2026 ASEE ANNUAL CONFERENCE June 21–24, 2026 | Charlotte Convention Center, NC
Host Sponsor UNC Charlotte
ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION
Paper ID #50531

A Case Study of Institutional Change: Reimagining Engineering Education through Principled Innovation

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Kurt Paterson enjoys re-imagining higher education with others, then making it happen.

Title: A Case Study of Institutional Change: Reimagining Engineering Education through Principled Innovation (WIP)

Introduction

As engineering challenges expand in scope and impact, there is growing recognition that technical skills alone are insufficient for preparing future engineers. Ethical reasoning, civic awareness, and inclusive design are now considered essential competencies in engineering education [1]. While ethics in engineering education often relates to professional standards and societal norms that define ethical behavior, moral reasoning addresses individuals' reflections on beliefs, intentions, and judgments about what is considered right and wrong. Traditional curricula frequently silo ethics as a separate module or stand-alone course, limiting students' engagement with moral complexities in real-world contexts [2]. To support moral development and ethical practice, institutions are investigating character-based frameworks that encourage moral reflection and advance to ethical behavior in broader social and professional contexts.

This study explores the implementation of a character-driven institutional framework, called Principled Innovation® (PI), a structured approach to rethinking teaching, learning, and research through moral, intellectual, performance, and civic character [3][see Appendix A]. Furthermore, the study considers how this framework is integrated within the engineering school at a large public research university to promote institutional transformation by introducing it to faculty, staff, and students.

Background

PI has been adopted into a polytechnic-focused engineering school through a series of organized efforts aimed at raising awareness, encouraging teamwork, and integrating its techniques into both academic and extracurricular contexts. The examples of these initiatives include: a) the PI Research Fellowship, that deepens the scope of research implications via a PI lens; b) the PI Teaching Fellowship, that facilitates the integration of PI into the development of courses and classroom instruction; c) the PI Book Club, that serves as a community of practice for faculty and staff; d) the Lunch and Learn series, that covers the PI structure through expert-moderated sessions; and e) a student awareness campaign that uses campus posters to create interest and encourage discussion. As a whole, these initiatives strive to redefine human-centered engineering education, stimulate perspective-taking, and connect individuals with complex societal topics.

The goal of this study is to analyze the initial phases of PI implementation and to identify approaches to spreading its use across a large engineering school. The study primarily aims to answer:

> **RQ1:** How can PI principles be effectively integrated into existing curricular and co-curricular structures?
>
> **RQ2:** What are the impacts of PI engagement activities on faculty, staff, and students?
>
> **RQ3:** What strategies are most effective for institutionalizing PI practices at scale?

Using surveys, interviews, reflection exercises, and program observation, this study investigates how (and whether) different stakeholder groups view PI as an emerging model for rethinking education, encouraging student participation, and integrating ethics into engineering education. By addressing institutional policies and teaching methods that foster long-term ethical and inclusive learning environments, the findings will add to the expanding body of knowledge on character-driven engineering education.

Methodology

This study investigates the early introduction of PI practices using an exploratory qualitative case study approach. Specifically, the case is described as the polytechnic-focused engineering school initiatives to integrate PI into teaching, research, and community culture where faculty, staff, and students are serving as essential stakeholders in this case study. A case study method was particularly chosen because it allows a thorough investigation of PI implementation within the school while taking into account the real-world context, complexity, and various viewpoints involved [4][5]. Because it enables rich, multi-source data gathering and analysis, this method is ideal for analyzing the relationship between institutional initiatives and stakeholder experiences.

PI initiatives consisting of the Research and Teaching Fellowships, Book Club, Lunch and Learn events, and student awareness campaigns were used to recruit participants. Students (n = 7) were recruited across the school, faculty (n = 9) during fellowship application periods, and staff (n = 20) during the book clubs and Lunch and Learn sessions. Data sources included surveys, focus groups, semi-structured interviews, and observation notes. Open-ended surveys were sent out via secure platforms at the end of the semester. To evaluate the perspectives of participants, challenges, and perceived outcomes of PI, 45- to 60-minute focus groups and interviews were conducted in person and over Zoom.

For enhanced validity, several data sources were triangulated according to Yin's (2018) case study research principles [4]. The interviews were audio-recorded and transcribed via AI-assisted transcription technologies (such as TurboScribe) for maximum accuracy and effectiveness. Thematic analysis was completed with both deductive codes from the PI framework and inductive codes derived from participant narratives. The analysis used Saldaña's (2021) two-cycle coding approach, which included descriptive and *in vivo* coding, accompanied by pattern coding to identify overarching themes [6]. Triangulating across multiple data sources further enhanced the validity of the findings and provided a comprehensive understanding of PI integration in the school of engineering.

One limitation is that the majority of the data came from Teaching and Research Fellows, who might be more favorably inclined toward PI. Additionally, demographic data (e.g., gender, race, ethnicity) were not collected, restricting the ability to evaluate differences between participant groups.

Findings

Analysis of the early stage PI initiatives revealed three cross-cutting themes.

Theme 1: Embedded and Experiential Integration

This theme aligns with the first research question, “How can PI principles be effectively integrated into existing curricular and co-curricular structures?”. During the book club discussions staff showed the importance of applying leadership concepts to everyday activities, like advising, teamwork, and decision making. Furthermore, according to the PI faculty fellows, PI works best when incorporated into current research and instructional methods rather than presented as a standalone approach. Teaching faculties noted that they incorporated PI via reflective and experiential techniques they were previously familiar with, such as games, peer review, and structured reflection included into assignments. According to one faculty member: "We used the PI dice game and the card decks as a way of giving peer feedback," while another stressed that PI was "there’s really no sort of delineation between it and some other pedagogy." Other research faculty mentioned incorporating PI into professional educational materials, projects, and rubrics that tackled ethical and social issues addressed with technical outcomes. In general, faculty emphasized the importance of tangible resources, such as collaborative materials, shared templates, and examples, in promoting ongoing PI integration across different disciplines and learning environments.

Theme 2: Ethical and Professional Capacities

This theme helps answer the second research question, “What are the impacts of PI engagement activities on faculty, staff, and students?”. PI Teaching Fellows discussed how PI engagement improved classroom instruction, professional development, and educational outcomes. Teaching Fellows also indicated growth in students' ethical reasoning and critical thinking, especially when considering technical decisions against moral and societal consequences. A teaching faculty member said that students questioned if a solution was "the best from a moral standpoint or…the best from a technical standpoint." The faculty also cited emotional, social, and professional benefits, including greater compassion, a willingness to listen, and a better understanding of human-centered design. PI-related scenarios stimulated "almost an emotional response" from students, according to one research faculty member, while another emphasized the importance of students "putting themselves into the user's shoes." Participants also reported how PI activities improved students' perceptions of the relevance of their education by helping them make connections between their coursework and future careers and professional practices. Students, when asked, defined clear principles of ethics around innovation, such as avoiding harm and prioritizing the needs of society, the book club discussions emphasized the significance of moral reflection prior to action, understanding of budgetary constraints, and the meaning of development over excellence. All these findings suggest that besides promoting the explicit teaching of ethical reasoning, PI also strengthens professional judgment and civic engagement, demonstrating how moral reflection under PI evolves into real classroom and career-related skills.

Theme 3: Institutional Alignment and Capacity for Scaling PI

This theme aligns with the third research question, “What strategies are most effective for institutionalizing PI practices at scale?”. Most of the faculty focused on the advantages of cross-disciplinary collaboration, indicating how cooperation across departments helps in fostering a common understanding and potential collaboration implications. One Research Fellow reflected

gaining "a better vision of how they operate… and how I could integrate with them [PI principles] in the future." Additionally, building credibility and clear exchanges were highlighted as crucial for expanding PI practices, especially in community-engaged settings. Another Research Fellow noted the need to define benefits, address ethical concerns, and provide practical examples to other stakeholders, especially regarding privacy and monitoring concerns. As one faculty stated, "People don't want to be monitored or spied on… we need to articulate the benefits and resolve privacy concerns." Through common language, structures, and communication channels, like newsletters, Slack spaces, and regular meeting procedures, the book club team suggested increasing institutional alignment. All these data emphasize that institutionalizing PI necessitates collaborative efforts across the teaching, research, and administrative organizations.

Discussion and Implications

The aforementioned preliminary findings, which are consistent with the literature on engineering education, indicate that effective integration of ethics and social dimensions require the introduction of principle-based decision-making frameworks into current instructional methodologies rather than considering them as distinct, extra components [7][8]. The PI model is seen as a unifying framework, merging technical efforts with ethical, humanistic, and civic dimensions, thereby enhancing the support for bringing ethics into curricula. The emphasis on empathy and reflective thinking aligns with the body of research on human-centered design and engineering development for professionals [9][10]. Additionally, the four-element PI structure mentioned earlier (moral, civic, performance and intellectual) enabled community-based research and academic training, extending professional growth into public spheres where trust and responsibility are fundamental. At the institutional level, consistency and scalability are required for sustainable PI implementation. PI faculty fellows recognized the importance of cross-unit collaboration and effective interaction to foster mutual understanding and trust. Faculty serve as complementary pedagogical innovators and institutional translators, collaborating with students and administrators, demonstrating the importance of coordinated efforts across teaching, research, and administration for sustained application [11][12]. Collectively, these preliminary findings suggest that PI may enhance technical, ethical, and cultural development within the school while requiring explicit institutional support to scale and sustain.

Conclusion and Future Work

This work-in-progress illustrates how the PI framework, with its character-driven approach, may be successfully incorporated into engineering education to promote ethical reasoning, empathy, and perspective-taking while aligning technical proficiency to its social impact. The study investigates early PI interventions across a large engineering university as an example of its application in teaching, research, and institutional contexts. Preliminary findings show that, rather than being used as a standalone initiative, the PI framework works best when incorporated into ongoing research, extracurricular, and academic activities. PI commitment encourages human-centered thinking, ethical reasoning, and reflective practice, thereby prompting engineering education and research to consider moral, societal, and technical aspects. Early findings highlight the importance of institutional alignment, including evaluation, collaboration, and communication, for sustainable adoption. Overall, the aforementioned preliminary findings

highlight the prerequisites for PI's ongoing institutional implications and provide it as a cohesive framework that links the sociological, ethical, and technical components of engineering education, as well as similar aspects of a flourishing engineering school.

Future research will include longitudinal monitoring of faculty practice and student-centered data, as well as the use of demographic data to better analyze different perspectives and how such frameworks can support diversity in engineering education. Scalable, values-driven approaches to engineering education will be further supported by cross-institutional research and improved evaluation of constructive findings.

Acknowledgment

This work is supported by the Kern Family Foundation. The views and conclusions expressed in this paper are those of the authors and do not necessarily reflect the views of the Foundation. The authors would like to sincerely thank the faculty fellows, staff, and students who participated in and contributed to the PI initiatives.

References:

[1] Wesner, A., Kadir, K., & Cushing, L. (2025). Educating Socially Responsible Engineers Through Critical Community-Engaged Pedagogy. *Education Sciences, 15*(10), 1330.

[2] Hardebolle, C., Héder, M., & Ramachandran, V. (2025). Education and Artificial Intelligence. *The Routledge International Handbook of Engineering Ethics Education*, 125.

[3] Anonymous. (Year). Institutional values-based framework. [URL removed for blind review]

[4] Yin, R. K. (2018). *Case study research and applications* (Vol. 6). Thousand Oaks, CA: Sage.

[5] Tisdell, E. J., Merriam, S. B., & Stuckey-Peyrot, H. L. (2025). *Qualitative research: A guide to design and implementation.* John Wiley & Sons.

[6] Saldana, J. (2021). The coding manual for qualitative researchers (4th ed.). Sage Publications.

[7] Colby, A., & Sullivan, W. M. (2008). Ethics teaching in undergraduate engineering education. *Journal of Engineering Education, 97*(3), 327-338.

[8] Herkert, J. R. (2000). Engineering ethics education in the USA: Content, pedagogy and curriculum. *European journal of engineering education, 25*(4), 303-313.

[9] Sheppard, S. D., Antonio, A. L., Brunhaver, S. R., & Gilmartin, S. (2014). Studying the career pathways of engineers. *Cambridge handbook of engineering education research*, 283-309.

[10] Zoltowski, C. B., Oakes, W. C., & Cardella, M. E. (2012). Students' ways of experiencing human-centered design. *Journal of Engineering Education, 101*(1), 28-59.

[11] Borrego, M., & Henderson, C. (2014). Increasing the use of evidence-based teaching in STEM higher education: A comparison of eight change strategies. *Journal of Engineering Education, 103*(2), 220-252.

[12] Froyd, J. E., Wankat, P. C., & Smith, K. A. (2012). Five major shifts in 100 years of engineering education. *Proceedings of the IEEE, 100*(Special Centennial Issue), 1344-1360.

Appendix A

Figure 1: Framework for the Practices of Principled Innovation