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Community-Based Learning for Sustainable and Reverse Logistics: Building a Cross-Border Practice Community

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Abstract: *The global logistics industry faces increasing challenges related to environmental sustainability and resource management. Sustainable logistics and reverse logistics are essential concepts that help reduce environmental impact, enhance operational efficiency, and support the circular economy. However, awareness and understanding of these concepts among emerging logistics practitioners and community members remain limited. This study presents the outcomes of an online community engagement program aimed at establishing a logistics learning community focused on sustainable and reverse logistics. The program involved collaborative activities between facilitators from Ural State University of Railway Transport, Russia, and participants representing the logistics practice community. Learning outcomes were measured through pre- and post-tests, showing a significant improvement in the average score from 41.1 to 87.4, demonstrating the program's success in building practical knowledge and application of sustainable logistics. To enhance the real-world application of knowledge, the program integrated small-group discussions where participants collaboratively worked on local case studies to apply the principles learned. This initiative offers valuable insights for designing future cross-border educational outreach and international academic collaboration using digital platforms.*

Introduction

Globalization and rapid technological advancements have significantly accelerated the growth and transformation of the global logistics industry. As businesses expand across borders and supply chains become increasingly complex and

interconnected, the demand for efficient, fast, and reliable logistics solutions continues to rise. However, alongside this rapid development comes a set of pressing challenges, particularly those related to environmental sustainability. The expansion of logistics activities has led to notable increases in carbon emissions, excessive energy consumption, and the accumulation of both industrial and packaging waste. These issues not only threaten ecological balance but also raise concerns about the long-term viability of current logistics practices.

In response to these growing environmental concerns, the concept of sustainable logistics has emerged as a comprehensive and strategic approach aimed at minimizing the negative ecological footprint of logistics operations. This approach emphasizes the adoption of environmentally friendly practices, including improved energy efficiency, emission reduction strategies, the use of alternative fuels, and responsible resource and waste management [1]. Sustainable logistics integrates these principles across all facets of logistics activities from transportation and warehousing to packaging and last-mile delivery thereby encouraging more holistic and accountable supply chain management.

Simultaneously, reverse logistics has gained prominence as a complementary mechanism supporting the principles of the circular economy. Reverse logistics involves the processes required to manage product returns, facilitate repairs, enable reuse, or support recycling and remanufacturing [2]. Unlike traditional forward logistics, which focuses on moving products from producers to consumers, reverse logistics addresses post-consumption product flows, aiming to reintegrate materials into the supply chain. This not only reduces landfill waste but also contributes to cost efficiency, resource conservation, and extended product lifecycles [3]. Together, sustainable and reverse logistics form a dual foundation for environmentally responsible logistics systems.

Despite their proven benefits, the adoption and implementation of sustainable and reverse logistics practices remain significantly limited in many developing countries, including Indonesia. Several persistent challenges hinder progress in this area. These

[1] Abdullah S. Karaman, Merve Kilic, and Ali Uyar, "Green Logistics Performance and Sustainability Reporting Practices of the Logistics Sector: The Moderating Effect of Corporate Governance," *Journal of Cleaner Production* 258 (2020): 120718, https://doi.org/10.1016/j.jclepro.2020.120718; Nursery Alfaridi S Nasution and Viany Utami Tjhin, "Circular Economy and Product-Service Systems in Customer Perspective: A Systematic Literature Review," *Advances in Transportation and Logistics Research* 3, no. 0 (2020): 820–827, https://proceedings.itltrisakti.ac.id/index.php/ATLR/article/view/344.

[2] Muztoba Ahmad Khan et al., "Review on Upgradability – A Product Lifetime Extension Strategy in the Context of Product Service Systems," *Journal of Cleaner Production* 204 (2018): 1154–1168, https://doi.org/10.1016/j.jclepro.2018.08.329; Gustav Sandin and Greg M. Peters, "Environmental Impact of Textile Reuse and Recycling – A Review," *Journal of Cleaner Production* 184 (2018): 353–365, https://doi.org/10.1016/j.jclepro.2018.02.266.

[3] Laksmi Ambarwati and Emi Rusmiati, "Pertimbangan Variabel Kesadaran Stakeholder Pada Tingkat Pengembalian Produk Dalam Kerangka Kerja Sistem Dinamik Untuk Rantai Pasok Terbalik Terintegrasi," *Jurnal Teknologi dan Manajemen* 20, no. 1 (2022): 1–8; Jan Philipp Werning and Stefan Spinler, "Transition to Circular Economy on Firm Level: Barrier Identification and Prioritization along the Value Chain," *Journal of Cleaner Production* 245 (2020).

include low adoption rates of green and smart logistics technologies, insufficient infrastructure to support sustainable practices, and a regulatory environment that does not adequately incentivize or mandate environmental responsibility in logistics operations [4]. Additionally, policy frameworks often lack coherence or enforcement, further complicating the integration of sustainable approaches into national logistics systems.

The educational sector, which plays a crucial role in shaping future logistics professionals, has also not fully addressed the urgency of sustainability. In many academic and training institutions in Indonesia and similar contexts, logistics education and capacity-building programs continue to be dominated by a focus on operational efficiency and cost reduction, with environmental considerations often relegated to peripheral or elective topics. As a result, many early-career practitioners enter the workforce without a comprehensive understanding of how sustainability can and should be embedded into logistics decision-making and system design.

Furthermore, logistics education systems in many developing countries, such as Indonesia, frequently do not incorporate sustainability as a core component of their curricula. Although there is growing awareness of environmental challenges and climate-related issues, the formal educational structures tend to prioritize operational efficiency, profitability, and cost minimization over long-term environmental impacts. This limited curricular integration has resulted in a workforce that often lacks the interdisciplinary understanding required to implement sustainable logistics strategies effectively within complex supply chains.

At the international level, the comprehension and implementation of sustainable logistics and reverse logistics also show significant gaps. While sustainability has become a global agenda, especially through frameworks like the UN Sustainable Development Goals (SDGs), the actual translation of sustainability principles into logistics education and practice remains uneven. For instance, [5] research highlight that while many institutions acknowledge the importance of sustainability, they often lack the tools, pedagogical strategies, and institutional incentives to embed these concepts meaningfully into logistics training. This disconnects between awareness and practical understanding presents a major barrier to progress.

On a global scale, the depth of understanding regarding sustainable logistics and

[4] Erry Sunarya et al., "Antecedents of Green Supply Chain Collaborative Innovation in Tourism SMEs: Moderating the Effects of Socio-Demographic Factors," *Uncertain Supply Chain Management* 11, no. 1 (2023): 161–168.

[5] Nursery Alfaridi Nasution et al., "The Effect of Institutional Pressure on Circular Economy Performance in Courier Express Parcel in Indonesia," *International Journal of Sustainable Development and Planning* 19, no. 5 (2024): 1795–1804; Julian Kirchherr et al., "Barriers to the Circular Economy: Evidence From the European Union (EU)," *Ecological Economics* 150, no. December 2017 (2018): 264–272, https://doi.org/10.1016/j.ecolecon.2018.04.028; Nina Tura et al., "Unlocking Circular Business: A Framework of Barriers and Drivers," *Journal of Cleaner Production* 212 (2019): 90–98.

reverse logistics remains uneven. In many countries, including Russia, awareness of environmental issues is growing, yet early-career logistics practitioners and emerging professionals often lack the practical knowledge and applied skills needed to implement sustainability strategies effectively. Research indicates that these practitioners, while increasingly exposed to sustainability rhetoric, still face difficulties in translating theoretical knowledge into practical applications within real-world logistics systems. This gap may be attributed in part to limited access to up-to-date international learning resources, restricted engagement with global case studies, and insufficient exposure to best practices from other nations.

Emerging logistics professionals in Russia represent a pertinent case in this context. Although awareness of sustainability is rising, many still struggle with applying sustainable logistics and reverse logistics principles in practical, real-world contexts. This gap can be attributed to several factors, most notably the limited access to international learning resources, outdated training materials, and a lack of direct exposure to global best practices. These challenges inhibit practitioners' ability to gain a comparative understanding of sustainability in logistics, especially when contrasted with more developed regions where circular economy principles and low-carbon logistics solutions are more deeply embedded into policy and practice.

As [6]previous studies argue, sustainability knowledge without actionable pathways tends to remain at the level of abstract idealism. [7] Further emphasize that genuine progress toward sustainable value creation requires not only conceptual education but also exposure to interdisciplinary problem-solving and real-case applications elements that are often missing from traditional logistics education models in both Russia and Indonesia.

The selection of facilitators from the Ural State University of Railway Transport in Russia to support this program is therefore highly relevant. By collaborating in building a logistics learning community, these facilitators contributed expertise and international perspective to enhance participants' understanding. The university represents a key institution for logistics education in Russia, particularly in the context of rail transportation, which plays a significant role in the country's domestic and international freight movement. According to the World Bank's Logistics Performance Index (LPI) in 2023, Russia ranked 88th out of 139 countries, with an overall score of 2.6 [8]. This relatively low ranking suggests that trade logistics in Russia is perceived as underperforming compared to global standards. Given Russia's strategic importance in transcontinental logistics especially within initiatives like China's Belt and Road Initiative efforts to enhance logistics education, particularly in sustainability, are both timely and

[6] Kirchherr et al., "Barriers to the Circular Economy: Evidence From the European Union (EU)."
[7] Tura et al., "Unlocking Circular Business: A Framework of Barriers and Drivers."
[8] World Bank, "Connecting to Compete 2023: Trade Logistics in an Uncertain Global Economy," *The Logistics Performance Index and Its Indicators* (2023): 90.

necessary.

By equipping participants with a deeper and more applied understanding of sustainable logistics and reverse logistics, there is potential to not only improve local practices but also strengthen the country's integration into global sustainable supply chains. As future professionals and policymakers, these emerging practitioners will play a pivotal role in transforming logistics systems to align with environmental, social, and economic sustainability goals.

At the same time, the development of digital technologies and online learning platforms has opened new possibilities for cross-border knowledge exchange. Online education enables institutions to reach diverse learner populations regardless of physical location, reducing barriers to participation and promoting inclusive learning environments. These platforms also allow for the delivery of interactive, multidisciplinary, and real-time educational experiences, often incorporating multimedia content, live discussions, and collaborative problem-solving activities. As such, online education has become an increasingly viable strategy for delivering international community engagement programs focused on sustainability.

In this context, the present study evaluates the outcomes of an online international outreach program designed to strengthen a logistics learning community in sustainable and reverse logistics. Community participants engaged in a structured series of online sessions that included theoretical instruction, group discussions, and applied case analysis. The primary objective was to build participants' conceptual knowledge, promote intercultural learning, and encourage the application of sustainability principles within logistics planning and decision-making.

To assess the program's effectiveness, the study employed a quantitative pre-test and post-test experimental design. This approach enabled the researchers to measure changes in participants' understanding before and after their involvement in the activity. In doing so, the study not only provides empirical evidence regarding the educational impact of online community engagement but also contributes to the ongoing discourse on the role of higher education in advancing sustainability within global logistics systems.

Method

This study aims to measure the change in participants' understanding of sustainable logistics and reverse logistics after participating in an online community service activity. The research uses a mixed-method approach, combining a quantitative pre-test and post-test experimental design with qualitative Participatory Action Research (PAR) and Community-Based Research (CBR) components. By incorporating PAR and CBR, this study enables deeper engagement with local communities, where participants not only acquire theoretical knowledge but also apply sustainability principles to real-

world logistics challenges.

The activity targeted a logistics learning community, which was collaboratively established as part of the program through a joint initiative between the authors and facilitators from Ural State University of Railway Transport, Russia. The community consisted of 61 participants, including early-career logistics practitioners, logistics trainees, and individuals from various professional and community backgrounds with an interest in sustainable logistics. These participants were independent from higher education institutions and were engaged through industry networks, logistics communities, and professional associations. The logistics learning community was intentionally formed to simulate real-world collaborative environments and serve as the primary focus of the community engagement program.

The activity was conducted online using the Zoom platform and a Learning Management System (LMS), allowing direct interaction between participants and facilitators. It started with an introduction to the basic theories of sustainable logistics and reverse logistics, followed by small group discussions on case studies from various countries. This aimed to explore the application of these concepts in local contexts, ensuring that participants could contextualize sustainability issues and apply them in real-world situations. Participants were also invited to develop circular logistics solutions based on the challenges faced in their respective countries to identify local resources that could contribute to sustainable practices.

At the end of the activity, a post-test was conducted to evaluate the participants' understanding, along with feedback collection to assess the effectiveness of the activity. Qualitative feedback was analyzed using thematic analysis to identify common themes around the application of sustainable logistics concepts in local contexts. Data analysis was performed by comparing pre-test and post-test scores to measure how participants' understanding had improved. This study is expected to provide insights into the effectiveness of online community service in enhancing the logistics learning community's understanding of sustainable logistics and reverse logistics, as well as its contribution to the development of global sustainable logistics education.

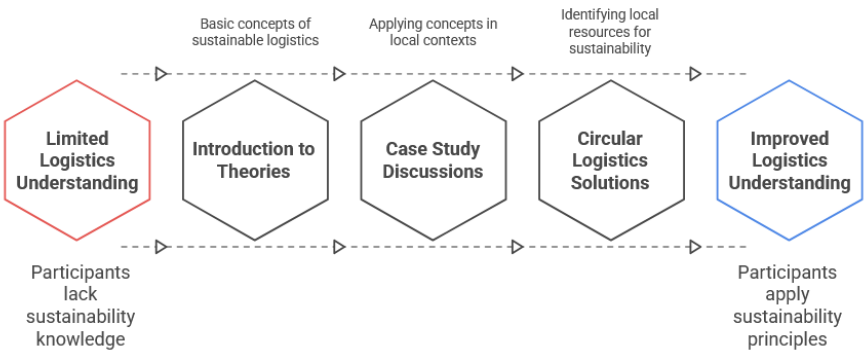

Figure 1. Enhancing Logistics Understanding via Online Community

Result

The authors conducted both a pre-test and a post-test to evaluate the extent of knowledge improvement achieved by members of the logistics learning community the primary focus of this community engagement program following the implementation of the online community-based learning program. Based on the collected data, 56% of participants identified as female, 40% as male, and 4% preferred not to disclose their gender, reflecting the diversity of the logistics learning community involved in this program. In total, 61 participants were actively involved in the logistics learning community throughout the program. This community included individuals preparing for careers in logistics, early-stage professionals, and logistics trainees from various regions. By engaging a diverse group of participants with different backgrounds and perspectives, the program ensured that the knowledge gained and solutions developed were relevant to real-world logistics challenges and directly applicable beyond the academic setting.

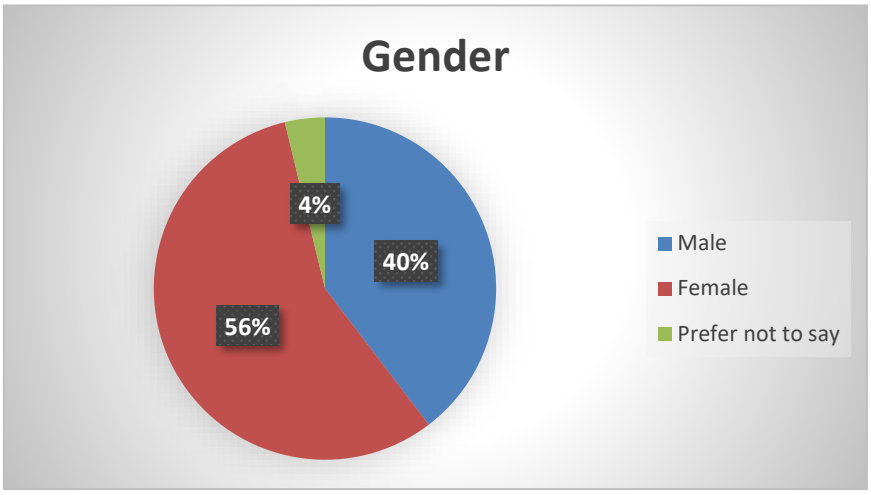

Figure 2. Responses by Gender

The findings of this study indicate a significant improvement in the logistics learning community's understanding of sustainable logistics and reverse logistics, as demonstrated by the increase in pre-test and post-test scores, as shown in Figure 3. Based on the data obtained, there were also variations in average scores across different gender groups. Overall, the male group achieved an average score of 90.63, while the female group recorded a slightly lower average score of 86.17. Meanwhile, the "prefer not to say" group demonstrated a notably higher average score of 100.

These differences in scores may reflect variations in how community members engage with the subject matter, highlighting the importance of accommodating diverse learning styles and approaches. While the average score for male participants is slightly higher than that of females, this does not necessarily indicate differences in ability or potential. Rather, it may be influenced by factors such as learning strategies, subject matter interest, or mindset. The exceptionally high score of the group that preferred not to disclose gender may also reflect unique factors, such as comfort level during testing or

response patterns.

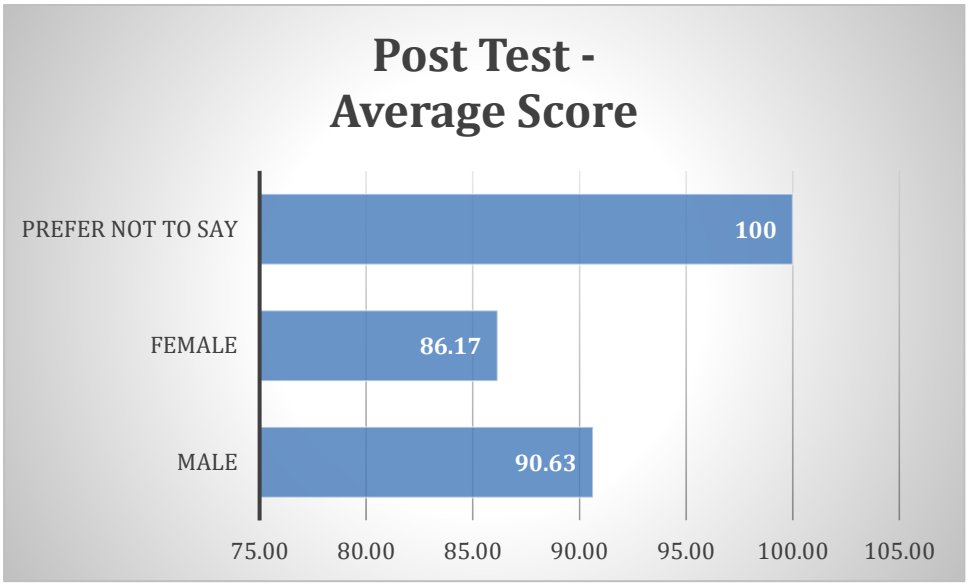

Figure 3. Average Post-Test Score - by Gender

In the context of logistics and sustainability education, certain concepts are often misunderstood or misapplied by participants, particularly within the logistics learning community, when distinguishing between systems or programs that aim to enhance environmental sustainability. Two common questions that frequently generated errors in responses illustrate these misunderstandings: (1) the definition of a closed-loop system in logistics, and (2) identifying a company that has successfully implemented a global electronic waste recycling program.

One of the most common misconceptions observed relates to the definition of a closed-loop system. When asked, "Which best describes a closed-loop system in logistics?", participants frequently selected the answer, "A system where logistics operations only focus on production," which is incorrect. The correct definition is "A system where used products are returned, remanufactured, and reintroduced into the market."

This misconception likely arises from a lack of clarity between closed-loop systems and traditional linear production models. A closed-loop system is integral to circular economy principles, emphasizing the return of used products for recycling, remanufacturing, or refurbishing, thereby reducing waste and extending resource lifecycles. In contrast, focusing solely on production aligns with open-loop systems, where products move in a one-way flow from creation to consumption without incorporating product return or reuse.

This confusion stems from participants' tendency to associate logistics with traditional production and distribution, leading to limited understanding of the role of reverse logistics and product return in sustainable supply chain management. This highlights the need for deeper education on the full scope of logistics systems beyond production-focused operations, particularly within collaborative community-based learning environments.

These findings align with previous research suggesting that technology-based education, particularly through online learning, serves as an effective medium for enhancing comprehension of complex and abstract logistics concepts 9. In this study, the online community engagement activity implemented through the Zoom platform and supported by a Learning Management System (LMS) proved effective in facilitating direct interaction and collaborative engagement between facilitators and members of the logistics learning community, despite geographical barriers.

The activity was structured to introduce foundational theories of sustainable and reverse logistics, followed by interactive small-group discussions of real-world case studies from multiple countries. Furthermore, participants collaboratively designed circular logistics solutions tailored to sustainability challenges within their respective contexts, thereby fostering practical application and critical thinking within the community.

The use of a quantitative experimental design, involving pre-test and post-test assessments, enabled the researchers to systematically measure changes in participants' understanding. The statistically significant improvement observed in post-test results indicates that the activity effectively supported knowledge acquisition and concept internalization.

These findings underscore the pedagogical value of online community engagement programs in international education, particularly in fields such as sustainable logistics that require both theoretical grounding and contextual adaptability. Moreover, this study contributes to the growing body of literature on global logistics education by demonstrating that well-structured, technology-enabled learning interventions can overcome spatial limitations while enhancing the logistics learning community's cognitive and reflective engagement with sustainability issues.

[9] Barbara Means et al., "Evaluation of Evidence-Based Practices in Online Learning," *Structure* (2009): 66, www.ed.gov/about/offices/list/opepd/ppss/reports.html.

Discussion

Sustainable logistics and reverse logistics are still considered relatively new fields for many practitioners and academics across different countries. This novelty often results in varying levels of understanding and implementation, particularly in diverse local contexts. Therefore, interactive and technology-driven approaches are essential to support the comprehension and practical application of these concepts within specific regional and cultural frameworks. In this context, an online community-based engagement program was designed to provide members of a logistics learning community with opportunities not only to gain theoretical knowledge but also to apply it collaboratively through group discussions and real-world case studies. These case studies were carefully selected to reflect the unique challenges and opportunities within the contexts represented by community participants, ensuring that the learning experience remained both contextually relevant and impactful [10][11][12].

The application of sustainable logistics and reverse logistics concepts within local contexts, as exemplified in the group discussions, is critical, given that logistics and supply chain management are highly dependent on local factors such as infrastructure, government policies, and consumer behavior. Although sustainable logistics is a global concept, its implementation must be tailored to the specific conditions and challenges faced by each country. By incorporating discussions on local implementation, the program not only strengthened the analytical capabilities of the logistics learning community but also encouraged participants to contextualize sustainability principles according to their respective national priorities, cultivating more grounded and culturally sensitive insights into global challenges.

By delivering concepts of sustainable logistics and reverse logistics, Indonesia has contributed to expanding access to sustainability-related knowledge in the logistics field, in alignment with the global goals of SDG 4 (Quality Education) and SDG 17 (Partnerships for the Goals). This program demonstrates Indonesia's proactive role in global education diplomacy, leveraging digital platforms to extend its educational outreach and promote collaborative learning across borders. It serves as a concrete model of how higher education can play a role in advancing international partnerships to achieve shared sustainability objectives and sets an example for other institutions aiming to localize the implementation of SDGs through education and engagement.

While online education offers substantial advantages in terms of accessibility and flexibility, it continues to face major challenges in ensuring participants' active

[10] Barbara Borusiak et al., "Towards Building Sustainable Consumption: A Study of Second-Hand Buying Intentions," *Sustainability (Switzerland)* 12, no. 3 (2020): 1–15.

[11] Means et al., "Evaluation of Evidence-Based Practices in Online Learning."

[12] Brittany Brand, Margaret Sass, and Kara Brascia, "Active Learning through Community Outreach: A Case Study of Service-Learning in a Natural Hazard, Vulnerability and Risk Class," *Higher Learning Research Communications* 9, no. 2 (2019).

engagement and the practical application of acquired knowledge. In this context, the findings of the study show that although comprehension scores improved, there remains a gap between theoretical understanding and the ability to translate that knowledge into actionable strategies in professional settings. This suggests that beyond the delivery of content, pedagogical approaches must incorporate elements such as follow-up mentoring, simulated problem-solving, and experiential learning. Therefore, long-term evaluation measures such as tracking alumni's application of knowledge in workplace practices or community projects are essential to assess the sustained impact of such programs and refine future instructional designs.

Conclusion

Overall, the results of this study reinforce existing literature that highlights the effectiveness of online education in promoting a deeper understanding of complex, globally relevant issues, particularly those related to sustainable logistics and reverse logistics [13]. The online community engagement program implemented in this study not only facilitated knowledge transfer but also enabled international collaboration, cross-cultural learning, and critical reflection on sustainability challenges within diverse national contexts. By integrating synchronous and asynchronous learning tools, the program provided a flexible yet structured environment in which members of the logistics learning community could actively engage with theoretical content, analyze practical case studies, and co-develop context-specific circular logistics solutions.

Importantly, this initiative illustrates that community service activities delivered through digital platforms can transcend geographical limitations and support meaningful, globally oriented educational experiences. Such models are particularly valuable in the context of contemporary higher education, where there is an increasing emphasis on equipping participants of logistics learning communities with competencies related to global citizenship, environmental stewardship, and systems thinking.

Furthermore, the findings provide a strong empirical basis for the future development and institutionalization of online-based community service frameworks within academic programs. These frameworks not only enhance participant learning outcomes but also contribute to broader societal objectives by aligning with the principles of the United Nations Sustainable Development Goals (SDGs), particularly those related to quality education (Goal 4), sustainable industry and infrastructure (Goal 9), and responsible consumption and production (Goal 12).

In addition to theoretical learning, this study emphasizes the importance of local community engagement through Participatory Action Research (PAR) and Community-Based Research (CBR). By working alongside local communities to develop real-world

[13] Borusiak et al., "Towards Building Sustainable Consumption: A Study of Second-Hand Buying Intentions."

solutions, members of the logistics learning community supported by facilitators from Ural State University were able to translate their theoretical knowledge into tangible, community-driven initiatives. This hands-on approach ensured that the solutions were not only academically relevant but also grounded in the local context, using Asset-Based Community Development (ABCD) principles to leverage local resources.

This study also highlights the value of integrating local knowledge and resources into educational programs, creating a bridge between local contexts and global sustainability practices. Through the application of ABCD, participants collaborated with local communities to identify local strengths and assets, ensuring that the solutions were sustainable and applicable in the long term. These solutions contributed not only to the learning process within the logistics learning community but also to addressing real-world challenges faced by the communities involved.

To ensure the sustainability of the program's impact, follow-up evaluations will be conducted to measure the long-term effects of the solutions developed by the logistics learning community and their continued application in local contexts. This follow-up will provide evidence of how the knowledge gained from the program has been implemented, ensuring that the contributions made by members of the logistics learning community have a lasting, positive impact on the community and are adaptable to evolving challenges.

Thus, this study offers a compelling case for universities and educational institutions to consider online community engagement as a strategic tool for expanding access, fostering intercultural collaboration, and advancing sustainability education on a global scale. By connecting local knowledge with global sustainability efforts, institutions can not only prepare members of the logistics learning community to become more effective professionals but also empower them to contribute meaningfully to global challenges, such as climate change, resource conservation, and social equity.

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