Bridging the Equity Gap: Environmental Justice Education in K–16 for Engineering Teaching and Learning

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Abstract

The Work In Progress research paper and ECSJ-DEED joint technical session highlight the crucial role of Environmental Justice Education (EJE) in bridging the gap between educators and students, especially in engineering education. By emphasizing local environmental justice issues and integrating them into curricula, we prepare engineers to address real-world challenges equitably. Despite the importance, educators struggle to incorporate environmental justice topics effectively, leading to a neglect of disproportionate environmental risks faced by marginalized communities. This paper builds on prior research, identifying a gap in defining and implementing environmental justice in education. It provides insights for engineering educators, emphasizing EJE's relevance in addressing sustainability and social equity. By promoting inclusive pedagogical approaches and continuous reflection, we aim to equip students with the skills to design ethical engineering solutions. Through collective efforts, we aspire to contribute to a more sustainable and equitable future, fostering understanding and action in Environmental Justice Education.

Key words: Environmental Justice, Equity, Engineering Education

Introduction

The purpose of this Work in Progress research paper and ECSJ-DEED joint technical session is to highlight the crucial role of Environmental Justice Education (EJE) in bridging the gap between educators and students, particularly in the context of engineering education. By exploring local environmental justice issues and emphasizing the necessity of integrating these issues into the curriculum, we can prepare the next generation of engineers to address real-world challenges and engage in equitable problem-solving. Given the profound implications of engineering solutions on both environmental sustainability and societal well-being, EJE stands as a pivotal bridge between educators and students, fostering meaningful connections by exploring local environmental justice issues.

Many educators struggle to effectively incorporate environmental justice topics into engineering education [1], [2]. K–16 education discourses and curricula frequently overlook environmental justice issues, neglecting to highlight the disproportionate environmental risks experienced by communities of color and individuals living in poverty [3], [4], [5]. Previously, we conducted a systematic literature review that meticulously examined empirical research investigating environmental justice education efforts within and outside of the United States [6]. Our analysis revealed a critical gap in contemporary research concerning both the definitions and implementation of environmental justice. Definitions of key terms within the environmental justice movement, such as the concept of environmental racism, were missing. Absent these foundations, the forms of environmental justice studied, practiced, and experienced by students in the reviewed literature were strongly misaligned with the concept and movement of environmental justice. These limitations in the field of education may also contribute to a lack of

clarity among educators, especially in engineering education, regarding the fundamental tenets of Environmental Justice and Environmental Justice Education.

This present study builds upon these findings to provide an indispensable resource for engineering educators. We outline our understanding of environmental justice education along with practical implementations for engineering educators.

Background on Environmental Justice

The foundation of the Environmental Justice (EJ) movement underscores the uneven distribution of environmental harms, encompassing hazardous waste, land use, extraction activities, and toxins released during capital production, primarily within marginalized communities [7], [8]. Notably, Robert D. Bullard, a prominent figure in the environmental justice movement, is credited with coining the term "environmental justice" [9]. Bullard's (2005) Environmental Justice (EJ) framework underscores several principles, including the rights of individuals to inhabit healthy environments devoid of pollution, equitable distribution of waste burdens from communities to companies, fair representation of communities of color in shaping environmental policies, and the accountability of governments and corporations to community-based decision-making processes for justice[10].

Bullard's framework accentuates contemporary concerns regarding pollution distribution, revealing a systematic process whereby states and communities developed environmentally favorable conditions, characterized by safety, accessibility, and green spaces, primarily in predominantly white neighborhoods [7], [9], [10]. Consequently, Bullard contends that white populations benefit from residing in more environmentally friendly areas.

The environmental justice movement emerged from the civil rights movement in the United States, as Black Americans and communities of color mobilized against the

disproportionate waste disposal in their neighborhoods and its adverse health effects. Historically, pivotal moments such as protests the disposal of PCB-tainted soil in a Warren County, North Carolina landfill underscored the convergence of the civil rights and environmental justice movements, fostering high levels of community engagement [8]. Moreover, the 1991 First National People of Color Environmental Leadership Summit catalyzed movement solidarity, resulting in the formulation of "The Seventeen Principles of Environmental Justice"[11]. A key outcome of the Summit was the assertion that environmental justice must be integrated into education, stating “Environmental Justice calls for the education of present and future generations which emphasizes social and environmental issues, based on our experience and an appreciation of our diverse cultural perspectives”[11]. Articulating what this aim might look like within engineering education, we argue, can broaden the scope of engineering education, empower students to understand and address EJ concerns within their work, and advance environmental equality.

Towards Environmental Justice Education Pedagogies in Engineering Education

Given the foundational principles of the Environmental Justice (EJ) movement, engineering educators can embody the tenets of Environmental Justice Education (EJE) through a pedagogical approach that integrates environmental content with social justice teachings at the local level. This approach fosters critical reflection among educators and learners and cultivates a robust understanding of disciplinary-specific knowledge, empowering both educators and learners to actively engage with communities to address current and future challenges.

EJE necessitates a comprehensive understanding of Environmental Justice (EJ) and its historical and current movement, which have emerged from grassroots communities struggles to

end the inequitable distribution of harmful environmental pollutants in communities of color and low income communities [5], [8]. Work within EJ honors the EJ movement when done in relationship with communities working towards EJ. Methodological practices and pedagogical approaches should align with the goals of EJ, emphasizing participatory pedagogies that center the voices and concerns of communities directly impacted by environmental injustices. Central to EJE is the recognition of marginalized communities often overlooked by mainstream environmental discourse. Collaborative approaches are essential, involving partnerships with students, families, organizations, and educators to develop locally relevant curricula and incorporate culturally responsive techniques. Understanding the historical context of colonization is critical, as it underpins the marginalization experienced by many communities. Decolonization, as a political and cultural endeavor, seeks to challenge and reverse the privileging of white knowledge, advocating for the inclusion of diverse perspectives, particularly those of Indigenous, Black, and non-white communities.

In conceptualizing EJE, it is imperative to recognize that all spaces inhabited by students constitute environments, necessitating a broadened understanding of environmental education beyond nature settings in distant ‘wilderness.’ Instead, students can view their environment as always encompassing their beings, including indoors and outdoors, and occuring everywhere humans work, play, and live. EJE serves as a decolonizing educational practice, challenging the centrality of whiteness in educational narratives and uplifting the self-determination and activism of Black and Indigenous communities [12]. From an engineering education perspective, the infusion of EJE tenats allows for a critical examination of the field of engineering in order to shift away from colonized viewpoints towards a more multicultural stance.

We highlight below five key features that we recommend exist within pedagogic endeavors that honor EJ. We arrived at these five features by conceptually grounding our own practices in alignment with the EJ principles and movement.

Our conceptualization of EJE prioritizes:

Commitment to Social Justice: Engineering educators can demonstrate their commitment to social justice by integrating discussions on principles such as equity, diversity, and inclusion into engineering ethics courses and professional development workshops. They can also design engineering projects that specifically address social disparities in access to technology and infrastructure, focusing on solutions that benefit underserved communities. Moreover, advocating for diversity and inclusion within the engineering profession is essential, requiring active promotion of representation and equitable opportunities for underrepresented groups.

Centering Marginalized Communities: In efforts to center marginalized communities, engineering educators can collaborate directly with underserved groups to co-create solutions that address their unique needs and challenges. This collaborative approach can involve establishing community advisory boards or focus groups composed of residents from marginalized areas to provide insights into engineering projects. Employing participatory design processes that prioritize community voices ensures that engineering solutions are culturally relevant and responsive to local contexts.

Understanding Local Injustices: Engineering educators can deepen their understanding of local injustices by conducting environmental justice assessments and impact studies

within communities. By collaborating with interdisciplinary teams of researchers and community stakeholders, they can investigate the root causes of environmental injustices and develop evidence-based strategies for mitigation and advocacy. Implementing community-based monitoring programs also empowers communities to advocate for policy changes and environmental remediation efforts.

Commitment to Action through Community Collaboration: To fulfill their commitment to action through community collaboration, engineering educators can partner with local governments, non-profit organizations, and stakeholders to support community-led development projects. This may involve facilitating student-led design competitions or hackathons focused on addressing environmental justice issues, fostering interdisciplinary collaboration and innovation. Long-term partnerships with community organizations can also support ongoing capacity-building initiatives, such as workforce development programs or engineering education outreach efforts.

*Continuous Self-Reflection and Curricular Transformation:*Engineering educators can integrate reflective practices into their courses and research projects. By incorporating case studies and real-world examples of engineering successes and failures in addressing environmental justice issues, students are prompted to consider the broader social, political, and ethical implications of their work. Engaging in ongoing professional development opportunities and dialogue with colleagues ensures educators stay informed about emerging trends, best practices, and evolving challenges in environmental justice and engineering.

Moving Forward

In conclusion, this work in progress paper and the ECSJ-DEED joint technical session underscore the pivotal role of Environmental Justice Education (EJE) in bridging the equity gap between educators and students of engineering and their communities. By delving into local environmental justice issues and advocating for their integration into curricula, we aim to equip the next generation of engineers with the necessary tools to address real-world challenges and engage in equitable problem-solving. The profound impact of engineering solutions on both environmental sustainability and societal well-being necessitates a thorough understanding of environmental justice principles, positioning EJE as a critical conduit between educators and students. Despite the evident importance of integrating environmental justice topics into engineering education, many educators face challenges in doing so effectively. Current K–16 education discourses often overlook environmental justice issues, perpetuating a neglect of the disproportionate environmental risks faced by marginalized communities. Our prior research identified a significant gap in the literature regarding the definitions and implementation of environmental justice in educational settings. This gap not only affects educators' clarity on the fundamental tenets of Environmental Justice but also hinders the development of a robust Environmental Justice Education framework.

This paper builds upon these findings to offer valuable insights for engineering educators. It highlights the challenges associated with integrating EJE into engineering curricula and emphasizes its critical relevance to both engineering professionals and students. As engineering disciplines influence environmental sustainability and social equity, it becomes imperative to educate future engineers on the ethical and practical dimensions of environmental justice. The

implications of EJE implementation, particularly within engineering education, are substantial. By addressing the existing knowledge gap and advocating for a more inclusive and equitable approach to engineering education, we strive to equip engineering students with the knowledge and skills needed to design and implement sustainable, just, and ethical engineering solutions. Through continuous self-reflection and curricular transformation, engineering educators can navigate these challenges effectively, incorporating environmental justice principles into their teaching practices and empowering students to become agents of positive change in their communities and beyond. Ultimately, our collective efforts aim to contribute to a more sustainable and equitable future for all, by highlighting these issues and having others join us in a collective understanding of Environmental Justice Education.

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