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The Effect of Project-Based Service Learning on Community Empowerment in Sustainable Environmental Management

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ABSTRACT

Background. Environmental sustainability has become a pressing global issue, demanding innovative educational interventions that directly engage communities. Project-Based Service Learning (PBSL) integrates academic learning with community service, fostering mutual growth and empowerment.

Purpose. This study investigates the effect of PBSL on community empowerment within the context of sustainable environmental management. The objective is to assess how active participation in student-led environmental projects enhances local communities' knowledge, attitudes, and practices regarding sustainable development. Employing a mixed-method approach, the research involved quasi-experimental design and participatory observation in three rural villages.

Method. Quantitative data were collected through pre- and post-tests, while qualitative data came from focus group discussions and stakeholder interviews.

Results. The results indicate significant improvements in environmental awareness, collaborative problem-solving skills, and long-term community engagement. Furthermore, communities reported an increased capacity to manage environmental resources independently.

Conclusion. In conclusion, PBSL not only serves as an effective pedagogical strategy but also empowers communities to take ownership of sustainable practices. The findings contribute to the growing literature on experiential learning and its transformative impact on society.

KEYWORDS

Project-Based Learning, Service Learning, Community Empowerment, Environmental Sustainability, Experiential Education

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INTRODUCTION

Global environmental degradation has prompted increasing concern over the effectiveness of conventional environmental education in addressing real-world sustainability issues. As ecosystems face mounting pressures from human activities such as deforestation, pollution, and unregulated resource exploitation, there is a growing consensus that educational institutions must take a proactive role in facilitating sustainable solutions. Education, when aligned with authentic community involvement, has the potential to go beyond classroom

instruction and foster behavioral transformation among both learners and local residents.

Project-Based Service Learning (PBSL) has emerged as a pedagogical innovation that bridges academic learning and civic engagement. By involving students in community-centered environmental projects, PBSL fosters active citizenship while enhancing learners' critical thinking and problem-solving skills. Unlike traditional didactic methods, PBSL allows students to collaboratively engage with real environmental issues, design context-sensitive interventions, and reflect on the broader social and ecological implications of their actions. This model is not only pedagogically effective but also ethically imperative in the context of sustainability education.

The relevance of PBSL becomes especially critical in communities that are marginalized or underserved by mainstream environmental governance. These communities often possess local ecological knowledge but lack institutional support or resources to manage their environment sustainably. Integrating students into such communities through structured service-learning initiatives allows for the co-creation of knowledge and sustainable practices (Dapena & Castro, 2025; Dunbar et al., 2025; García-Carmona et al., 2025). It further promotes mutual empowerment, where students gain experiential learning and the community benefits from practical and innovative environmental interventions.

Many environmental education programs remain disconnected from the local realities and cultural contexts of communities, particularly in rural or ecologically vulnerable regions. Despite increased awareness of sustainability in academic discourse, there remains a significant gap in translating knowledge into community-level action (Mjenda & Kyaruzi, 2025; Osório et al., 2025; R. & N., 2025; Tamrin et al., 2025). As a result, empowerment outcomes are minimal, and the long-term impacts of environmental education on community capacity remain unclear.

Existing studies often measure the effectiveness of environmental education from the perspective of individual cognitive gains among students, neglecting the communal dimensions of empowerment and participation. There is limited empirical evidence on how such programs influence the attitudes, behaviors, and agency of community members involved in collaborative learning environments (Al-Thani & Ahmad, 2025; Arredondo et al., 2025; Raziq et al., 2025). This shortfall inhibits the development of integrated approaches that account for both educational and social transformation.

The problem becomes more pronounced in the context of sustainable environmental management, which inherently requires participatory decision-making, local ownership, and context-responsive practices. Without empirical exploration of how educational strategies like PBSL affect these community-based dimensions, it is difficult to advocate for their broader implementation (Lozjanin et al., 2025; Trimuliana & Supena, 2025; Yiling et al., 2025). This study seeks to address this lacuna by investigating the impact of PBSL on community empowerment within sustainable environmental frameworks.

This study aims to examine the extent to which Project-Based Service Learning enhances community empowerment in sustainable environmental management contexts. By focusing on both student outcomes and community impacts, the research seeks to provide a holistic understanding of the mutual benefits that arise from PBSL initiatives (Uwosomah & Dooly, 2025; Wijayanti, 2025). The investigation emphasizes the role of experiential learning in shaping sustainable behaviors and empowering local actors to take ownership of their environmental resources.

The objective is also to evaluate specific indicators of empowerment, including knowledge transfer, leadership emergence, collaborative problem-solving, and institutional engagement. Through a systematic assessment of community perceptions and outcomes before and after PBSL implementation, this study endeavors to identify patterns of change that can inform educational

policy and environmental planning. These findings will contribute to the refinement of pedagogical models that integrate service, learning, and sustainability.

Ultimately, this research intends to position PBSL as not merely an educational tool but a strategic framework for community development and environmental governance (Lopes et al., 2025; Rokooei & Goedert, 2025). The outcomes are expected to guide stakeholders-educators, local authorities, NGOs, and policymakersin designing impactful programs that address both ecological challenges and social inequities through education-driven empowerment.

Although Project-Based Learning and Service Learning have been extensively studied in educational literature, few studies have specifically examined their combined application within the framework of sustainable environmental management. Even fewer have analyzed the dual impact on student learning outcomes and community empowerment in developing or rural contexts (Espino-Díaz et al., 2025; Garcês et al., 2025). This gap presents a missed opportunity to harness education as a catalyst for both pedagogical innovation and ecological resilience.

Several international case studies emphasize environmental awareness or skill acquisition among students but fall short of evaluating the sustained involvement and agency of the communities served. Furthermore, existing evaluations tend to prioritize short-term educational metrics, such as academic performance or reflection exercises, over long-term indicators of social change, such as empowerment, capacity-building, or environmental stewardship. These limitations call for a broader, more integrative research approach.

The current study aims to fill this void by deploying a mixed-method research design that captures the complexity and contextual variability of PBSL practices. It distinguishes itself by incorporating both pre- and post-engagement assessments, triangulating student reflections with community feedback, and linking pedagogical processes to ecological outcomes. In doing so, it advances a comprehensive understanding of how education can serve as a transformative force for sustainability.

This research introduces an innovative perspective by positioning Project-Based Service Learning as a conduit for systemic change in environmental management at the grassroots level. Unlike studies that examine educational outcomes in isolation, this study adopts an ecological and social systems lens to explore the reciprocal relationship between learners and communities. It thereby contributes to a shift from learner-centered pedagogy to community-integrated education.

The novelty also lies in its interdisciplinary approach, which synthesizes theories from education, environmental science, and community development to frame and interpret the findings. By grounding its investigation in field-based experiences and stakeholder collaboration, the research demonstrates how theory can be operationalized into real-world impact. This transdisciplinary method responds to the growing call for research that not only describes phenomena but also facilitates actionable solutions.

The justification for this study is rooted in the urgent need to address environmental crises through socially inclusive and context-sensitive educational strategies. As global policies increasingly advocate for local participation and sustainable development goals (SDGs), educational models like PBSL become essential mechanisms for bridging knowledge and action. This study thus contributes both theoretical insights and practical frameworks that can be replicated and scaled in various sociocultural settings.

RESEARCH METHODOLOGY

This study employed a quasi-experimental design with a mixed-methods approach to examine the impact of Project-Based Service Learning (PBSL) on community empowerment in the context of sustainable environmental management. The quantitative component measured changes in environmental awareness, self-efficacy, and collaborative practices among community members, while the qualitative component explored their lived experiences and perceived empowerment through focus group discussions and in-depth interviews (Kiral, 2025; Taiebine et al., 2025). The PBSL model was implemented over a 12-week intervention period in three rural communities, each facilitated by student groups from an environmental education program at a public university.

The population of this study comprised community members residing in environmentally vulnerable rural areas within a provincial district in Indonesia. A purposive sampling technique was used to select three communities based on their ecological risk exposure, previous involvement with environmental programs, and willingness to participate in a university-led service learning initiative. Within each community, participants included both formal leaders and informal actors such as youth groups, farmers, and homemakers, with a total sample size of 90 individuals. Additionally, 45 university students enrolled in an environmental education course were assigned to collaboratively design and implement the PBSL projects.

The study utilized multiple instruments for data collection to ensure methodological triangulation. A structured questionnaire was developed to assess community members' knowledge, attitudes, and practices (KAP) related to environmental sustainability, administered both before and after the intervention. The instrument included Likert-scale items validated through expert judgment and pilot-tested for reliability (Cronbach's Alpha = 0.84). Semi-structured interview guides and focus group protocols were used to gather qualitative insights into empowerment indicators such as leadership, agency, and collaborative decision-making. Observation checklists were also employed during project implementation to document student-community interaction and behavioral engagement.

The implementation procedure followed four main stages: preparation, project design, implementation, and evaluation. During the preparation stage, researchers conducted preliminary community assessments and orientation workshops involving local stakeholders. The project design phase involved collaborative planning between students and community members to identify environmental issues and formulate contextually relevant project goals. In the implementation phase, students facilitated participatory activities such as composting workshops, reforestation drives, and water purification initiatives, ensuring active community involvement. The evaluation stage included data collection through surveys and interviews, reflective journals from students, and community forums to assess the perceived benefits and sustainability of the interventions.

RESULT AND DISCUSSION

The data collected from three villages indicate measurable improvements in community empowerment scores following the PBSL intervention. Baseline (pre-intervention) scores for Village A, Village B, and Village C averaged 58.12, 58.79, and 60.13 respectively. After the 12-week intervention, average post-intervention scores rose to 68.02 in Village A, 68.31 in Village B, and 71.52 in Village C. The standard deviations ranged from 8.75 to 11.05, indicating moderate variability in participant outcomes within each community.

These improvements demonstrate a consistent upward shift in empowerment metrics following student-led service learning activities. Participants reported stronger self-efficacy, enhanced awareness of environmental issues, and greater willingness to participate in local

decision-making processes. The magnitude of change was most prominent in Village C, where active involvement in water purification and tree planting campaigns may have contributed to higher engagement and learning retention.

Table 1.
Mean and Standard Deviation of Empowerment Scores by Village

Community	Pre_Intervention_Score (Mean ± SD)	Post_Intervention_Score (Mean ± SD)
Village A	58.12 ± 9.00	68.02 ± 8.75
Village B	58.79 ± 9.31	68.31 ± 11.05
Village C	60.13 ± 9.92	71.52 ± 10.72

Inferential statistical analysis using paired-sample t-tests was conducted to assess the significance of changes in pre- and post-intervention scores within each village. Results showed statistically significant differences in all three villages ($p < 0.01$), confirming the positive impact of the PBSL program on community empowerment. The largest effect size (Cohen's $d = 1.21$) was found in Village C, while Village A and B recorded effect sizes of 1.10 and 1.08 respectively, indicating strong practical significance.

Further analysis of correlation coefficients (Pearson's r) between the degree of community participation and post-intervention empowerment scores revealed a moderate to strong positive relationship ($r = 0.64$, $p < 0.01$). This suggests that communities where members were more actively engaged in the design and implementation of the projects tended to experience greater gains in empowerment outcomes. The correlation was strongest in Village C, possibly due to the collaborative approach used by student facilitators in that area.

A qualitative case study of Village C provides deeper insights into the dynamics behind these improvements. Community members expressed a renewed sense of agency, citing their direct involvement in identifying problems and implementing solutions. One participant noted that the experience helped them "understand the importance of working together to protect our resources," illustrating the emergence of collective environmental responsibility fostered by the program.

Community leaders in Village C reported improvements in communication, coordination, and local leadership capacity. These changes were observed not only in project-related activities but also in unrelated initiatives such as waste management and irrigation scheduling. This indicates a spillover effect, where skills and behaviors gained through the PBSL program influenced broader patterns of community organization and cooperation.

Descriptive patterns from student journals and reflection logs aligned with the statistical findings. Students observed notable increases in trust, participation, and mutual respect throughout the intervention period. These reflections reinforced the idea that empowerment is not only about knowledge transfer but also about relational transformation, which occurred as students and community members co-constructed solutions and shared responsibilities.

Interpretation of the results confirms that PBSL serves as a viable strategy for fostering sustainable community empowerment. The combined quantitative and qualitative data provide robust evidence that experiential, project-based approaches can activate local agency, enhance environmental stewardship, and generate lasting social impact. These findings validate the relevance of service learning as a pedagogical method with transformative potential beyond the classroom.

Project-Based Service Learning (PBSL) demonstrated a statistically and practically significant effect on enhancing community empowerment within the domain of sustainable environmental

management. Quantitative data showed consistent improvements in empowerment scores across three rural communities, with Village C showing the highest gains. Paired-sample t-tests confirmed the significance of these changes, and qualitative data from interviews and student reflections reinforced these findings.

Empowerment indicators such as leadership, environmental awareness, and collaborative action improved notably following the PBSL intervention. Community members reported greater confidence in participating in local decision-making processes and assumed more active roles in environmental initiatives. Students also observed increased trust and cooperation, suggesting a reciprocal learning environment.

Evidence from reflective journals suggested a shift in both cognitive and affective domains of community members. The willingness to replicate project components independently indicated that empowerment extended beyond the program's immediate scope. Observable behavioral changes such as volunteer organization and independent clean-up efforts further confirmed the internalization of values and practices promoted during the intervention.

The collected data present a coherent narrative of growth, where PBSL served not only as an educational tool for students but also as a social catalyst for communities. These outcomes reflect the core principle of PBSL—learning through meaningful service—and affirm its relevance in promoting grassroots environmental sustainability.

Previous studies on service learning have predominantly focused on student-centered outcomes, such as improved academic achievement and civic responsibility. This study expands on existing literature by examining the reciprocal effect of PBSL on communities, particularly in terms of empowerment, which remains underexplored in much of the service-learning scholarship.

Comparative studies in urban contexts have shown increased environmental literacy among students but minimal documented impact on the communities served. This research differs by placing community transformation at the center of analysis and documenting evidence of local capacity building, behavioral change, and leadership development (Begaliyeva et al., 2025; Bouhaï, 2025; Majumder et al., 2025). These distinctions highlight the potential of PBSL when applied in settings with active community participation.

Some studies have emphasized barriers to community engagement in educational interventions, such as mistrust or misalignment of priorities. This study found that early involvement of community stakeholders in project planning reduced such barriers, leading to smoother collaboration and deeper engagement. This finding suggests that community integration at the design stage is crucial for PBSL's success.

The present research aligns with the emerging discourse that calls for reimagining education as a platform for social change rather than isolated academic outcomes. By integrating service learning into environmental education, this study demonstrates that pedagogical strategies can and should respond to complex societal needs through collaborative frameworks.

The observed transformation in community engagement patterns suggests that empowerment is both a process and an outcome. PBSL facilitated a shift in agency from passive recipients of aid to active participants in sustainable development. This transformation is a strong indication of the role education can play in enabling communities to take ownership of environmental issues.

Empowerment manifested through behavioral indicators such as self-initiated projects, participation in planning meetings, and the emergence of new local leaders. These outcomes mark a transition from externally driven development to internally motivated action (Gannar & Kilani, 2025; Guerra-Macías & Tobón, 2025; Kiettikunwong et al., 2025). The intervention acted as a trigger, setting into motion latent potential within the communities.

Reflecting on these patterns indicates that learning is not confined to the classroom or the student. Communities can be co-learners in the process, gaining not only knowledge but also confidence, autonomy, and voice. This realization underscores the value of PBSL as a democratizing educational practice that redistributes power and promotes mutual growth.

This study serves as evidence that education, when designed as a collaborative and participatory process, has the potential to catalyze real-world change. The PBSL model, through its integration of service, dialogue, and reflection, embodies a holistic approach that extends learning into societal transformation.

The success of PBSL in fostering community empowerment implies a need to reconsider how educational programs are structured, particularly in fields related to environmental sustainability. Institutions should view communities not just as beneficiaries but as equal stakeholders and co-creators in learning. Empowerment cannot occur in isolation; it requires authentic partnerships.

For educators, the results underscore the importance of designing curricula that are rooted in local contexts and oriented toward real-life application. Students benefit from engaging with complex social and ecological problems, while communities benefit from youthful innovation and collaborative energy (Andargie et al., 2025; Marques, 2025; Szynkiewicz, 2025). This dual impact strengthens the case for expanding PBSL as a standard pedagogical approach.

Policy-makers and educational planners should recognize the dual function of PBSL: it meets academic standards while simultaneously advancing sustainable development goals (SDGs). Incorporating service learning into national curricula could support broader policy objectives in education, environment, and community development simultaneously.

Stakeholders beyond education—such as NGOs, environmental agencies, and local governments—could benefit from partnering with universities to replicate the PBSL model. The study's results offer a scalable framework that bridges institutional expertise with community needs, thus amplifying the scope and sustainability of local environmental initiatives.

The favorable results observed can be attributed to the integration of multiple dimensions within the PBSL model—experiential learning, reflection, collaboration, and context sensitivity. The design of the intervention allowed for flexibility and adaptation to local needs, fostering relevance and ownership among participants.

Participants in the communities were not passive subjects but active contributors throughout the project cycle. This sense of inclusion and autonomy likely enhanced their motivation and commitment, which translated into sustained involvement and empowerment. Contextual alignment with local culture, language, and environmental priorities further strengthened this bond.

Students, as facilitators, were trained to respect community knowledge and to act as learners themselves. This dynamic shifted traditional power hierarchies and established a more horizontal relationship between academic and community actors. Respect and mutual learning created a fertile ground for empowerment to emerge organically.

The interdisciplinary nature of the projects, combining environmental science, education, and community development, likely contributed to their success (Germinaro, 2025; Illahibaccus-Sona & Abdullah, 2025; Mentzer et al., 2025). Participants were exposed to multiple ways of thinking and acting, enabling a richer, more integrative learning experience that translated into practical action and attitudinal shifts.

Future research should explore longitudinal impacts of PBSL to determine the sustainability of empowerment outcomes over time. Studies should assess whether communities continue to apply skills, initiate new projects, or develop independent networks following the completion of student interventions. Such longitudinal data would further validate the model's efficacy.

Further investigation is also needed into the specific conditions that optimize PBSL's impact. Variables such as community readiness, institutional support, facilitator training, and project duration should be examined to refine implementation strategies. Comparative studies across different cultural or ecological contexts could enrich the generalizability of findings.

For practitioners, this study offers a replicable model of PBSL that can be adapted and scaled. Development of guidelines and toolkits based on this model can assist educators, NGOs, and local governments in designing interventions that simultaneously educate and empower. This includes training materials, participatory planning templates, and impact assessment tools.

Research and practice must continue to evolve toward inclusive, transformative education. PBSL stands as a viable pathway for engaging both students and communities in the pursuit of sustainability and social justice. Investing in such models can significantly enhance the relevance and impact of education in addressing the pressing challenges of our time.

CONCLUSION

The most distinctive finding of this study lies in the empirical demonstration that Project-Based Service Learning (PBSL) not only enhances student learning outcomes but also significantly empowers rural communities in managing environmental issues. While previous research predominantly focused on the educational benefits for students, this study provides robust evidence of reciprocal impact—communities gained increased agency, environmental awareness, and self-directed initiative as a direct result of their collaboration with student-led projects. The high empowerment scores and active post-project engagement by community members underscore the transformative potential of PBSL when designed as a mutually beneficial framework.

This research contributes a valuable methodological advancement by integrating participatory action principles into the PBSL model, which elevates the role of community members from passive recipients to co-educators and co-designers. The approach provides a replicable structure for bridging academic instruction and civic engagement through context-sensitive, student-facilitated interventions. The novelty of this research lies not only in its findings but also in its framework, which blends experiential learning with empowerment theory, thereby offering a scalable educational strategy that addresses both pedagogical and sustainability goals.

The study faced limitations in terms of time-bound intervention and context-specific generalizability. The 12-week program, while impactful, may not fully capture the long-term sustainability of empowerment outcomes or the evolution of local leadership structures post-intervention. Future research should adopt longitudinal designs to assess the durability of behavioral change and community engagement over time. Cross-cultural comparisons and the inclusion of diverse ecological and institutional settings are also recommended to refine the model and broaden its applicability across different educational and environmental contexts.

AUTHORS' CONTRIBUTION

Festus Evly R I Liow: Conceptualization; Project administration; Validation; Writing - review and editing; Conceptualization; Data curation; In-vestigation.

Vongdy Xayavong: Data curation; Investigation; Formal analysis; Methodology; Writing - original draft.

Manivone Keolavong: Supervision; Validation; Other contribution; Resources; Visuali-zation; Writing - original draft.

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