

# You can change the world, but not this homework assignment: The contradictory rhetoric of engineering agency

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**Abstract**— This work-in-progress paper suggests that engineering recruitment messaging and engineering pedagogy send mixed messages to students. We describe the early stages of a critical discourse analysis study that shows recruitment messaging often portraying engineers as powerful agents of change, while the phrasings of pedagogical documents such as textbooks and homework assignments often position engineering students as lacking agency to question or change the constraints that define the problems they must solve. Our analysis of engineering education discourse uses the rhetorical concept of “topoi,” or commonplaces, to identify common articulations of what it means to be an engineer. Based on theoretical work on agency in sociology, semiotics, and rhetoric, we conclude that common descriptions of engineers in engineering education discourse can offer conflicting ideas of how much agency engineers possess to change the world around them.

**Keywords**— *rhetoric; philosophy; postmodernism; critical discourse analysis; agency*

## I. INTRODUCTION

This work-in-progress paper is part of our series on postmodern philosophy and rhetoric as articulatory tools for engineering education practitioners. The messages we send engineering students about engineering are of interest to those working on “the interaction of engineering activities with politics, society, and culture” and “helping engineers to... appreciate their professional and ethical responsibilities [1].” Examining engineering rhetoric promotes a mindset of critical engineering rather than merely instrumental reasoning; engineering is not just the solving of well-specified problems, but also includes critical dialogue over precisely what problems to solve.

In this work-in-progress paper, we lay the groundwork for our first investigation, which focuses on the rhetoric of agency. The development of agency in students, defined as “the capacity, condition, or state of acting or of exerting power” (Merriam-Webster), is frequently a key goal of engineering education. This goal is apparent in engineering programs’ recruitment strategies that rely on descriptions of engineers as changemakers. The authors’ own institutions, for example, include such descriptions in their mission and value statements. The first, Olin College, describes its mission, in part, as “graduating engineering innovators who will be leaders in solving the pressing global challenges of today and tomorrow

[2].” The second institution, the University of Kentucky, advertises a vision of “educating students to meet the global engineering challenges of the 21st century” and “conducting pioneering research for the advancement of our society.” These goals position engineers as powerful agents, leading efforts to solve broad, complex problems.

Although engineering students might be attracted to the field because of these sorts of grand, overarching goals statements, they spend a far greater proportion of their time immersed in the day-to-day messages of engineering pedagogy: lectures, homework, projects, and so forth. These messages are typically not designed for “marketing” overt messages about the profession to students, but they nonetheless influence the professional socialization of future engineers. As engineering educators, how do our explicit messages to students about engineering and engineers correspond with the implicit messaging we immerse them in every day, perhaps unintentionally? To begin answering this question, we used critical discourse analysis to identify two common ways (or as rhetoricians would name them, “topoi”) of describing engineers. Throughout, we focus on the rhetoric of agency: how do engineering education documents position engineers as having, or not having, power to “shape the future [4]”?

## II. THEORETICAL AND RHETORICAL APPROACHES TO AGENCY

The notion of power and agency in engineering education swims amidst a sea of complex sociotechnical tensions. Theorists from other disciplines have examined these topics in ways that are directly useful to our work. Our analysis of engineering education discourse is informed by a number of them, including Bourdieu’s concept of structural power, Freire’s construction of critical pedagogy, Barthes’ distinction between “readerly” and “writerly” texts, and Brummett’s analysis of various types of epistemic rhetoric. Each of these theories and their connections to our work are described in more detail below.

Societies, including engineering education cultures, shape and are shaped by structures of power, as described in the work of Pierre Bourdieu [5]. Everyday actions and words can unknowingly reflect and propagate those patterns, and educational environments are no exception. This “hidden curriculum” can propagate class structures and working relationships, as when simple instructor utterances like “put

that in my wastebasket” imply a student’s ownership (or lack of relationship) to the material objects present in their classrooms [6]. Similarly, the phrases used by math teachers transmit an underlying cultural philosophy of “what math is and how to do it,” and this culture shapes student approaches to the subject [7]. When students and instructors are aware of these power structures, they can design educational experiences to challenge and disrupt them [8]. This approach is sometimes referred to as “critical pedagogy,” and our work here supports the goals of critical pedagogy by using critical discourse analysis to highlight ways in which engineering education discourse can undermine students’ sense of agency.

This critical analytic approach to texts is also enhanced by applying the concepts of texts being alternatively “readerly” or “writerly.” Philosopher and semiotician Roland Barthes coined the two terms in order to refer to the role of a text’s reader [9]. Texts themselves can be said to take a more readerly or writerly approach. A “writerly” text reminds readers of their ability to modify that text; consider a book with writing prompts and blank pages, or a wiki page with a prominent “edit me!” button and instructions on how to add and edit content. In contrast, a readerly text treats readers only as readers, passive recipients of knowledge. Readerly texts place readers in the epistemological position that Baxter-Magolda calls “following formulas” [10] and Kegan calls the “third order of consciousness” whereby external voices serve as privileged authorities [11]. In a sense, if expertise is the ability to independently create and navigate within a complex context, readerly texts restrict readers from reaching for higher levels of expertise [12]. This distinction between “readerly” and “writerly” establishes a distinction in agency; in other words, texts can afford readers more rather than less agency, both in a literal sense (as in the example of editable wikis) and in a more abstract sense (as in the case of texts that position readers as capable of questioning or modifying their contents, even if not directly within those texts). Engineering education discourse thus has the power to position its audience as either passive, accepting the world it describes as given, or active, purposively changing that world.

Finally, rhetorician Barry Brummett writes about the methodological, sociological, and ontological meanings of epistemic rhetoric as variations that can lead to fundamentally different views of discourse’s role in the world [13]. As epistemology refers to the way we make knowledge, epistemic rhetoric refers to discourse’s role in our making of knowledge. The methodological meaning of epistemic rhetoric is that discourse functions simply as a tool; knowledge is out there for discovery in both the material and social realms, and language is the mechanism by which we discover and communicate it. The sociological meaning of epistemic rhetoric agrees that knowledge exists in the material realm to be discovered and communicated, but that in the social realm, discourse functions to communicate and mediate debate about questions with no one right answer. Engineers may do a great deal of work in the material realm, building and shaping concrete objects; they gain a great deal of knowledge about that material realm, but also that material work’s effects may extend beyond those intended by the engineers. For example, material constraints on a building’s construction may drive its design, but debates

about the need to make that building accessible to disabled users may influence its design as well.

The ontological meaning of epistemic rhetoric takes discourse to be an unavoidable mediating screen between humans and all knowledge, whether about material things or social issues. This approach both acknowledges that material reality exists while also acknowledging that scientific knowledge relies on human perceptions and framing. In other words, there is a material reality, but we do not have unmediated access to it; our discourse shapes the ways in which we come in contact with, and shape, reality. In relation to engineering education, these differing roles assumed for discourse have crucially different outcomes. Discourse as a tool for discovering pre-existing truth looks very different than discourse as a tool for fundamentally shaping our perceptions of, and abilities within, the realities we inhabit. In turn, these differing roles for discourse imply varying levels of agency for the engineering students and educators deploying and experiencing that discourse.

What these theoretical stances show is that discourse matters. The way we talk about things influences how people perceive them and how they imagine their own agency with respect to them. This insight is a starting point for our investigation of engineering education discourse, as it both establishes the value of doing this sort of discourse analysis and illuminates how some common engineering education statements point to underlying philosophical assumptions that might actually limit the power of engineers and engineering educators who hold them. We are not merely concerned that audiences may be confused by mixed messages that both promote and diminish agency. Rather, we propose that agency-diminishing discourse can actually have serious consequences for the material outcomes of engineering practice, even as it concomitantly undercuts sincere attempts to improve engineering practice and culture.

### III. METHODOLOGY: CRITICAL DISCOURSE ANALYSIS (CDA) AND RHETORICAL TOPOI

Our approach draws on this rich body of thought in ways that transgress and challenge research conventions that separate theory from method and from data. As a specific starting point, we use critical discourse analysis (CDA) as an approach for examining a small dataset of formal and informal engineering education text artifacts. As its name implies, CDA involves the analysis of “discourse,” which in this context refers to all meaning-making symbols and practices, including texts, conversations, images, body language, and more. The discourse data is defined as “socially constitutive as well as socially shaped [15].” In other words, discourse is not a tool whose users have complete control over its functioning and its effects. Rather, discourse often shapes social structures in unforeseen and unacknowledged ways. Taking a CDA approach to engineering education means starting from the assumption that engineering socialization is influenced by the discourse of engineers and engineering educators.

CDA is specifically not a method; rather, it is an approach to analysis that employs whatever methods can make sense of discourse data in light of social theory. Instead of prescribing a

specific series of analysis operations beforehand, we follow Jackson and Mazzei [14] in placing our data corpus (of formal and informal engineering education text artifacts) in conversation with theoretical examinations of the role of discourse in creating agency. This methodological approach of “thinking with theory” rather than pre-specifying method is more typical in the humanities than in engineering disciplines. The translation and explication of a rhetorical approach into an engineering education context constitutes another contribution we hope to make to both fields in the course of this project. As part of this, we will need to unpack the ways methodologically fluid research addresses questions of quality and validity, as it does so in ways atypical of current methodologies in use for engineering education research.

Whatever methods it employs, a CDA approach combines careful reading of discourse with an attentiveness to its potential social effects, particularly with respect to power dynamics and ideological positioning. Data collection and analysis methods chosen for CDA may compare grammatical structures, analyze concordances in large corpora, or identify connections between institutional language and culture, among others. Despite these differences, CDA research can be consistently characterized by the kinds of questions it asks: How does discourse invite its creators and audiences to imagine themselves? How does it perpetuate or challenge the status quo? How does it reify institutions and power relationships within institutions?

Using these sorts of theoretical tools allows us to see engineering discourse in a powerful new way. For instance, our pilot analysis suggests that engineering education discourse produces two common, but conflicting, visions of what it means to be an engineer. When engineering students are exposed to these conflicting visions, the conflict undermines attempts to form those students as professionals who are able to “shape the future.” These two competing visions function as what rhetorical scholars refer to as “topoi”: recurring commonplaces in discourse. In classical rhetoric, Aristotle presented topoi as general categories for identifying the types of information and ideas available for use in arguments; topoi thus enable rhetors to start with broad categories of information types and from them develop specific content for their own arguments [16].

Contemporary rhetoricians have emphasized the lasting value of topoi as a concept not only for constructing, but also for analyzing arguments [17]. We extend here the analytic use of topoi to examine discourse more broadly, in order to identify commonplaces that recur across texts which might not be traditionally considered “arguments.”

#### IV. RESULTS FROM EARLY PILOT ANALYSIS: TOPOI OF ENGINEER AS POWERFUL AGENT VS. ENGINEER AS NON-AGENT

In our pilot analysis of a small set of texts relevant to engineering education, we identified recurring examples of two topoi, which we refer to for short as “engineer as powerful agent” and “engineer as non-agent.” The differences between these visions hinge on agency, as the first idealizes engineers as powerful agents shaping the world and the second

minimizes engineers’ agency to challenge given constraints within particular problem spaces.

The first topos, “engineer as powerful agent,” can be found in multiple instances of engineering discourse, including engineering course texts, college recruiting materials, and online technical communities. The National Academy of Engineering’s (NAE) “Changing the Conversation” project offers a compelling example of discourse that describes engineers as important agents of positive change [4]. For this project, an NAE committee undertook the task of developing better outreach strategies to recruit more engineering majors and increase diversity in engineering. The exigency for the project was the perception, confirmed by focus group data, that students and their parents did not see engineering as a field “that will empower them to help others and make the world a better place.” Instead, parents especially believe “engineers to be narrowly focused on technical details rather than [sic] engaged with the social and human dimensions of engineering projects [18].” To counter these assumptions, the committee developed a “positioning statement” intended to guide marketing and public outreach by the engineering profession.

In full, the positioning statement reads,

No profession unleashes the spirit of innovation like engineering. From research to real-world applications, engineers constantly discover how to improve our lives by creating bold new solutions that connect science to life in unexpected, forward-thinking ways. Few professions turn so many ideas into so many realities. Few have such a direct and positive effect on people’s everyday lives. We are counting on engineers and their imaginations to help us meet the needs of the 21st century.

A number of phrases in this statement reflect an expansive view of engineers’ agency, suggesting that engineers are uniquely equipped change the world in spite of whatever constraints currently exist. In forwarding this view, the NAE committee underwrites the topos of “engineer as powerful agent,” reiterating it through their terminological choices. The idea that engineers “discover” and “create” underpins the idea that engineers are in the business of “creating bold new solutions” that are “unexpected” and “forward-thinking,” and the whole process is reliant on “a spirit of innovation” and “engineers and their imaginations.” This topos is compelling; it offers potential future engineers the hope that engineering will empower them to change the world around them in major and meaningful ways. However, it promotes only a surface-level view of engineers as powerful agents of change in the world.

Once students inspired to become engineers begin coursework, they may find that the engineering pedagogy they encounter in formal educational settings presents a limited version of agency that conflicts with that topos. For example, undergraduate-level assignments for supposedly “open-ended” projects are often set up with strict limits to prevent students from shaping aspects of their work. Without explicit contextualization of those limits as potentially negotiable and socially constructed for the sake of efficiency and focus in student learning, engineering education discourse can send the unintentional message that engineers must accept rather than question the constraints they are given. This message forms the

topos of “engineer as non-agent”; even though engineering students may make or do things within the parameters of the assignment, they lack agency to make any fundamental changes to the assumptions and requirements driving the assignment.

We can see similar tensions between the “engineer as powerful agent” and “engineer as non-agent” topoi in the stark contrast between the hacker/maker subculture of engineering education and the reliance on components-off-the-shelf (COTS) and pre-built libraries for course assignments. The informal hacker/maker subculture of engineering education emphasizes keeping technologies “hackable,” or modifiable by their owners, which enables engineering learners to examine and learn from the designs of others, without pre-fabricated and inflexible constraints on how or what to hack and make. However, the emphasis on efficiency, standardization, and reuse, which encourage the use of COTS and pre-built libraries, if left uncontextualized, can indicate a contradictory philosophy of not being able to edit the world one is given.

## V. DISCUSSION AND CONCLUSION

Making visible this explicit and implicit enculturation of students into the broader engineering community has important ramifications for recruitment and retention in engineering education. Identifying the topoi that characterize that enculturation is key to making it visible, particularly when unreflective use of a topos, such as “engineer as non-agent,” can undermine deliberate efforts to recruit and retain students using a different, empowering topos, such as “engineer as powerful agent.”

This work is in its early stages, and we plan to expand our small pilot dataset to provide more well-grounded and more complex analysis of the topoi under examination. Furthering the “engineer as powerful agent” topos may also aid in attempts to increase both enrollment and empowerment of engineering students from underrepresented groups. This work will ideally address a major concern for engineering programs and societies: recruitment and retainment of underrepresented minorities in engineering spaces. One possible outcome is the production of alternative phrasings for educators who want their course materials to subtly reinforce and develop the agency of future engineers.

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