024). Universities consume significant energy daily, leading to energy availability, usage, and cost challenges. Academic buildings primarily utilize electricity for space cooling (49%) and lighting (39%), while overall, electricity accounts for 29% of the university's total energy demand (Jay *et al.* 2022). In a more recent study, the energy-related carbon emission of buildings is roughly 8% while nearly 30% of primary usage worldwide (UNEP, 2023).

Similarly, the Philippines has some of the highest electricity prices in Southeast Asia and a growing population, which seriously challenges the country's ability to produce energy. For many Asian countries, finding enough fuel has become challenging because of the rising price of liquefied natural gas (LNG). LNG prices in Asia had increased by 300% from the previous October 2022 (Hashem, 2023) Rising energy prices are forcing poorer countries off the market, endangering energy availability for millions of people. The Philippines is currently facing an impending energy crisis, which is motivating the nation to use renewable energy. A major dilemma also emerges when fuel prices climb. The urgency of transitioning to renewable energy sources is underscored by its potential to reduce carbon emissions, stabilize energy prices, and enhance energy security (Tawalbeh *et al.* 202; Creutzig *et al.*, 2017).

Education plays an essential role in driving this transformation. Teachers are key in raising awareness and encouraging behavioral shifts toward accepting clean energy solutions (Pada *et al.*, 2025; Asumadu-Sarkodie & Owusu, 2016). Recent studies emphasize the importance of preparing preservice teachers with both knowledge and pedagogical strategies to weave sustainability topics into their future teaching practices effectively (Dhaka, 2024; Genç & Durak, 2023; Bertschy *et al.*, 2013). In this regard, Environmental Science courses should go beyond present theoretical concepts; they must include hands-on experiences that encourage critical thinking and enable students to make climate-conscious choices (Bacolod, 2021; Gallagher *et al.*, 2020)]. Nevertheless, research indicates that integrating renewable energy education into school curricula remains inadequate, especially within teacher training programs (Edsand & Broich, 2020; Halder *et al.*, 2014).



[1] Faculty Member, Philippines
[*] Corresponding author's e-mail: mercyjoy_mendez@umindanao.edu.ph

Furthermore, related studies increasingly emphasize the economic and ecological benefits of integrating solar energy into educational institutions like schools and universities. For example, studies show that solar panels can help cut down institutional expenses, lighten the financial load on students, and promote a sense of environmental awareness (Jain & Jain, 2017; Shrimali & Rohra, 2012). International examples demonstrate that solar power campuses improve students' learning experiences and support global efforts to reduce carbon emissions (Kamat & Nasnodkar, 2019; Numbi et a. 2017, Bapat & Bapat 2016). However, challenges, especially the major upfront costs, call for supportive financial strategies and committed administrative leadership (Rasoulinezhad, 2020; Leisen *et al.*, 2019).

Higher education institutions must lead research and development for the sustainable energy transition to achieve the Sustainable Development Goals by 2030. Universities must support an energy evolution because they direct future leaders' education and manage diverse stakeholder collaborations (Olivieri *et al.*, 2020). According to scholars, education is the most effective means of achieving the SDGs. Moreover, it was asserted that the usage of fossil fuels has had a disastrous effect on the environment and humankind, contributing to everything from global warming to air and water pollution (Denchak, 2024).

Integrating solar energy and other renewable systems into educational facilities offers a powerful way to cut down carbon emissions and position schools and universities as pioneers in combating climate change. This approach supports global goals like the Paris Agreement and the Sustainable Development Goals. Specifically, SDG 4 (Quality Education), SDG 7 (Affordable and Clean Energy), SDG 9 (Industry, Innovation, and Infrastructure), SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action) emphasize how the education sector can play a key role by incorporating sustainability into curricula and operational practices.

Despite the global push toward renewable energy, surprisingly limited research focuses on how these concepts are woven into teacher education programs and university curricula in the Philippines. Most existing studies concentrate on renewable energy adoption in residential or industrial settings, leaving a gap in understanding how future teachers perceive and engage with renewable energy in their academic journey. Also, recent researches emphasizes that education systems need to do more than inform; they should actively enable learners to become part of the sustainability solution through project-based learning, real-world applications, and comprehensive teaching methods (Liju, 2024; Iqbal *et al.* 2023; Khalo & Damoah, 2023).

In particular, the study of Fudalan *et al.*, (2025) suggested that through environmental projects, it reduces carbon emissions, improve air quality and lower respiratory health risks.

This study aims to fill those gaps by exploring how Higher Education Institutions (HEIs), specifically in one big university in Mindanao, view renewable energy solutions. It examines the potential for integrating solar energy into campus operations and how renewable energy concepts are incorporated into the Environmental Science course. The research also ties the sustainability efforts of these institutions to the United Nations' Sustainable Development Goals, emphasizing how HEIs can play an essential role in advancing global sustainability agendas. The importance of this work is driven by pressing environmental, social, and economic challenges, making it essential for higher education institutions to adopt renewable energy solutions. Doing so promotes sustainability and aligns with broader global efforts to achieve these critical goals.

The purpose of this study is to determine the insights of preservice teachers regarding renewable energy concepts and their integration into the Environmental Science course, aligning with the context of their training as future educators. This investigation seeks to identify the awareness, perspectives, and overall understanding of renewable energy sources among pre-service teachers, which is crucial for assessing the role of educational institutions in promoting sustainable practices. By exploring these insights, the study highlights the potential of renewable energy to inform decision-making, support curriculum development, and facilitate future adoption within the university setting. The findings aim to guide university administrators in implementing effective strategies that enhance awareness, foster community engagement, and increase the acceptance of renewable energy initiatives on campus. Ultimately, this research contributes to the broader discourse on renewable energy integration in education, underscoring the significance of preparing future educators to advocate for sustainable development and climate action.

## MATERIALS AND METHODS

### Research Participants

The participants of this study included pre-service teachers at one of the Higher Education Institutions (HEIs). Ten (10) individuals were purposefully selected, comprising five (5) pre-service teachers in In-depth interviews and five (5) focus group discussions. Qualified preservice teachers are enrolled in the College of Teacher Education and have taken the GE15 (Environmental Science).

Choosing ten participants for this study makes sense based on suggestion that qualitative design research usually involves between five and twenty-five people, depending on how rich the data is and what the study aims to discover (Creswell, 2013). Experts in qualitative research also mention that it can usually reach data saturation with around 9 to 17 interviews and 4 to 8 focus groups (Shelton *et al.*, 2022). The number of participants selected fits well within what is generally accepted in qualitative research.

**Research Instrument**

The researcher conducted a semi-structured interview to obtain the necessary data. This allows the participants to elaborate, providing greater flexibility, range, and the capacity to elicit more information. They offer individuals the opportunity to respond on their terms more than standardized interviews, while maintaining a good comparability structure, surpassing that of focused interviews. May (1997) believes that interviewing is the best method for researching complex topics because researchers can educate participants on their roles during conversations. Using a semi-structured interview, the researcher can question in various ways and focus on details while respecting a guide (Doyle, 2020).

The in-depth and focus-group discussion interview guide consisted of three open-ended research questions focused on the participants' awareness, perceptions, and insights regarding the renewable energy source. Each main question was supported by three probing questions designed to elicit detailed responses and encourage participants to elaborate on their thoughts and feelings. The researcher developed the questions, which experts validated to ensure relevance, clarity, and alignment with the study's objectives.

**Research Design & Procedure**

This study employed qualitative research in association with a qualitative descriptive approach. As stated in qualitative research that it pursues comprehending real-life problems and contributes deeper perception into participants' experiences (Tenny *et al.*, 2022). It expedites the exploration of participants' perspectives, and allows researchers to accumulate abundant, descriptive data that convey "why" and "how" of their experiences (Bliss, 2016). A thematic method is used to arrange the data obtained from the in-depth interview and focused group discussion. Using thematic analysis enables researchers to structure and evaluate sophisticated data sets in a qualitative way. It tries to identify patterns that highlight the story contained within the data information (King, 2004; Rice & Ezzy, 1999). Exploring the transcripts allows the researchers to find themes. The chosen method proved better than quantitative strategy that is often inflexible (Creswell, 2013). Qualitative interviews enabled the researchers to explore the insights of pre-service teachers regarding the renewable energy source connected to their environmental science course.

The qualitative approach enables the researchers to explore unexpected themes and ideas that emerged during the interviews, and to probe further into areas of particular interest or importance to participants (Patton, 2015). By gathering data directly from the target population, the researchers aimed to give voice to students' perceptions, concerns, and insights, and to use these insights to inform strategies for promoting renewable energy sources in the selected institution of Mindanao.

After obtaining approval, the researchers sent consent forms and agreements to potential participants via email or in-person letter. Upon receiving confirmation from participants, the researchers scheduled individual interview sessions at times convenient for the participants. The face-to-face interviews were conducted, and with the participants' consent, the sessions were audio-recorded for transcription. The researchers also took notes during the interviews to supplement the audio recordings.

In addition, in-depth interviews were used to get a deeper understanding of the insights of pre-service teachers. This method makes it possible to fully explore personal points of view, thoughts, and attitudes towards renewable energy. Interviews allow a researcher to have the flexibility to explore in depth topics or issues noted throughout feedback responses from participants. Also, they are very valuable in discussing sensitive topics or getting more detailed information that would not appear in group settings (Boyce & Neale, 2006).

The study also supplemented Focused Group Discussions (FGDs) to foster rich discussions that enabled diverse participation and dynamic exchange among participants. FGDs promote collective brainstorming and interaction and facilitate the identification of shared concerns and the discussion of group dynamics shaping perceptions of renewable energy sources. This approach enriches the understanding of how renewable energy concepts are perceived within the Environmental Science course and encourages a broader discourse in educational environments about adopting this approach (Krueger & Casey, 2015).

In any research endeavor, researchers must remain aware of how their work impacts participants and society, necessitating responsible conduct. Kumar (2005) states that collecting information without participants' knowledge and consent is unethical. Therefore, researchers inform participants that their involvement is voluntary and that they can withdraw anytime. They obtained informed consent from all participants, who were told they did not have to answer uncomfortable questions. Before interviews, participants receive details about the topics discussed, the purpose of the research, and how their information will be used. Researchers also inform them about the interview's expected duration and provide time for questions before and after. All participants sign a consent form to confirm their willingness to participate while ensuring confidentiality and anonymity.

After transcribing the data, researchers code, analyze, interpret, and verify it. Transcribing interviews helps deepen understanding as researchers listen to and read the material multiple times. Coding starts once all data is transcribed. Researchers use key terms as codes to categorize and organize the text, which is vital in qualitative research (Saldaña, 2021). The data is then analyzed and grouped into main themes and sub-themes that emerge during coding. Each theme receives a specific code. Next, researchers interpret the data by identifying recurring themes and noting similarities and differences. The final step involves verifying the data by reviewing transcripts and codes to confirm or adjust earlier hypotheses (Saldaña, 2021).

## RESULTS AND DISCUSSION

The thematic analysis of the interview data revealed yielded three major themes: (1) Awareness of Renewable Energy Concepts, (2) Support in Potential Adoption of Solar Energy, and (3) Overall Insights on Renewable Energy Sources. These themes, along with their corresponding subthemes, and analytic summary statement, are summarized in Table 1.

**Table 1**: Thematic Analysis Summary

| Theme | Subthemes | Analytic Summary Statements |
|---|---|---|
| Awareness of Renewable Energy Concepts | • Understanding of renewable energy<br>• Practical learning and awareness gap | Learned renewable energy concepts from their Environmental Science, People and Earth's Ecosystem, and Science, Technology, and Society subjects through classroom discussions, but focused on theoretical concepts only. A practical learning application is needed to gain a deep understanding of renewable energy. |
| Support in Potential Adoption of Solar Energy | • Driving factors for solar energy adoption<br>• Barriers to solar energy adoption | Supported the potential adoption of solar energy, knowing the environmental benefits and future cost reduction. It needs high initial investment and desirability, management, and expertise of solar energy. |
| Overall Insights on Renewable Energy Sources | • Positive attitudes towards renewable energy<br>• Educational role in sustainability<br>• Mitigating environmental degradation | Gained optimism about the benefits of renewable energy and environmental awareness, as it helps address climate change. The significance of renewable energy lies in its deep understanding and equipping future students with practical skills and sustainable practices. Switching to renewable energy can play a significant role in reducing greenhouse gas emissions, which is crucial for slowing down global warming. |

### Theme 1: Awareness of Renewable Energy Concepts

Awareness of renewable energy concepts pertains to the knowledge of pre-service teachers about the types of renewable energy such as solar, wind, hydro, geothermal, and biomass. Participants demonstrated awareness of renewable energy concepts, which they attributed from classroom discussions in their environmental science courses.

*We are taught about renewable energy sources like solar, wind, and hydropower, but mostly in class discussions. [FGD 1]*

*I'm aware of renewable energy concepts based on the topics being discussed during our environmental science course. [FGD 2]*

Some of the participants learned from personal research, earlier subjects, and online exposure.

*I have learned it even before, for example in GE 22 people and the earth's ecosystem... we were able to actually grasp a little bit of it… [ FGD 1]*

*I've learned renewable energy not just in environmental science courses but as well as in Science, Technology, and Society. [FGD 3]*

*In my case, I learn about renewable energy because it was related to my study about United Nation Sustainable Development Goals. [IDI 2]*

*I am aware about the renewable resources because of what I've been reading online or hear from other people and also in high school. [IDI 5]*

However, the participants emphasizes the need for more practical, hands-on learning experiences. They argue that focusing solely on theoretical concepts and memorization limits students' understanding of renewable energy, and advocate for integrating experiential learning to grasp sustainability practices and applications effectively.

We are more focused in cognitive, it's more on the memorization... this cognitive part will be pointless if there's no such practical knowledge that are being applied. [FGD1]

It's very saddening how in the environmental science course, it often focuses on theoretical concepts and merely about rote memorization [IDI 1]

It was just pure discussion and examination. It was just discussed, no practical applications [IDI 3]

### Theme 2: Support in Potential Adoption of Solar Energy

Support in potential adoption of solar energy refers to the collaborative encouragement for integrating solar power energy in universities. The participant from pre-service teachers shows their general knowledge in supporting solar power energy as beneficial in reducing carbon footprints. The participants emphasized reducing carbon footprints and greenhouse gas effects by transitioning from fossil fuels to renewable solar energy sources.

*I support switching to solar energy, especially due to recent frequent brownouts, as it's a sustainable source that reduces carbon emissions. [IDI 1]*

*Our school should begin exploring and gradually applying renewable energy solutions, starting with research and small-scale trials, especially in response to frequent brownouts and increasing energy demands. [FGD 5]*

*I support adopting renewable energy in this institution as it shows the university's commitment to the United Nation sustainable goals. [FGD 3]*

Additionally, the participants described barriers to solar energy adoption, particularly in the high initial investment, desirability of management, and maintenance and expertise.

*I think funding would be the main problem for implementing a solar powered energy source. Putting that equipment in each building of the campus would be kind of expensive now. And then like, it is up to the drive of the university's administration if they really want to pursue renewable energy source. [FGD 2]*

*First are finances, second is the desire of the management. [FGD 5]*

*So other than the financial and feasibility of the renewable energy in our university, I believe one of the challenges would also be the kind of openness of the management regarding this concept. The management should have the openness or willingness to conduct a shift because we can't decide. No matter what how we suggest or no matter how many we are agreeing on this concept. But if the management is not able to or is it open for this kind of shift, then it will not be feasible. [FGD 3]*

*The most pressing barrier is its reliance on maintenance, and other expenses for hiring experts. [IDI 3]*

**Theme 3: Overall Insights on Renewable Energy Sources**

Overall insights of renewable energy sources describes the different main views or perspectives of pre-service science teachers. It shows that they are hopeful about the role clean energy can play in fighting climate change, supporting sustainability efforts, and seeing themselves as important messengers for raising environmental awareness and encouraging action in the future.

*I really have a positive attitude towards renewable energy sources. Not only does it help us not deplete our nonrenewable energy sources very fast, but it could also help us in many ways such as alleviating the cost of student expenses and tuition fees. [FGD 2]*

*Renewable energy sources are essential for creating a sustainable and inclusive energy in the future. [FGD 4]*

*Renewable energy sources are essential to foster a sustainable future because they provide cleaner alternatives to fossil fuels. It's helpful to mitigate climate change. [IDI 2]*

*Renewable energy will not run out of energy. There is also a chance that it could be implemented in the long run. [IDI 3]*

The pre-service teachers see their future role as really important in pushing sustainability education forward. As future teachers, they need to include renewable energy topics in their lessons and prepare their students to handle environmental issues. Teachers can help students understand and take action on renewable energy practices by connecting the Environmental Science course with ideas about sustainable development.

*I believe that as future educators, I believe that we have a powerful responsibility to shape the minds of our future learners. It is very important to instill in them the urgency and the potential for renewable energy sources, since the world is actually rapidly shifting. And it is our duty as teachers to ensure that our students are not only aware of this change but are also equipped to be part of it. [FGD 1]*

*As a future educator, it is important for us to provide students on how to save energy and how to become environmentally literate or have a deeper understanding of how to save energy, and especially about renewable energy sources. [IDI 3]*

*It's very crucial to equip students with practical skills related to renewable energy technologies and sustainable practices. This can be followed through educational programs that focus on experiential learning. So, learning by doing, so that the students will adapt the learning to their everyday lives. [IDI 2]*

Most pre-service teachers kept emphasizing that switching to renewable energy is important in tackling climate change and its harmful effects on the environment.

*I believe non-renewable resources emit more carbon, contributing to global warming, whereas renewable sources offer a cleaner alternative renewable that could help address climate change by reducing emissions. [IDI 5]*

*Coal and oil actually release harmful gases in warming our planet and cause climate problems such as climate change and realizing that on the other hand, this renewable energy source produces little to no pollution. It actually helps us to reduce these harmful emissions. [FGD 1]*

*Renewable energy, like solar or wind power, it reduces fossil fuels. And it would help to mitigate climate change. [IDI 4]*

Participants responses show that everyone understands that moving to renewable energy sources is a key way to reduce harmful emissions and fight climate change and environmental damage.

**Discussion**

This study determined the insights of preservice teachers regarding renewable energy concepts and their integration into the Environmental Science course, aligning with the context of their training as future educators. Awareness of renewable energy concepts, support in potential adoption of solar energy, and overall insights on renewable energy sources are identified themes in this study.

The prominence of awareness of renewable energy concepts, particularly related to understanding of renewable energy, and practical learning and awareness gap is consistent with the prior researches. This study's findings show that learning about renewable energy at a young age, whether by school or your own initiative, can have a powerful effect. This supports the findings of the previous studies who identified that students enhanced their understanding of renewable energy from multiple sources (Ji *et al.*, 2023; Al-Amin, 2022; López Prol & Steininger, 2020). In addition, teaching future educators about renewable energy is key to addressing environmental problems. This supports the study which found that adding renewable energy topics to school and lessons can help students enhance their understanding (García *et al.*, 2021). The participants in this study also emphasize the importance of integrating lessons that are more effectively connected to everyday life. The result upholds the view that what students learn in class must

lead to concrete actions, such as energy conservation and recycling (Akinsemolu & Onyeaka, 2024). This also confirms what discovered that students learn more intensely about renewable energy when they experience practical learning (Mansfield, 2023).

The emergence of support in potential adoption of solar energy, including the driving factors for solar energy adoption and its barriers are congruous with previous studies. This study highlights solar energy's crucial role in helping the environment by reducing carbon footprints and supporting environmental living. The result agreed the study that the Paris Agreement's targets include limiting global warming to below 2 degrees Celsius above pre-industrial levels (Masson *et al.*, 2022). By reducing carbon emissions, educational institutions are crucial, especially in supporting the effort to mitigate climate change and promote sustainability in institutions that can benefit students.

Additionally, the result of the study also substantiates the notion that adopting solar energy can be helpful in long run investment that can reduce students' tuition fee while also benefiting the environment and the institutions supporting with the existing studies, which highlight how the solar energy plays vital role in solar-powered campuses serve as living laboratories, enriching students' learning experiences and nurturing a culture of sustainability (Redzuan *et al.*, 2022; Khin & Jayaranjan, 2022; Kamat & Nasnodkar, 2019). However, financial constraints as a major barrier to installing solar panels in educational institutions were common concerns and administrative openness is key to making solar initiatives a reality, it signifies to the previous studies (Xiong & Dai, 2023; Khan *et al.*, 2022; Rasoulinezhad, 2020) that acknowledges the essential role of financial mechanisms in supporting the transition to a low-carbon economy. Their perspectives underline that financial investment, administrative readiness, and space availability must work together to support a successful transition to solar energy in the educational setting. Also, the solar energy adaptation significantly impacts key elements, particularly in the availability of expert personnel and demands for maintenance to ensure long-term use. This supports the finding emphasized that solar energy systems' adoption and long term efficiency heavily rely on proper maintenance and the availability of skilled personnel (Achouch *et al.*, 2022). The demands are associated with administration and long-term planning, particularly regarding economic costs, environmental, and technological institutional challenges.

The identification of the overall insights of pre-service teachers on renewable energy sources reinforces the positive attitudes towards renewable energy, educational role in sustainability, and mitigating environmental degradation. The findings support the notion that a good educational structure greatly affects future teachers' desire to support renewable technologies (Genç & Durak, 2023). That research links knowledge to favorable attitudes about how it is used. This also supports the study that knowledge of the benefits of renewable energy can encourage younger people to adopt sustainable energy practices (Kamat & Nasnodkar, 2019). The result revealed that renewable energy is key to combating climate change, which supports the findings that effective global policies driving renewable adoption (Olajiga *et al.*, 2024) while stress the need for diverse renewable technologies to meet global energy demands (Darkoh *et al.*, 2025). These findings reinforce pre-service teachers' views with up-to-date evidence and policy insights. Similarly, it agreed with the point of view that environmental education is not just about knowing facts but about building the critical skills needed for sustainable living (Liju, 2024). Likewise, it support the idea that adding renewable energy topics into school programs can help fight climate change by giving students the knowledge and tools to become advocates. Improving curricula and engaging with the public are essential for a more sustainable future of (Iqbal *et al.*, 2023).

## CONCLUSION

The results of this study have some important effects on how we develop curricula, promote sustainability at universities, and train teachers. First off, the results emphasize how urgently colleges and universities, need better to incorporate renewable energy ideas into their Environmental Science courses. The course must shift toward a more practical, hands-on approach. Instead of just memorizing facts, students should get real experiences, develop critical thinking skills, and learn things they can use in daily life, especially regarding sustainability.

The study also points out how important it is to raise awareness about renewable energy and the environmental damage caused by relying on nonrenewable sources. When students become more aware, they can develop habits like saving electricity by turning off lights and devices they are not using. Plus, this awareness encourages conversations about clean energy options and how we can all help protect our planet. The study also emphasizes how big universities in Mindanao can become a leader in climate action and sustainable education by welcoming renewable energy solutions, such as installing solar panels on campus.

To sum up, this study emphasizes how important it is to help preservice teachers become more environmentally aware. As they prepare to become future educators, their knowledge and enthusiasm can inspire the next generation to participate in climate action and sustainability. This influence can last well beyond their time at university, making a real difference.

The study found that pre-service teachers in the selected big university generally know about renewable energy sources like solar, wind, and hydropower. However, most of this knowledge is basic, and the Environmental Science course does not go into much detail or offer many practical experiences. While many students can point out renewable energy's environmental and economic benefits, such as lowering carbon emissions and supporting

sustainability, they do not often get opportunities to apply what they have learned hands-on. The course mainly covers theory, with little focus on real-world applications or activities that involve doing or practicing.

Moreover, many participants strongly supported bringing solar energy into the university. They saw it as a smart move in the long run because it can save money over time and fits well with the United Nations Sustainable Development Goals. Still, they also pointed out some challenges, like the high upfront costs to set things up, the current infrastructure not being fully ready, needing specialized technical knowledge, and whether the university leadership is willing and open to trying new things like this. Ultimately, these future teachers emphasize how important it is to include renewable energy education in college and earlier in school. Their views show they are ready to support sustainability efforts. However, they also point out that schools need to make some changes in how they teach and what they focus on to make renewable energy a part of education.

## REFERENCES


Achouch, M., Dimitrova, M., Ziane, K., Sattarpanah Karganroudi, S., Dhouib, R., Ibrahim, H. and Adda, M., (2022). On predictive maintenance in industry 4.0: Overview, models, and challenges. *Applied Sciences, 12*(16), p.8081. https://doi.org/10.3390/app12168081

Akinsemolu, A. A., & Onyeaka, H. (2024). The role of green education in achieving the sustainable development goals: A review. *Renewable and Sustainable Energy Reviews, 188*, 115239. https://doi.org/10.1016/j.rser.2024.115239

Alghamdi, A., Farahat, H., & Emam, A. (2020). Energy consumption and carbon emissions in university campuses: A study of the energy footprint in higher education institutions. *Energy and Buildings, 223*, 110086. http://10.1016/j.enbuild.2020.110086

Asumadu-Sarkodie, S., & Owusu, P. A. (2016). A review of renewable energy sources, sustainability issues and climate change mitigation. *Cogent Engineering, 3*(1), 1167990. https://doi.org/10.1080/23311916.2016.1167990

Bacolod, D. (2021). Teaching the Environmental Science Education in the 21st-Century. *International Journal of Scientific Research in Multidisciplinary Studies, 9(*10), 8-15. DOI: 10.18535/ijsrm/v9i10.el03

Bapat, O. V., & Bapat, V. N. (2016). An overview of solar energy policy of India and few prominent nations in the world. *Paper presented at the 2016 IEEE 1st International Conference on Power Electronics, Intelligent Control and Energy Systems* (ICPEICES). 10.1109/ICPEICES.2016.7853551

Bertschy, F., Künzli, C., & Lehmann, M. (2013). Teachers' competencies for the implementation of educational offers in the field of education for sustainable development. *Sustainability, 5*(12), 5067-5080. https://doi.org/10.3390/su5125067

Bliss, A. (2016). Qualitative research methods: A guide for students and researchers. Oxford University Press.

Boyce, C., & Neale, P. (2006). *Conducting in-depth interviews: A guide for designing and conducting in-depth interviews for evaluation input*. Pathfinder International.

Creswell, J. W. (2013). *Qualitative inquiry and research design: Choosing among five approaches* (3rd ed.). Sage Publications.

Creutzig, F., Jochem, P., Edelenbosch, O. Y., Mattauch, L., Vuuren, D. P. van, McCollum, D., & Minx, J. (2017). *Transport: A roadblock to climate change mitigation? Science, 350*(6263), 911–912. https://doi.org/10.1126/science.aac8033

Darkoh, G. O., Laweh, N., Dasori, E. A., & Abilla, M. L. (2025). Harnessing renewable energy technologies to mitigate climate change and address rising energy demands. *EPRA International Journal of Climate and Resource Economic Review*, 23-27. https://doi.org/10.36713/epra19712

Denchak, M. (2022). *Fossil fuels: The dirty facts. Natural Resources Defense Council* (NRDC). https://www.nrdc.org/stories/fossil-fuels- dirty-facts

Dhaka, R. (2024). Role of teachers and higher education in achieving the sustainable development goals. *International Journal for Multidisciplinary Research, 6*(1), 2-40. https://doi.org/10.36948/ijfmr.2024.v06i01.11792.

Doyle, A. (2020). What Is a Semi-Structured Interview? *Definition & Examples of a Semi-Structured Interview*. https://www.thebalancecareers.com/what-is-a-semi-structured- interview-2061632

Edsand, R., & Broich, F. (2020). The role of renewable energy education in middle and high school curricula. *Renewable and Sustainable Energy Reviews, 48*(1), 185-190. https://doi.org/10.1016/j.rser.2019.06.018

Elavarasan, R. M., Pugazhendhi, R., Shafiullah, G. M., Irfan, M., & Malik, B. (2020). Comprehensive review on renewable energy development, challenges, and policies in Southeast Asia. *Sustainable Energy Technologies and Assessments, 40*, 100765. https://doi.org/10.1016/j.seta.2020.100765

Fudalan, M. V., Casabal , G. T., Epe, J. G. B., Besa , E. S. B., Aurea, T. J., Rosales, I. L. R., Fudalan , E. R. V., Fernandez , B. K. V., Fudalan , K. L. V., & Fudalan Rod, M. V. (2025). Towards Sustainable Energy: Evidenced-Based Practices in Implementing Renewable Energy Projects. *American Journal of Multidisciplinary Research and Innovation , 4*(5), 53-73. https://doi.org/10.54536/ajmri.v4i5.4762

Gallagher, D. J., Graham, A., & Ryan, T. (2020). Enhancing environmental science education through hands-on learning: A case study in renewable energy applications. *Journal of Environmental Education, 51*(2), 107-121. https://doi.org/10.1080/00958964.2020.1751512

García-Ferrero, J., Merchán Corral, R. P., Roco, J. M. M., Medina, A., & Santos, M. J. (2021). Towards a sustainable future through renewable energies

at secondary school: An educational proposal. *Sustainability, 13*(22), 12904. https://doi.org/10.3390/su132212904

Genç, M. and Durak, B. (2023). Pre-service teachers' perception of renewable energy sources: a case study of düzce university. *Mimbar Sekolah Dasar, 10*(3), 561-577. 10.53400/mimbar-sd.v10i3.55005

Halder, P., Havu-Nuutinen, S., Pietarinen, J., Pelkonen, P. & Zyadin A. (2014). *Subject knowledge and perceptions of bioenergy among school teachers in India: Results from a survey. Resources, 3*(4), 599 613. https://doi.org/10.3390/resources3040599

Hashem, H. M. (2023). Renewable energy adoption and economic efficiency: A focus on solar energy in Southeast Asia. *Energy Economics, 115*, 105370. https://doi.org/10.1016/j.eneco.2022.105370

Iqbal, M., Ul-Durar, S., Arshed, N., Shahzad, K., & Ayub, U. (2023). Connecting higher education and renewable energy to attain sustainability for brics countries: a climate kuznets curve perspective. *International Journal of Emerging Markets*. https://doi.org/10.1108/ijoem04-2023-0555

Irfan, M., Razzaq, A., Ahmad, M., & Rehman, A. (2020). A study on the effectiveness of sustainable energy policies in the context of climate change: Evidence from Pakistan. *Journal of Cleaner Production, 247*, 119146. http://10.1016/j.jclepro.2019.119146

Jabeen, A., Irfan, M., & Razzaq, A. (2020). Analyzing the environmental and economic impacts of energy transitions in developing economies. *Energy Reports, 6*, 455–462. http://10.1016/j.egyr.2020.01.029

Jain, S., & Jain, P. (2017). The rise of renewable energy implementation in South Africa. *Energy Procedia, 143*, 721-726 https://doi.org/10.1016/j.egypro.2017.12.752

Jay, V., Ylaya, V., & Malicay, L. (2022). Assessment of Energy Savings Potentials at University in Lanao del Norte, Philippines. *International Research Journal of Advanced Engineering and Science, 7*(2), 22–28 .Retrieved from https://irjaes.com/wp-content/uploads/2022/03/IRJAES-V7N1P337Y22.pdf

Ji, H., Coronado, A. B., Mueller, M. A., Esposito, L. J., Tait, D., & Kim, H. J. (2023). A Learning Ecology Perspective of Energy Literacy among Youth: A Case Study from Alabama High Schools. *Sustainability, 15*(22), 16055. https://doi.org/10.3390/su152216055

Kaczmarczyk, B. and Urych, I. (2022). Perception of the transition to a zeroemission economy in the opinion of polish students. *Energies, 15*(3), 1102. https://doi.org/10.3390/en15031102

Kamat, Y., & Nasnodkar, S. (2019). A survey on the barriers and facilitators to edtech adoption in rural schools in developing countries. International Journal of Intelligent *Automation and Computing, 2*(1), 32-51. https://research.tensorgate.org/index.php/IJIAC/article/view/58

Kavari, A., Irfan, M., & Nawaz, A. (2019). The impact of fossil fuel energy consumption on CO2 emissions: Evidence from rich, emerging, and poor economies. *Energy, Sustainability and Society, 9*(1), 44.Retrieved from https://file.pide.org.pk/pdfpdr/2014/327-346.pdf

Keramitsoglou, K. M. (2016). Exploring adolescents' knowledge, perceptions and attitudes towards Renewable Energy Sources: A colour choice approach. *Renewable and Sustainable Energy Reviews, 59*, 1159–1169. https://doi.org/10.1016/j.rser.2015.12.047

Khalo, X. and Damoah, B. (2023). Reinvigorating climate change education in universities a social transformative agenda. *Environmental Science and Sustainable Development,* 19-26. https://doi.org/10.21625/essd.v8i4.1013

Khan M, Riaz H, Ahmed M, Saeed A (2022) Does green finance really deliver what is expected? An empirical perspective. *Borsa Istanb Rev 22*(3):586–593 https://doi.org/10.1016/j.bir.2021.07.006

Khin, Y. M., & Jayaranjan, D. (2022). Air-Conditioning for Green Universities. *Paper presented at the 19th International Symposium on Management* (INSYMA 2022). 10.2991/978-94-6463-008-4_126

King, N. (2004). Using templates in the thematic analysis of text. *In C. Cassell & G. Symon* (Eds.), Essential guide to qualitative methods in organizational research (pp. 257–270). Sage Publications.

Krueger, R. A., & Casey, M. A. (2015). *Focus groups: A practical guide for applied research* (5th ed.). Sage Publications.

Kumar, R. (2005). *Research methodology: A step-by-step guide for beginners* (2nd ed.). Sage Publications.

Leisen, R., Steffen, B., Weber, C., 2019. Regulatory risk and the resilience of new sustainable business models in the energy sector. *J. Clean. Prod. 219*, 865–878. https://doi.org/10.1016/J.JCLEPRO.2019.01.330

Liju, M. (2024). Environmental education and skilling the students for future. *International Journal of Research Publication and Reviews, 5*(3), 162- 164. https://doi.org/10.55248/gengpi.5.0324.0605

López Prol, J., & Steininger, K. W. (2020). Photovoltaic self- consumption is now profitable in Spain: Effects of the new regulation on prosumers' internal rate of return. *Energy Policy, 146*, 111793. https://doi.org/10.1016/j.enpol.2020.111793

Mansfield, M. (2023). *The Impact of Hands-on Environmental Science Lessons on Middle School Students Learning.* https://digitalcommons.csumb.edu/cgi/viewcontent.cgi?article=2581&context=caps_thes_all#:~:text=In%20conclusion%2C%20the%20NGSS%20standards,7

Masson-Delmotte, V., Zhai, P., Pörtner, H.-O., Roberts, D., Skea, J., & Shukla, P. R. (2022). *Global Warming of 1.5 C: IPCC special report on impacts of global warming of 1.5 C above pre-industrial levels in context of strengthening response to climate change, sustainable development, and efforts to eradicate poverty*: Cambridge University Press. https://www.cambridge.org/core/services/aopcambridgecore/conten t/view/F7A8197ED6B28A8840D13915A537AF68/97810091 57957pre_i-ii.pdf/frontmatter.pdf

May, T. (1997). *Social research: Issues, methods & process* (2nd ed.). Open University Press.

Munaro, M. R., & John, V. M. (2024, May 10). Energy efficiency in the higher education institutions: A review of actions and their contribution to sustainable development. *In V. Ungureanu, et al.* (Eds.), Proceedings of the 4th International Conference "Coordinating Engineering for Sustainability and Resilience" & Midterm Conference of Circular B "Implementation of Circular 55 Economy in the Built Environment" (pp. 207–217). Springer. https://doi.org/10.1007/978-3-031-57800-7_19

Numbi, B., Malinga, S., Chidzonga, R., & Mulangu, T. (2017). Energy cost saving potential in educational buildings-case study of MUT campus. *Paper presented at the 2017 international conference on the industrial and commercial use of energy* (ICUE). https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8068004&is number=8067979

Olajiga, O. K., festus-ikhuoria, I. c., Adebayo, R. A., & Obiuto, N. C. (2024). Sustainable development and renewable energy policy: a review of global trends and success stories. *International Journal of Advanced Multidisciplinary Research and Studies, 4*(2), 648-656. https://doi.org/10.62225/2583049x.2024.4.2.2551

Olivieri, F., Cuadrado, M., & Leon, J. (2020). Higher education institutions as drivers of energy transformation: Research, education, and innovation. *Energy Reports, 6,* 503–516. https://doi.org/10.1016/j.egyr.2020.03.011

Pada, A., Chanunan, A. A., & Supriyatna, N. (2025). Fostering Environmental Awareness Through Sustainable Development Goal-Oriented Ethno-STEM Approach in Elementary Education. *Jurnal Pendidikan IPA Indonesia, 14*(3), 593–605. https://doi.org/10.15294/jpii.v14i3.24420.

Patton, M. Q. (2015). Qualitative research and evaluation methods (4th ed.). Sage Publications.

Rasoulinezhad, E. (2020). Environmental Impact Assessment Analysis in the Kahak's Wind Farm. *Journal of Environmental Assessment Policy and Management, 22*(1/2), 1–15. https://www.jstor.org/stable/27139939

Redzuan, R. H., Wan Zulkefli, W. F., Yusoff, M. N. H., Mohd Noor, H. A., Husain, R., & Redzuan, R. H. (2022). Energy efficiency by using solar panels in a university campus: UMK City Campus. Paper presented at the International Conference on Entrepreneurship, Business and Technology.*InCEBT 2022. Springer, Singapore*. https://doi.org/10.1007/978-981-99-2337-3_71

Rezaee, M., Yousefi, M., & Alipour, M. (2019). Challenges and prospects of renewable energy in the developing world: A case study of Iran. *Renewable Energy, 136*, 1044–1053. http://10.1016/j.renene.2018.09.098

Rice, P., & Ezzy, D. (1999). *Qualitative research methods: A health focus.* Oxford University Press.

Saldaña, J. (2021). The Coding Manual for Qualitative Researchers (4th ed.). SAGE.

Shelton, R. C., Philbin, M. M., & Ramanadhan, S. (2022). Qualitative research methods in chronic disease: Introduction and opportunities to promote health equity. *Annual Review of Public Health, 43*, 193–210. https://doi.org/10.1146/annurev-publhealth-012420-105104

Shrimali, G., & Rohra, S. (2012). India's solar mission: A review. *Renewable and Sustainable Energy Reviews, 16*(8), 6317- 6332.https://doi.org/10.1016/j.rser.2012.06.018

Tawalbeh, M., Al-Othman, A., Abdelsalam, E. M., Alami, A. H., Alshorbaji, A., & Al-Omari, S. B. (2021). Environmental impacts of solar photovoltaic systems: A critical review of recent progress and future outlook. *Science of the Total Environment, 759*,143505. https://doi.org/10.1016/j.scitotenv.2020.143505

Tenny, S., Brannan, G. D., Brannan, J. M., & Sharts-Hopko, N. C. (2022). Qualitative research: Data collection and analysis. *In StatPearls. StatPearls Publishing.* https://www.ncbi.nlm.nih.gov/books/NBK470395/.

United Nations Environment Programme (UNEP). (2023). Buildings and climate change: Energy efficiency and sustainable construction. *United Nations Environment Programme*. Retrieved from https://globalabc.org/sites/default/files/2024-11/global_status_report_buildings_construction_2023.pdf

Xiong, Y. & Dai , L. (2023) *Does green finance investment impact on sustainable development: Role of technological innovation and renewable energy*. Renewable Energy https://doi.org/10.1016/j.renene.2023.06.002