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Disruption by Design: The Trade-off Between Perceived Stability and Authentic Empathy in Undergraduate Engineering Design Education

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Disruption by Design (WIP): Exploring the Relationship Between Blank-Slate Customer Discovery, Empathy, and Emotional Intelligence in Engineering Education

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Abstract

This Work-in-Progress study explores the pedagogical impact of a blank-slate "Disruption" intervention compared to a Traditional incremental innovation approach in a sophomore-level, customer-centered engineering design course. The Disruption condition served to mitigate solution anchoring by instructing students to disregard existing solutions during early customer discovery. Two course sections (N = 46) were examined.

Preliminary quantitative findings suggest a divergence between empathy and perceived emotional intelligence (EI) across pedagogical conditions. Students in the Disruption section reported higher empathy scores, while students in the Traditional section reported higher perceived EI. Emergent thematic analysis of open-ended responses provides contextual insight into these differences. Traditional students emphasized procedural elements such as customer engagement and project management, whereas Disruption students described deeper engagement with real-world complexity alongside greater challenges in teamwork and role differentiation.

These early findings suggest a potential trade-off between perceived emotional stability and authentic empathetic engagement when students are placed in ambiguity-rich design environments. Data collection will continue across additional course sections to examine the robustness of this pattern. This study contributes preliminary evidence to discussions of empathy development, emotional regulation, and pedagogical design choices in undergraduate engineering design education.

1. Introduction

As engineering shifts toward human-centered problem solving, the demand for non-technical competencies like empathy and emotional intelligence (EI) has intensified [1]. While authentic design experiences featuring open-ended problems and real stakeholders are intended to foster these traits, novice designers often struggle with solution anchoring, a cognitive bias where early exposure to existing practices constrains ideation [3]. Solution anchoring limits novice designers' ability to explore alternative representatives of the problem, often resulting in incremental refinements rather than innovative solutions. This tendency to prematurely converge on familiar approaches can reduce meaningful engagement and limit transformative outcomes [4].

To mitigate solution anchoring, early-stage disruptions that delay solution generation have been proposed to reopen the problem space [5]. However, such authentic, ambiguous contexts place significant emotional demands on students, requiring them to regulate frustration and anxiety [2]. While EI is often viewed as a downstream outcome, it may serve as a critical mediating mechanism that enables students to persist through design uncertainty [6].

This Work-in-Progress (WIP) study compares a Disruption pedagogy (emphasizing solution anchoring abatement and "blank slate" problem solving) with a Traditional incremental innovation model. We explore the trade-off between the "pedagogical safety net" of existing solutions and the development of authentic engineering behaviors.

Research Questions:

RQ1: How do Traditional and Disruption pedagogical approaches differ in their effects on student empathy and emotional intelligence?

RQ2: What themes emerge in student perceptions of learning outcomes and challenges across these two approaches?

RQ3: How do qualitative themes explain observed differences in quantitative outcomes?

2. Methods

2.1 Context and Instructional Intervention

Participants were undergraduate engineering students (N = 46) enrolled in the sophomore-level Entrepreneurial Engineering Design Studio at Lawrence Technological University. The interdisciplinary course engages students from multiple engineering majors in semester-long, customer-centered service-learning projects with community partners serving underserved populations, including individuals with disabilities and older adults aging in place. Both community contexts require students to expand beyond their own lived experiences and technical assumptions in order to understand stakeholder needs, constraints, and values. These partnerships are intentionally structured to cultivate perspective-taking and authentic empathy through direct engagement with users whose daily realities often differ markedly from those of traditional undergraduate students.

Teams work through opportunity identification, problem definition, ideation, prototyping, and iterative refinement within authentic, ill-structured design contexts.

For the results reported in this Work-in-Progress study, two sections of the course were examined (N = 46). One section (Disruption; n = 24) implemented a blank-slate customer discovery intervention in which students were instructed to disregard existing solutions and workarounds used by the partner organization in order to mitigate solution anchoring and encourage problem reframing. The second section (Traditional; n = 22) followed the standard course structure, engaging in human-centered design without explicit suspension of existing solutions.

To strengthen the comparative analysis and improve generalizability, data collection will be extended to four additional course sections in the subsequent academic year, again implementing parallel Disruption and Traditional pedagogical structures. These additional cohorts will allow for replication and expanded analysis of the empathy–emotional intelligence trade-off observed in the preliminary findings. Accordingly, results presented in this paper should be interpreted as preliminary and exploratory, consistent with the aims of a Work-in-Progress study.

2.2 Blank-Slate Customer Discovery Disruption
The presence of these two instructional conditions within the same course context enabled a comparison of student engagement-related outcomes between the Disruption and Traditional design experiences.

2.2 Quantitative Instruments
At course completion, students completed an online survey including two validated self-report instruments:

- **Emotional Intelligence:** Wong and Law Emotional Intelligence Scale (WLEIS) [7], a 16-item instrument measuring self-emotion appraisal, others-emotion appraisal, use of emotion, and regulation of emotion.
- **Empathy:** Brief Form of the Interpersonal Reactivity Index (B–IRI) [8], a 16-item multidimensional measure of trait empathy (e.g., perspective-taking, empathic concern).

2.3 Qualitative Data Collection
At course completion, students completed an online survey containing two open-ended qualitative questions: (1) "What were the biggest takeaways from the course that had the most impact on your engineering career?" (2) "What was the most challenging aspect of the course?"

2.4 Analysis
Descriptive statistics were generated using JASP (Version 0.95.4) [9].

Open-ended responses were analyzed using an emergent thematic approach supported by Anthropic's Claude Opus 4.5 LLM with the prompt: *"Conduct an emergent thematic analysis to identify recurring patterns in student open-ended responses."* Ten themes emerged inductively.

Theme prevalence was compared across conditions, and percentage-point differences (Traditional minus Disruption) were visualized in Python (Version 3.12). Positive values indicate greater prevalence in Traditional responses; negative values indicate greater prevalence in Disruption responses.

3. Results

3.1 Quantitative Findings

Preliminary descriptive analyses indicate differences in self-reported empathy and perceived emotional intelligence (EI) across instructional conditions. Students in the Disruption cohort reported higher mean empathy scores ($M = 2.45$, $SD = 0.78$) compared to students in the Traditional cohort ($M = 2.05$, $SD = 0.90$). Conversely, students in the Traditional cohort reported higher perceived EI scores ($M = 5.88$, $SD = 0.64$) compared to the Disruption cohort ($M = 5.54$, $SD = 0.81$).

Given the exploratory nature of this Work-in-Progress study and the current sample size ($N = 46$), analyses are limited to descriptive statistics. No inferential claims are made at this stage. However, the pattern suggests a potential divergence in how students experience empathy and emotional regulation under different pedagogical structures.

One possible interpretation is that the blank-slate Disruption condition, by reducing reliance on existing solutions, may increase direct engagement with user needs and problem ambiguity. This deeper engagement may correspond with higher empathy scores. At the same time, the ambiguity introduced by the Disruption condition may contribute to lower perceived emotional stability, reflected in reduced self-reported EI. Additional cohorts and inferential analyses will be required to determine whether this pattern is robust and statistically meaningful.

3.2 Qualitative Findings

Emergent thematic analysis of open-ended responses revealed differences in how students described both their learning takeaways and challenges across conditions (see Figure 1).

For "Biggest Takeaways," responses from the Traditional cohort more frequently emphasized procedural elements such as Customer Focus (+24.6 percentage points) and Project Management (+9.5). In contrast, the Disruption cohort more frequently emphasized Real-world Application (−7.6) and Problem Solving (−7.6), suggesting greater salience of authentic design engagement.

For “Most Challenging Aspects,” Traditional students more frequently identified Documentation & Presentation as a challenge (+18.2), whereas Disruption students more frequently reported challenges related to Teamwork & Communication (−14.8), Role Differentiation (−12.1), and Systems Thinking (−8.3). These differences suggest that the Disruption condition may shift perceived difficulty from administrative or procedural tasks toward interpersonal coordination and system-level integration.

While these thematic differences provide contextual insight into the quantitative patterns, they should be interpreted cautiously. As additional sections are incorporated in the following academic year, qualitative patterns will be re-examined to determine the stability and transferability of these emergent themes.

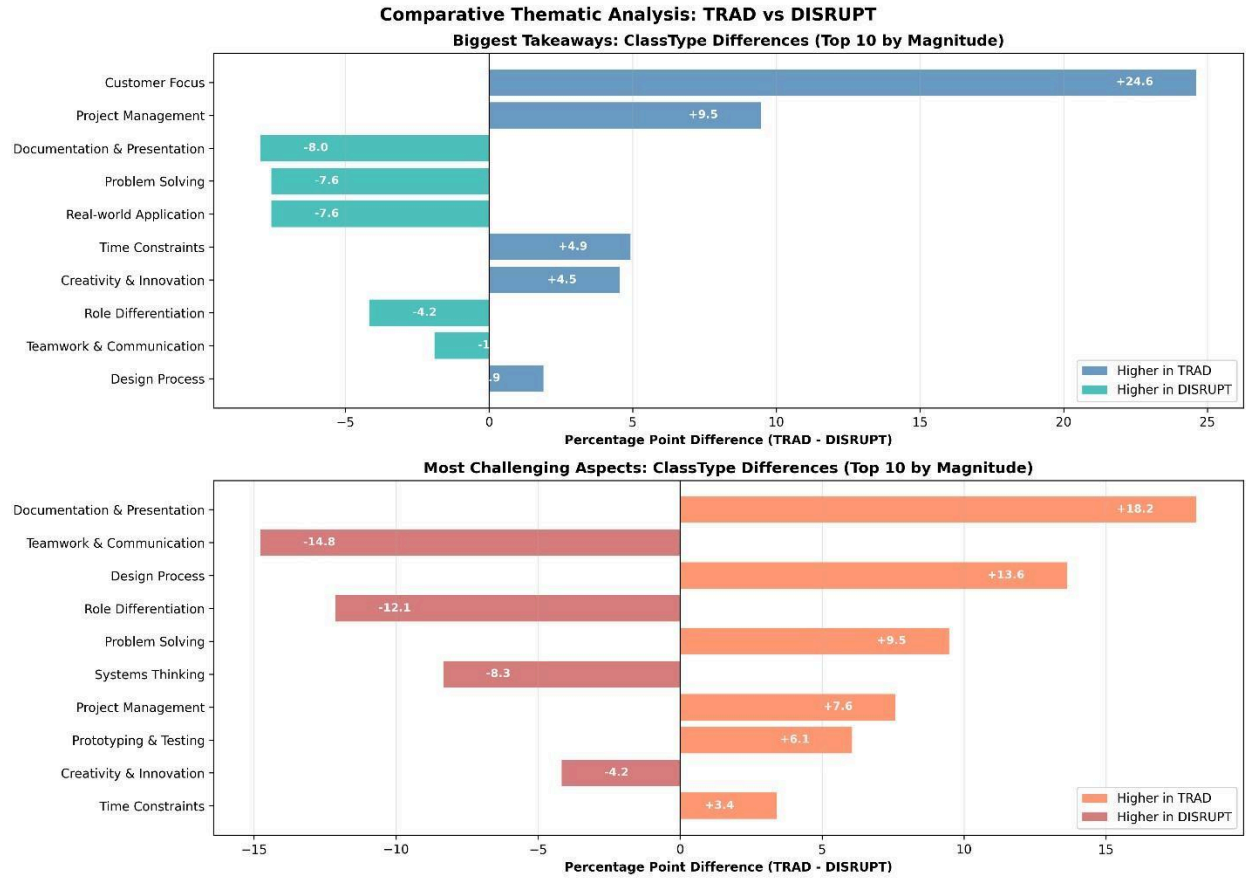

Figure 1. Comparative Thematic Analysis

4. Discussion

4.1 RQ1: Differential Effects on Empathy and Emotional Intelligence

Preliminary findings suggest that the Disruption pedagogy may be associated with higher self-reported empathy but lower perceived emotional intelligence compared to the Traditional condition. While these differences are based on descriptive statistics and should be interpreted cautiously, the observed pattern raises questions about how pedagogical structure influences students' emotional experiences in design contexts.

One possible interpretation is that the blank-slate intervention forces students to engage directly with ambiguous user's needs, which may create more opportunities for perspective-taking. At the same time, operating without predefined solution anchors may introduce greater uncertainty, potentially affecting students' perceptions of their emotional regulation. Additional data collection and inferential analyses are needed to determine whether this divergence persists across cohorts and reaches statistical significance.

4.2 RQ2: Emergent Themes Across Pedagogical Approaches

The qualitative findings provide contextual insight into how students experienced each instructional condition. Traditional students more frequently emphasized procedural elements such as customer focus and project management, while Disruption students more often described real-world application and problem-solving as salient learning outcomes.

In terms of challenges, Traditional students reported documentation and process implementation as primary difficulties. In contrast, Disruption students more frequently identified teamwork, role differentiation, and systems integration as challenging. These patterns suggest that the blank-slate condition may shift the locus of difficulty from process management to interpersonal and integrative design work.

As thematic analysis was conducted inductively and the sample remains limited, these findings should be interpreted as exploratory. Future cohorts will allow examination of whether these patterns are consistent across different community contexts and student compositions.

4.3 RQ3: Qualitative Context for Quantitative Patterns

Taken together, the quantitative and qualitative findings suggest a possible tension between perceived emotional stability and authentic engagement with ambiguity-rich design environments. The higher empathy scores in the Disruption cohort are consistent with their reported immersion in complex team dynamics and stakeholder interactions. Conversely, the lower perceived EI scores may reflect students' heightened awareness of emotional demands in such contexts rather than diminished capacity.

We tentatively characterize this contrast as movement from "comfortable detachment" toward "engaged struggle." In the Traditional condition, clearer procedural structures and solution anchors may support feelings of emotional control. In the Disruption condition, reduced reliance on existing solutions appears to expose students more directly to ambiguity, conflict, and coordination challenges. This exposure may simultaneously deepen perspective-taking while taxing perceived emotional regulation.

At this stage, these interpretations remain provisional. Expanded data collection will allow for testing whether ambiguity exposure mediates the relationship between pedagogy and empathy, and whether perceived EI rebounds as students gain experience navigating such contexts.

4.4 Implications for Engineering Design Pedagogy

Although preliminary, these findings raise important considerations for engineering educators. If ambiguity-rich, blank-slate approaches do increase opportunities for empathy development, instructors may need to intentionally scaffold teamwork and emotional regulation strategies to mitigate perceived strain. Conversely, more structured approaches may preserve emotional stability but risk limiting depth of engagement with user complexity.

Rather than framing the pedagogical choice as binary, future work may explore how structured scaffolds can be layered onto disruption-based approaches to balance emotional demands with developmental gains.

4.5 Limitations

This study is limited by its sample size (N = 46), non-random assignment, and single-institution context. Analyses are currently descriptive and exploratory.

In the upcoming academic year, four additional course sections will be incorporated, again implementing parallel Disruption and Traditional conditions. This expanded dataset will allow:

- Inferential statistical testing
- Examination of effect sizes
- Re-analysis of thematic prevalence
- Exploration of potential mediating variables (e.g., ambiguity tolerance, team functioning)

Longer-term work may also investigate whether perceived EI changes over time as students gain repeated exposure to ambiguity-rich design environments.

5. Conclusion

This Work-in-Progress study explored how a blank-slate Disruption pedagogy compares with a Traditional incremental innovation approach in shaping students' reported empathy and perceived emotional intelligence within an undergraduate engineering design course. Preliminary findings suggest a potential divergence: students in the Disruption condition reported higher empathy, while students in the Traditional condition reported higher perceived emotional intelligence.

Although exploratory and based on descriptive analyses, these findings raise important questions about how instructional structure influences students' experiences of ambiguity, teamwork, and stakeholder engagement. As additional cohorts are incorporated and inferential analyses are conducted, this work aims to clarify whether ambiguity-rich pedagogical approaches meaningfully shape the development of empathy and emotional regulation in engineering students. Understanding these dynamics may help educators design learning environments that balance emotional challenge with developmental growth.

References

[1] J. Walther, S. E. Miller, and N. W. Sochacka, "A Model of Empathy in Engineering as a Core Skill, Practice Orientation, and Professional Way of Being," *Journal of Engineering Education,* vol. 106, no. 1, pp. 123–148, 2017/01/01 2017, doi: 10.1002/jee.20159.

[2] D. McInerney, "Insights into product design students' perception of, and engagement with, creativity in design education," (in eng), *Int J Technol Des Educ,* vol. 33, no. 3, pp. 1199–1219, 2023, doi: 10.1007/s10798-022-09766-x.

[3] D. G. Jansson and S. M. Smith, "Design fixation," *Design Studies,* vol. 12, no. 1, pp. 3–11, 1991/01/01/ 1991, doi: https://doi.org/10.1016/0142-694X(91)90003-F.

[4] D. P. Moreno, L. T. Blessing, M. C. Yang, A. A. Hernández, and K. L. Wood, "Overcoming design fixation: Design by analogy studies and nonintuitive findings," *Artificial Intelligence for Engineering Design, Analysis and Manufacturing,* vol. 30, no. 2, pp. 185–199, 2016, doi: 10.1017/S0890060416000068.

[5] S. M. Smith and J. Linsey, "A Three-Pronged Approach for Overcoming Design Fixation," *The Journal of Creative Behavior,* vol. 45, no. 2, pp. 83–91, 2011/06/01 2011, doi: https://doi.org/10.1002/j.2162-6057.2011.tb01087.x.

[6] P. Salovey and J. D. Mayer, "Emotional intelligence," *Imagination, Cognition, and Personality,* vol. 9, pp. 185–211, 1990.

[7] C. S. Wong and K. S. Law, "The effects of leader and follower emotional intelligence on performance and attitude: An exploratory study," *The Leadership Quarterly,* vol. 13, no. 3, pp. 243–274, 2002, doi: 10.1016/S1048-9843(02)00099-1.

[8] S. Ingoglia, A. Lo Coco, and P. Albiero, "Development of a Brief Form of the Interpersonal Reactivity Index (B–IRI)," *Journal of Personality Assessment,* vol. 98, no. 5, pp. 461–471, 2016/09/02 2016, doi: 10.1080/00223891.2016.1149858.

[9] JASP Team, "JASP (Version 0.95.4)[Computer software]." [Online]. Available: https://jasp-stats.org/