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Recycling and Resiliency Framed as Faculty Challenges in Advancing Sustainable Science Education

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Abstract

Purpose:

This study aimed to investigate how faculty members at Northern Iloilo State University–Ajuy Campus utilize recycled materials and innovative practices to promote sustainable science education. Specifically, it examined the ways environmental sustainability is integrated into teaching strategies to cultivate students' critical thinking, strengthen their sense of environmental stewardship, and align classroom learning with the United Nations Sustainable Development Goals (SDGs).

Methods:

A narrative research design was employed, using structured interviews with four faculty members who teach science-related courses. The resulting data were subjected to thematic analysis to uncover recurring strategies, challenges, and innovations in integrating sustainability into classroom instruction.

Results:

Findings revealed that faculty members actively integrated recycled materials and partnered with local businesses to develop instructional resources. They employed innovative pedagogical strategies—such as arts-integrated STEM lessons and project-based learning activities—to contextualize environmental issues for students. However, persistent barriers, including time constraints, insufficient funding, and limited institutional support, were identified as major challenges to the broader implementation of these sustainability initiatives.

Application:

Faculty members displayed a strong commitment to sustainability despite systemic limitations. Their resilience and creativity emerged as critical drivers of environmentally responsible teaching practices. Nevertheless, institutional constraints curtailed the scalability and consistency of these initiatives, highlighting the need for stronger organizational support.

Implications: This study underscores the importance of systemic support—through adequate funding, targeted training, and curricular flexibility—to institutionalize sustainable practices in science education. By aligning these initiatives with SDG 4 (Quality Education), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), and SDG 15 (Life on Land), higher education institutions can play a transformative role in cultivating a generation of environmentally conscious learners.

Keywords: Recycling, Resiliency, Faculty Challenges, Sustainable Science Education, Environmental Sustainability

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1. Introduction

The world today faces unprecedented environmental challenges, including global warming, climate change, biodiversity loss, and land degradation, which are largely driven by indiscriminate waste disposal, unsustainable consumption patterns, and the overexploitation of natural resources. The increasing frequency and severity of extreme weather events such as typhoons, droughts, and floods further underscore the urgent need for coordinated global action on climate change and sustainable living (Reffhaug & Lysgaard, 2024). Addressing these interconnected issues requires an integrative response that embeds sustainability principles into education systems, public policies, and community life.

Education, particularly science, plays a pivotal role in cultivating environmental awareness, ecological accountability, and sustainable lifestyles. In alignment with the United Nations Sustainable Development Goals (SDGs)—specifically SDG 4 (Quality Education), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), and SDG 15 (Life on Land)—integrating sustainability into teaching and learning is essential for equipping future generations with the knowledge and skills needed to address complex environmental challenges. SDG 4 emphasizes the importance of inclusive, quality education in fostering lifelong learning, while SDG 12 promotes reduced environmental footprints and minimized waste. SDGs 13 and 15 emphasize the urgency of climate resilience and biodiversity conservation as cornerstones of sustainable development.

In the Philippine context, the integration of sustainability into education is mandated by Republic Act No. 9512, also known as the National Environmental Awareness and Education Act of 2008, which requires the inclusion of environmental education at all levels. Yet, despite this progressive policy framework, many higher education institutions struggle with implementation due to insufficient funding, limited resources, and a lack of institutional support (Chao, 2022). Science educators frequently face challenges, including inadequate access to teaching resources, insufficient training, and time constraints.

Against this backdrop, the use of recycled materials in teaching has emerged as an economical and creative pedagogical strategy. Beyond advancing SDG 12 by promoting responsible consumption and waste reduction, this approach enhances experiential learning, fosters innovation, and nurtures environmental stewardship among students. By providing contextual, real-world learning experiences, recycled-material teaching practices also support the achievement of SDGs 13 and 15 by increasing students' awareness of climate change and biodiversity conservation.

This study aims to examine how faculty members at Northern Iloilo State University–Ajuy Campus navigate both the challenges and opportunities of incorporating recycled materials into science education. Focusing on their lived narratives, it seeks to illuminate how science teachers interpret, translate, and adapt sustainability paradigms within resource-constrained environments. Insights from these narratives aim to inform institution-wide initiatives and policies that promote sustainability education.

1.1 Significance of the Study

This study offers valuable insights into grassroots-level sustainability initiatives within Philippine higher education, highlighting the potential of faculty-driven innovations to overcome systemic constraints and advance environmental education goals. Its findings enrich the discourse on sustainable pedagogy and provide evidence-based guidance for higher education institutions, policymakers, and other education stakeholders in creating supportive environments that facilitate the integration of sustainability across the curriculum. Ultimately, the study aligns with the broader educational reform agenda by advocating for creative, context-responsive, and environmentally grounded approaches to science education.

1.2 Research Framework

Figure 1 presents the conceptual paradigm of the study. Grounded in a constructivist epistemology, the research assumes that knowledge is actively built through human experiences and interactions. It examines the experiences of science faculty members at Northern Iloilo State University–Ajuy Campus and how they construct teaching practices and engage with recycled materials. The study is

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further informed by sustainability education theory, which emphasizes pedagogical approaches that cultivate environmental stewardship and sustainable practices. In this framework, faculty members' lived experiences shape their knowledge and understanding, enabling them to design meaningful learning opportunities that promote environmental awareness and sustainability among students.

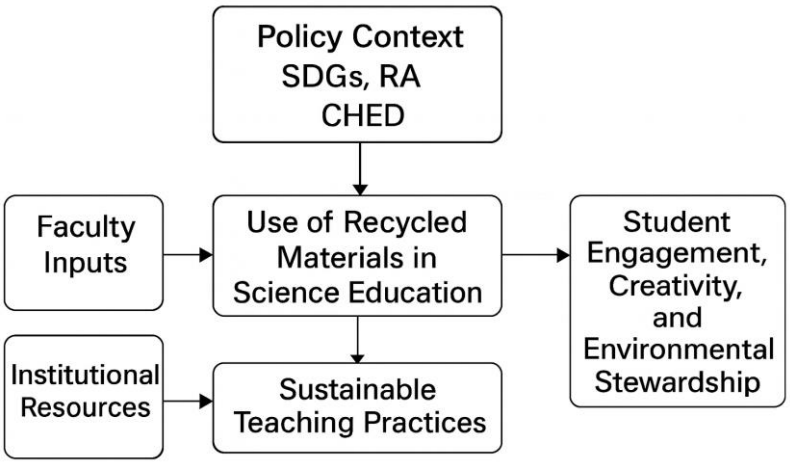

Figure 1. Schematic Diagram of the Study

2. Literature Review

2.1 Faculty Engagement and Student Success

Faculty engagement plays a critical role in enhancing student learning outcomes, emotional well-being, and self-confidence by extending beyond traditional instruction to encompass mentorship, curriculum development, research, and institutional governance (Li & Xue, 2023; Raboca & Carbunarean, 2024). Meta-analytic evidence indicates that positive faculty–student interactions are among the strongest predictors of student engagement and academic performance (Li & Xue, 2023). This is further reinforced by Kahu and Nelson's (2018) student engagement theory, which underscores how faculty presence and active learning scaffolding cultivate greater student motivation and resilience.

2.2 Faculty Engagement in Sustainability

Faculty leadership is pivotal in embedding sustainability within higher education. Morris and Johnson (2022) identified inadequate resources and limited institutional support as major barriers to faculty-led sustainability initiatives. Yet evidence shows that targeted support—such as professional development opportunities and provision of material resources—effectively promotes faculty engagement in these efforts. Building on this, Lee and Smith (2022) found that aligning curricula with

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recycled-material use enhances experiential learning and models responsible consumption, thereby positioning faculty as key change agents who shape students' attitudes and behaviors toward sustainability.

2.3 Interdisciplinary Collaboration for Sustainability

Collaboration across academic disciplines significantly strengthens the integration of sustainability into higher education. Tornio (2024) demonstrated that interdisciplinary partnerships create platforms for sharing resources, fostering innovative teaching practices, and achieving more comprehensive sustainability outcomes—enhancing both faculty work and student learning experiences.

3.4.Sustainable Laboratory and Science Practices

Sustainable science education—including the integration of green chemistry principles and eco-friendly laboratory technologies—is essential for reducing the environmental footprint of educational settings. A recent synthesis by Ikegami et al. (2025) underscores how efficient laboratory design can significantly decrease energy consumption and hazardous waste production. Complementing this, Jones and Patel (2020) found that project-based, interdisciplinary science curricula enhance students' engagement with real-world environmental challenges. Taylor and Smith (2022) further observed that implementing sustainable laboratory technologies—such as digital management systems—can simultaneously improve research quality and strengthen environmental performance.

3.5 Synthesis and Implications

The reviewed literature consistently identifies faculty engagement as a central driver of both academic success and sustainability within higher education. Faculty members who are adequately supported, equipped with resources, and empowered to incorporate recycled materials into their teaching make substantial contributions to students' cognitive development and environmental awareness. Their active participation not only elevates instructional quality but also fosters a culture of sustainability that extends beyond the classroom. Furthermore, interdisciplinary collaboration and the integration of green technologies into academic practices amplify the impact of sustainability-focused education. To ensure effective implementation, higher education institutions should adopt comprehensive strategies that include structured training and professional development in sustainability education, allocation of funding and teaching resources for innovative practices, provision of incentives to encourage cross-disciplinary collaboration, and incorporation of sustainable laboratory practices into institutional policies. These measures position faculty as transformative agents capable of embedding the United Nations Sustainable Development Goals—specifically SDG 4 (Quality Education), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), and SDG 15 (Life on Land)—into the academic fabric. Ultimately, such efforts cultivate responsible, sustainability-oriented graduates who are well-prepared to address complex environmental challenges in their future professional and civic roles.

3. Methodology

3.1 Research Design

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This study employed a narrative research design to examine the experiences of faculty members integrating recycled materials into sustainable science teaching at Northern Iloilo State University–Ajuy Campus. Narrative research, as a qualitative methodology, centers on capturing lived experiences through personal storytelling and reflection. It provides a rich and contextualized understanding of individual perspectives, particularly how professional beliefs, practices, and motivations shape pedagogical approaches (Creswell & Poth, 2016). This design was well-suited for the present study as it enabled an in-depth exploration of the personal and professional journeys of science educators who actively advance sustainability through innovative teaching strategies. By using narrative inquiry, the researchers were able to elicit nuanced insights into the challenges, strategies, and values associated with employing recycled materials in science education.

3.2 Participants of the Study

The participants of this study were four faculty members teaching science at Northern Iloilo State University–Ajuy Campus. They were purposefully selected for their demonstrated engagement in sustainability-oriented teaching and their documented use of recycled materials in the classroom. Purposive sampling was employed to ensure the inclusion of participants with relevant expertise, experience, and commitment to sustainable education (Palinkas et al., 2015). Narrative inquiry emphasizes depth rather than breadth; therefore, focusing on four participants aligns with qualitative research recommendations—particularly in narrative studies—where small, carefully chosen samples support rich and nuanced thematic analysis (Clandinin & Connelly, 2000; Riessman, 2008). All participants were fully briefed on the research objectives and voluntarily consented to participate. Informed consent was obtained prior to data collection to ensure adherence to ethical research standards.

3.3 Data Gathering Instrument

Data were collected using a semi-structured interview protocol intentionally designed to balance consistency across interviews with flexibility to probe participants' individual experiences in depth. This approach enabled the researchers to guide discussions around predetermined themes while also allowing participants to share their unique narratives and reflections (Salomão, 2023). The interview guide comprised two main sections. The first gathered background information—including participants' age, years of teaching experience, and involvement in sustainability initiatives. The second addressed core themes such as the role of recycled materials in instructional decision-making, challenges encountered in implementing sustainability-focused lessons, and strategies employed to overcome these obstacles. Each interview lasted approximately 45–60 minutes and was audio-recorded with the participants' consent. Field notes were simultaneously taken to capture nonverbal cues, contextual details, and other observations that enriched the qualitative data.

3.4 Data Analysis

The interview data were analyzed using Braun and Clarke's (2006) six-phase thematic analysis framework, a rigorous and systematic approach for identifying and refining meaningful patterns within qualitative narratives. In Phase 1, the researchers became familiar with the data by transcribing and repeatedly reviewing the interview recordings. In Phase 2, initial codes were generated using NVivo 12 software to ensure a transparent and traceable coding process. Phase 3 involved searching for thematic patterns, with particular attention to faculty engagement with recycled materials and sustainability practices. In Phase 4, these emerging themes were reviewed for coherence and consistency across all four narratives. During Phase 5, the finalized themes were clearly defined, named, and supported by verbatim excerpts from the interviews. Finally, in Phase 6, the themes were synthesized into a coherent report that integrated participant voices with relevant literature to provide a comprehensive understanding of the findings.

To enhance the credibility and trustworthiness of the analysis, member checking was conducted by sharing interview transcripts and preliminary interpretations with participants for validation (Lincoln & Guba, 1985). Additionally, peer debriefing with fellow researchers helped ensure analytical rigor and minimize potential bias in interpretation.

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3.5 Ethical Considerations

This study adhered to established ethical guidelines for qualitative research, prioritizing the protection of participant rights, data confidentiality, and academic integrity. Ethical approval was obtained from the Institutional Research Board (IRB) of Northern Iloilo State University before data collection commenced. All participants received clear, written information about the study's purpose, the nature of their involvement, potential risks, and their rights as research participants. Informed consent was secured from each participant prior to participation. To safeguard confidentiality and anonymity, pseudonyms were assigned in all documentation and reporting. All data—including audio recordings and transcripts—were stored in encrypted digital files accessible only to the research team. Participants were also informed of their right to withdraw from the study at any point without penalty. These procedures were designed to align with international ethical standards for qualitative research, ensuring a research process that was both responsible and respectful (Tracy, 2010).

4. Results and Discussion

Figure 2 presents the thematic map derived from the narrative data collected in the study. It visually illustrates the major themes and corresponding subthemes that emerged from faculty members' experiences with the integration of recycled materials into science education.

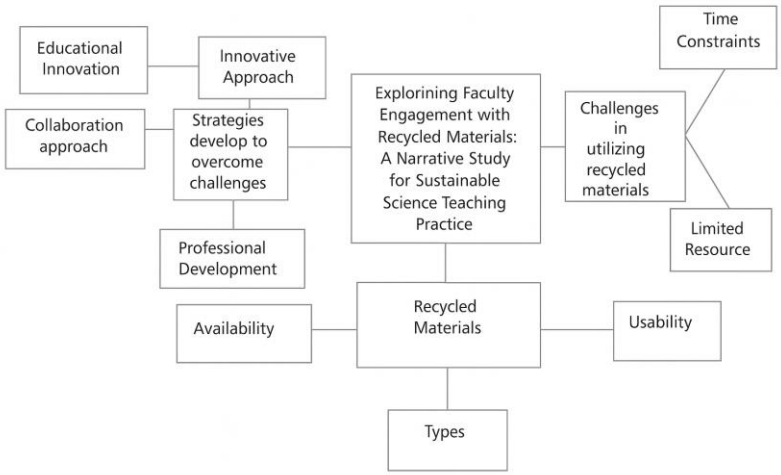

Figure 2. Thematic Map of Faculty Engagement with Recycled Materials in Sustainable Science Teaching

At the center of the thematic map is faculty engagement with recycled materials, from which three core themes emerged: (1) challenges, (2) strategies, and (3) characteristics of the recycled materials. The first theme highlights the main challenges in utilizing recycled materials, including time constraints, limited resources, and concerns about usability. In response to these obstacles, faculty members developed specific strategies—such as adopting innovative teaching approaches, engaging in professional development, pursuing educational innovations, and fostering collaboration—which reflect their adaptive responses to contextual limitations. The third theme focuses on the recycled materials themselves, particularly their availability and types, which directly shape how they are integrated into science teaching.

This thematic map complements the study's narrative findings by providing a conceptual framework that links faculty experiences, pedagogical practices, and the sustainability-related constraints and enablers they encounter. It visually summarizes how science educators at Northern Iloilo State

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University–Ajuy Campus navigate and enact sustainability through the creative use of recycled instructional resources. The patterns revealed underscore both the systemic challenges faced by faculty and their capacity for innovation, reinforcing the importance of institutional support, resource allocation, and professional development to scale these practices. These findings were supported by Edulan and Fajardo (2024), who found that out-of-field science teachers in Western Mindanao faced limited resources and inadequate training, which align with the challenges of material scarcity and professional development constraints identified in this study. Similarly, Espinola (2023) reported that the use of sustainability-oriented learning materials in Grade 8 ecology classes in the Philippines was hindered by the insufficient availability of locally sourced environmental teaching aids and inconsistent teacher preparation, underscoring the importance of both material characteristics and faculty strategies. In addition, Quimat and Picardal (2024) emphasized through a meta-analysis that teacher competence and the availability of appropriate instructional materials significantly predict successful outcomes in Education for Sustainable Development (ESD), reinforcing the role of institutional support and resource allocation.

Table 1 presents the emergent themes, subthemes, and illustrative quotations from faculty participants that capture their practices in promoting sustainable science education through the integration of recycled materials.

Table 1: Faculty Narratives on Practices for Sustainable Science Education Using Recycled Materials

Themes	Sub-Themes	Selected Quotations
Collaboration Support	Partnership	"Collaborate with some business establishments to source out high-quality materials for science class." – *Faculty 1*
Innovative Approach	Transformational Practice	"Encouraging the students to bring such recycled materials from their homes and use it on the task given to them such as activities." – *Faculty 2*
Professional Development	Mentorship and Training	"Teaching them what we learn from practical experience in our ongoing trainings and strategies regarding recyclable materials." – *Faculty 3*
Educational Innovation	Creative Pedagogical Integration	"Create a new lesson plan and activities that integrate recycled materials into science experiments, making sustainability a core component of the teaching process." – *Faculty 3*

The table is organized to showcase how faculty members operationalize sustainability through collaboration, innovation, professional growth, and pedagogical transformation. The first theme, *Collaboration Support*, highlights partnerships with external stakeholders—such as local businesses and community groups—to source recycled materials for instructional use. *Innovative Approach* reflects how faculty actively engage students by involving them in sourcing and utilizing recycled materials during class activities, thereby fostering ownership and experiential learning. *Professional Development* captures the role of mentorship and knowledge-sharing, where faculty disseminate practical insights gained from training programs and hands-on experience with sustainable materials. Finally, *Educational Innovation* underscores how faculty redesign lessons, incorporate recycled materials into science experiments, and frame sustainability as a core teaching objective rather than an add-on topic.

Taken together, the table illustrates the multifaceted efforts of faculty to embed sustainable practices into science education through collaborative, reflective, and creative approaches. These findings echo earlier literature (e.g., Morris & Johnson, 2022; Lee & Smith, 2022) showing that institutional support, partnerships, and faculty agency are key drivers of successful sustainability integration. They also suggest that such practices, when scaled, can cultivate student engagement, model responsible consumption, and help higher education institutions advance the United Nations Sustainable Development Goals.

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Recent studies in the Philippines further substantiate these themes. Duran and Mariñas (2024) found that educators' attitudes, knowledge, and institutional support are significant predictors of their intention to integrate sustainability, thereby emphasizing the critical role of professional development and robust institutional backing in driving pedagogical transformation. Espinola (2023) demonstrated that sustainability-oriented learning materials can enhance student engagement and ecological awareness, though their effectiveness is often constrained by limited local resources and varying levels of teacher preparedness. These findings echo the themes of "Innovative Approach" and "Characteristics of Materials," highlighting both the opportunities and persistent barriers in advancing sustainability in education.

Table 2 presents the key challenges faced by faculty members in integrating recycled materials into sustainable science teaching.

Table 2. Emerging Themes on Challenges Encountered by Faculty in Utilizing Recycled Materials for Sustainable Science Teaching

Themes	Sub-Themes	Selected Quotations
Limited Resources	Material Scarcity	"I can find difficulty in obtaining sufficient quantities or specific types of recycled materials." – *Teacher A*
	Resource Accessibility	"I need to gather materials, design and ensure that they align with the curriculum standard." – *Teacher D*
Time Constraints	Instructional Planning	"I need to gather materials, design and ensure that they align with the curriculum standard." – *Teacher D*

Two major themes emerged from the narratives: *Limited Resources* and *Time Constraints*. Within the theme of Limited Resources, faculty highlighted persistent issues of material scarcity, citing difficulties in obtaining sufficient or appropriate types of recycled materials for instructional use. A related subtheme, *Resource Accessibility*, reflects the challenge of ensuring that collected materials not only meet quantity needs but also comply with curriculum standards. The second theme, *Time Constraints*, underscores the additional workload faculty face when integrating recycled materials. Participants described the need to allocate extra time for sourcing, preparing, and aligning materials with learning objectives, adding layers of complexity to instructional planning.

This table illustrates the practical barriers faculty encounter when embedding sustainability into science education, pointing to the importance of institutional support in terms of time allowances, access to materials, and curriculum-aligned resources. These findings resonate with prior research (Morris & Johnson, 2022; Palinkas et al., 2015) that identifies resource scarcity and workload intensification as key impediments to faculty-led sustainability initiatives. Addressing these constraints through structured resource provision, streamlined procurement systems, and workload adjustments could strengthen faculty capacity to model sustainable practice effectively in science education.

Edulan and Fajardo (2024), in their investigation of out-of-field science teachers in Western Mindanao, similarly identified a lack of resources and insufficient training as the principal challenges faced by these educators. Participants reported limited availability of appropriate instructional materials and substantial time demands associated with lesson preparation, often compounded by minimal institutional support. These findings underscore the imperative for systemic interventions, including the allocation of dedicated time allowances, the provision of curriculum-aligned teaching resources, and the implementation of policies aimed at reducing faculty workload. Such measures are essential to facilitate the adoption and sustainability of best practices in science education.

Tupas and Matsuura (2020) examined the development of instructional visual aids from recycled materials, noting that the production of effective, curriculum-aligned resources necessitates considerable teacher creativity and significant preparation time. In a related study, Violanda, Claur, and Madrigal (2023) documented that the implementation of Education for Sustainable Development (ESD) in a

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Philippine state university was impeded by institutional and logistical barriers, such as limited access to materials and increased workload pressures, which collectively hindered the sustained advancement of faculty-led sustainability initiatives. Collectively, these studies reinforce the necessity of institutional interventions—such as providing dedicated time allowances, centralized material sourcing, and distributing curriculum-aligned resource kits—to empower faculty members to effectively model and sustain best practices in science education.

Table 3 presents the emerging themes on the use of recycled materials in sustainable science teaching in higher education, highlighting three core areas: availability, contextualization, and usability.

Table 3. Emerging Themes on Recycled Materials for Sustainable Science Teaching Practice in Higher Education

Themes	Sub-Themes	Selected Quotations
Availability	Resource Accessibility	"With a reliable supply of recyclable materials, I can confidently plan and execute lessons that integrate these resources." – *Faculty 1*
	Examples of Materials Used	"Popsicle sticks, carton boxes, chocolate containers, Styrofoam, drinking straws." – *Faculty 2* "Bond papers, used bottled water, parts of damaged appliances but some parts are still functioning." – *Faculty 3*
Contextualizatio	Localization of Instructional Materials	"Make reuse/recycle materials in providing quality education to my students through localized materials in activities using recycled materials." – *Faculty 1*
Usability	Instructional Innovation and Implementation	"It is a way to introduce students on how to utilize waste materials into a new product or innovation through the implementation of instructional materials using recycled resources. Basically, this existing concern in our environment influences me to use recycled materials." – *Faculty 1*

Faculty members consistently highlighted that ready access to recyclable materials is essential for effective lesson planning and classroom implementation. Commonly used items—such as popsicle sticks, cartons, bottles, and discarded appliance parts—served as versatile resources for hands-on science activities. Contextualization emerged as another important theme, with teachers deliberately localizing their instruction by integrating recycled materials into community-based projects and activities. This approach not only strengthens curriculum relevance but also deepens student engagement by linking classroom concepts to everyday life.

Usability was equally significant, as faculty described how recycled materials enhanced instructional innovation. By encouraging students to repurpose waste into functional learning tools or new products, educators fostered creativity, problem-solving, and resourcefulness. These practices show how recycled materials can support sustainability goals while simultaneously developing students' critical thinking and practical skills.

Overall, these findings indicate that the effective use of recycled materials in science education goes beyond mere substitution of conventional resources; it functions as a pedagogical strategy that enriches learning outcomes, cultivates environmental awareness, and models responsible consumption for students. To further strengthen these benefits, institutions can provide structured support for material sources, training on sustainable practices, and opportunities for faculty collaboration in designing context-specific, reusable learning resources.

These findings are corroborated by Espinola (2023), who observed that the use of sustainability-oriented and contextually relevant learning materials in Grade 8 ecology classes led to increased student interest and ecological awareness. However, Espinola noted that the efficacy of such materials depends on their alignment with the local context. Similarly, Tupas and Matsuura (2020) investigated the development of instructional visual aids derived from recycled marine resources in the Visayan Sea, demonstrating that locally contextualized materials can greatly enrich science instruction, albeit at the cost of increased

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demands on teacher creativity and preparation time. Furthermore, Duran and Mariñas (2024) underscored the pivotal role of educators' knowledge, attitudes, and institutional support in facilitating the integration of sustainability into higher education curricula, thereby highlighting the necessity of targeted training and robust structural support to maximize the pedagogical value of recycled resources. Collectively, these studies affirm that recycled materials function not merely as alternatives to conventional instructional resources, but as transformative pedagogical instruments capable of enhancing learning outcomes, fostering environmental consciousness, and modeling responsible consumption—provided that appropriate institutional and curricular frameworks support their integration.

5. Conclusion

This study examined the narratives of science faculty members at Northern Iloilo State University–Ajuy Campus who integrate recycled materials into their teaching as part of sustainable science education. The findings underscore that faculty members are pivotal change agents in embedding sustainability within higher education. Through creative strategies—such as forming partnerships with local businesses, involving students in material sourcing, and pursuing professional development—they were able to design innovative, contextually relevant lessons that promote environmental stewardship and align with the United Nations Sustainable Development Goals (SDG 4, SDG 12, SDG 13, and SDG 15). Despite persistent barriers—including scarcity of suitable materials, limited institutional support, and additional time demands—faculty displayed a high level of commitment and adaptability in pursuing sustainability goals. Their experiences illustrate the transformative potential of faculty agency, collaboration, and resourcefulness in advancing sustainability-focused science education. This study contributes to a deeper understanding of how recycled materials can be leveraged not merely as substitutes for traditional teaching tools but as catalysts for pedagogical innovation and environmental awareness. Universities should implement structured, ongoing training programs on sustainability education, green pedagogy, and the innovative use of recycled or localized materials. Such initiatives would equip faculty with the skills, knowledge, and confidence to deliver high-quality sustainability-focused instruction. Administrators should allocate funding, logistical assistance, and designated storage or preparation spaces to facilitate the sourcing and use of recycled materials. Streamlined access to resources can reduce the time and effort required for lesson preparation. Academic leaders should promote cross-departmental projects and communities of practice, enabling faculty to co-design sustainability initiatives, share expertise, and model collaborative problem-solving for students. Curriculum developers and policy-makers should embed sustainability principles into institutional and program-level frameworks, ensuring environmental responsibility becomes a standard and measurable component of teaching and learning. Future studies could expand the scope by including more institutions, examining diverse disciplines, or assessing the long-term effects of recycled-material-based instruction on students' environmental attitudes, scientific engagement, and civic responsibility.

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