

Early Insights from a Coding Framework for Narratives of Engineering Practitioners and Pedagogical Development: IUSE-Funded Project Updates

Bailey Kathryn McOwen, Virginia Polytechnic Institute and State University

Bailey McOwen is a Ph.D. candidate in the Department of Engineering Education at Virginia Tech as well as a master's student in the Engineering Administration program of the Grado Department of Industrial and Systems Engineering at Virginia Tech. Bailey's research focuses on workforce development, specifically the continued professional training of engineering practitioners, engineering ethics in practice, and the application of emerging technologies in professional education. Through her research, service, and academic work, she aims to bridge engineering education and industry needs to support ethical engineering and lifelong learning practices across diverse engineering pathways.

Dr. Marie C. Parette, Virginia Polytechnic Institute and State University

Marie C. Parette is a Professor of Engineering Education at Virginia Tech and a founding co-editor-in-chief of *Studies in Engineering Education*. She holds a B.S. in chemical engineering and an M.A. in English from Virginia Tech and Ph.D. in English from the University of Wisconsin-Madison. She is PI or co-PI on numerous NSF grants exploring communication, teamwork, design, professional identity, and inclusion in engineering. Drawing on theories of situated learning and identity development, her research explores examines the ways in which engineering education supports students' professional development in a range of contexts, with a particular focus on the school to work transition.

Dr. Dayoung Kim, Virginia Polytechnic Institute and State University

Dr. Dayoung Kim is an Assistant Professor in the Department of Engineering Education (College of Engineering) at Virginia Tech and a Director of the LABoratory for Innovative and REsponsible ENgineering workforce (LAB-IREEN). She also serves as an Executive Committee Member and Affiliate Faculty of the Center for Future Work Places and Practices (CFWPP). Her Engineering Practice research examines the practice of engineers across a range of employment settings, including business organizations – from startups to large, established firms – and government agencies. Building on insights from this work, her Engineering Workforce Development research focuses on developing the future engineering workforce capable of contributing innovatively and responsibly within their own contexts. Across her research, teaching, and service, she aims to bridge academia, industry, and government by translating insights from engineering practice into scalable systems for education, workforce development, and science and technology policy. She received her Ph.D. in Engineering Education from Purdue University and her B.S. and M.S. in Chemical Engineering from Yonsei University and Purdue University, respectively. She was the 2022 Christine Mirzayan Science & Technology Policy Graduate Fellow at the National Academies of Sciences, Engineering, and Medicine (NASEM).

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Introduction

Engineering ethics education remains a core component of the professional formation of engineers and accreditation requirements for engineering programs. Yet, research has identified persistent limitations in how ethics is taught within engineering curricula, including limited integration of lived professional contexts and insufficient attention to engineering students' moral identity development [1], [2], [3], [4]. Traditional pedagogies that utilize professional codes of ethics and case studies often miss how engineers actually experience, interpret, and enact ethical responsibilities in practice [5], [6].

Narrative pedagogy has emerged as a promising alternative approach to ethics education, grounded in theories of narrative identity and moral development [7], [8], [9]. Narrative methods allow learners to engage with ethical issues through story, reflection, and identity work beyond the application of rules or principles alone. Prior educational research demonstrates that autobiographical writing and dialogical reflection can deepen students' ethical awareness and connect personal values to emerging professional identities [10]. However, within engineering education, few studies have systematically examined practicing engineers' narratives to understand their values and their integration into their professional life, which could potentially inform curricular design for engineering students.

This NSF IUSE-funded project investigates how engineering ethics education can be strengthened by centering narrative pedagogy and professional identity development. The project examines moral narratives of practicing engineers to understand the values that manifest in the professional practice of engineers and uses these insights to design a pedagogy called Scaffolded Ethics Autobiography (SEA), which utilizes the practicing engineers' narratives to offer engineering students opportunities to reflect on their values and future careers. The project is organized into three phases: Phase 1 focuses on analyzing practitioners' moral narratives and developing the SEA materials; Phase 2 evaluates the impact of the SEA pedagogy on students' moral narratives and professional engineering identity; and Phase 3 examines how the identity developments relate to students' engineering career interests and choices.

This paper will report the current status of Phase 1 and Phase 2, particularly: (1) the development of a coding framework to analyze narratives of practicing engineers, grounded in Schwartz's [11] theory of basic human values, and (2) the design and pilot implementation of classroom pedagogy informed by the analytic findings.

Moral Narrative Coding Framework

The first phase of this project focuses on analyzing moral narratives of practicing engineers to better understand how values are constructed, articulated, and enacted in professional practice.

Using qualitative coding methods, we examine engineers' narratives to address three guiding research questions:

1. What moral values do engineers bring to their professional practice?
2. From what sources do engineers trace the origins of those values?
3. How do engineers articulate the relationship between their values and their current work?

Together, these questions provide an empirically grounded foundation for understanding professional identity formation in engineering and for informing the design of value-centered pedagogical interventions.

Data Collection

Data derived from 25 semi-structured interviews conducted with practicing engineers across varied disciplines, industries, and experience levels. Interviews (90–120 minutes) explored participants' professional trajectories, values, formative influences, and experiences making value-laden decisions in workplace contexts. Transcripts were anonymized using pseudonyms. In prior work [12], each interview was synthesized into a narrative summary representing the participant's moral narrative that preserved the engineers' language, career contexts, and value orientations. These narratives are coherent accounts of personal and professional values and career experiences, reflecting their development as an engineer as a moral agent. The present study applies systematic coding procedures to the original transcripts.

Coding Procedures

Data analysis followed iterative qualitative coding procedures outlined by Miles et al. [13] and Saldaña [14] and was conducted using MAXQDA qualitative analysis software. The first-cycle in vivo coding captured participants' own language related to values, motivations, service commitments, and ethical responsibilities [15]. This preserved practitioners' own language and meaning-making rather than framing the data with pre-defined theoretical structures.

During the second cycle of coding, emergent codes were organized deductively using Schwartz's [11] Theory of Basic Human Values, which identifies ten cross-cultural values grouped into four domains: (1) Self-Transcendence (benevolence, universalism), (2) Openness to Change (self-direction, stimulation, hedonism), (3) Self-Enhancement (achievement, power) and (4) Conservation (security, conformity, tradition).

Narrative segments were categorized under Schwartz's values only when they referred specifically to work-related motivations or behaviors. Values expressed in non-professional contexts were excluded to preserve a workplace and professional context focus. Multiple rounds of peer debriefing refined codebook alignment and supported interpretive rigor.

Preliminary Findings

Across the 25 transcripts, nine of Schwartz's ten values were represented. Regarding the dominant value categories, benevolence, universalism, and tradition were the most prominent

values. Participants frequently framed ethical responsibility in terms of protecting coworkers, patients, users, communities, and the broader public. Environment, fairness/equity, and accountability were frequently mentioned in these transcripts. Additionally, openness-to-change values, particularly self-direction and stimulation, also appeared regularly. Engineers described intellectual challenge, innovation, and problem-solving as some of the significant values in professional satisfaction. Also notable was the presence of achievement values, which emerged through expressions of pride in diligence, trailblazing, and professional growth.

Regarding the limited or absent value categories, conformity, security, and hedonism appeared infrequently while power did not appear across transcripts. Conformity emerged around discussions of deference to authority and gaining goodwill within the workplace. Security varied from concern with ensuring physical safety to striving for financial safety and personal well-being. Hedonism, when mentioned, was comprised of participants' desire to engage in activities they enjoy and being happy. Participants rarely framed their work in terms of authority, dominance, or control over people or resources, and these did not appear as aspects they valued. This may be due to the context in which the data was collected; original interviews pertained to ethics, so participants may not have discussed power if they did not find it connected to their ethics.

Pedagogical Design and Translation

The instructional materials were developed grounded in findings from the analysis of practicing engineers' moral narratives. A subset of the practitioner narratives (six of them) was then curated to represent diversity in discipline, career path, values, and professional roles, resulting in a set of engineer personas used as core instructional texts (Table 1). These personas were selected to expose students to multiple ways ethics is experienced and enacted in engineering practice, rather than presenting a single normative model of ethical behavior.

Table 1. Personas of the six professional ethics statements.

	Sophia	Brooks	Margaret	Graham	Scarlett	Edward
Description	The Impact-Driven Optimizer	The Libertarian Tinkerer	The Systems Mentor	The Safety Steward	The Purpose-Driven Trailblazer	The Climate Engineer
Role	Portfolio Program Manager	Product Manager	VP of Quality	Regional HSE Manager	CEO	Technical Leader
Field/ Industry	Biomedical Engineering, Pharmaceuticals	Software Engineering, AI Platforms	Industrial Engineering, Automotive	Chemical Engineering, Process & Emergency Safety	Cybersecurity	Mechanical & Chemical Engineering
Core Values	Impact, Empathy, Patient-Focus	Freedom, Creativity, Generosity	Transparency, Work-Life Balance, Equity, Belonging	Safety, Integrity, Faith	Service, Integrity, Pioneering	Sustainability, Family, Curiosity

Quote	<i>"If we impact just one person's life for the better, that's already a success-- and I know we're doing that every day."</i>	<i>"I want to build cool stuff that helps people do what they want-- without hurting anyone else."</i>	<i>"If I suffered through it, I want to fix it so you don't have to."</i>	<i>"Every safety rule was written in blood. Follow them so no one else has to pay the price I've seen."</i>	<i>"You don't need a title to do good-- you just need a mission worth showing up for."</i>	<i>"I want to solve the problems we cause-- using the same skills that caused them in the first place."</i>
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The pedagogical design was structured to scaffold students' ethical reflection across three phases, moving from personal reflection to practitioner narrative analysis and synthesis. In the first phase, students first drafted their own moral narrative to establish a baseline understanding of their values and ethical identity, without reference to formal ethical frameworks. In the second phase, students selected three narratives to read for a subsequent class. In class, students completed a short online survey about which narratives they read, why, and what most surprised or resonated with them about their readings. The teams then also looked at the codes of ethics from relevant professional engineering societies and discussed the implications of both the codes and their own values for their work on the project. Each student then individually revised their narratives to integrate the relevant professional goals with their own values and identify areas of conflict or alignment between their values and the project. In the final phase, students revised their Professional Ethics Statement, aiming for them to integrate personal values, practitioner insights, and professional codes of ethics, ultimately positioning ethics as a lived, evolving component of engineering identity rather than an external set of rules.

Pilot Implementation

The pedagogical materials were piloted in a year-long interdisciplinary senior capstone design course enrolling 66 students from multiple engineering disciplines. The ethics module was introduced during a class session early in the design sequence to frame the role of professional values in engineering practice. All students then completed all instructional activities as multiple homework assignments, including the values reflection assignment, practitioner narrative readings, and written reflections, as well as the revised assignment integrating professional codes of ethics. In-class time was used primarily to contextualize the activity within broader discussions of engineering professionalism.

Recruitment

Participants were recruited from a senior capstone design course using a two-step recruitment process approved by the Virginia Tech Institutional Review Board (IRB #24-677). First, a member of the research team visited the course in person to introduce the study, describe its purpose and procedures, and answer student questions. Following this visit, students received an invitation containing a brief description of the study, a link to the online survey, and information about informed consent. Participation was voluntary, and students were informed that their decision to participate or not would have no impact on their course grades.

Assessment

The surveys assess students' engineering identity through existing measures developed by Godwin [16] and Borrego et al. [17]. Additional items examine the salience of professional ethical values (e.g., integrity, commitment to public welfare) within students' professional self-concepts were also included in the survey [18]. The surveys also collect career-interest data and demographic information and allow for the optional submission of draft and final ethics autobiographies to support the analysis of identity and ethical development.

Feedback

Instructor feedback indicated that the materials were accessible and relevant to students and effective in supporting reflection on ethics as a lived dimension of professional practice. Students engaged meaningfully with the narratives, drawing connections between practitioners' experiences and their own developing professional identities. While the narrative materials effectively supported student engagement and reflection, the optional survey participation yielded low response rates. Consequently, revisions will be made to embed survey completion within required course activities, while only the data from students who consented to participate will be used for analysis.

Discussion

Empirical study of practitioners' narratives has started to establish a grounded understanding of values enacted in professional engineering contexts. A pilot implementation of these insights into classroom pedagogical materials demonstrates how students connect personal ethics as a lived and contextualized aspect of engineering work.

Based on pilot implementation and instructor feedback, revisions will be made to expand narrative selection, streamline reflection prompts, and more tightly integrate survey instruments into required course activities to improve participation and data quality. Future implementations will incorporate these refinements and expand deployment across additional courses. Ongoing work includes completing analyses addressing RQ2 and RQ3 of the practitioner interview study, using additional deductive frameworks [19] and conducting quantitative pre/post analyses to examine how narrative-based pedagogy influences students' professional identity development and career intentions.

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