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WHO IS THE BEST ENGINEER?: IDENTITY THEORY AS A FRAMEWORK TO REFLECT ON OUR ROLE IN THE CONSTRUCTION OF BELIEFS ABOUT THE VALUE OF SOCIAL RESPONSIBILITY IN ENGINEERING

Emily Dringenberg [1]
The Ohio State University
Columbus, OH USA
ORCID: 0000-0001-7635-7047

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ABSTRACT

The 2024 SEFI conference posed the question, "*How can we ensure the highest quality of technical competence while at the same time ensuring that social and environmental responsibility is core to the identity of engineering graduates?*" Identity formation is a complex process that has been theorized in many ways. In this workshop, I invited participants to consider Holland and colleagues' theory of identity as a useful framework for reflecting on our how our participation in engineering education contributes to beliefs about what makes a "real" or the "best" engineer. This theory posits that within our classrooms, students are participating in a complex cultural practice through which they ultimately learn to identify (and be identified) as more or less of an engineer than others. Our everyday classroom practices ultimately function to co-construct 1) shared beliefs about what makes a "good" engineer, and 2) everyone's relative position in a social hierarchy. Furthermore, identify development is theorized to include both social forces (i.e., rules and guidelines that influence how people behave in a social space) and individual agency (i.e., we are not just carbon copies of culture or norms because our actions shape the culture and norms). Understanding identity development as such empowers us to be intentional with our own participation in identity construction by providing theoretical entry points for conveying the value of social responsibility. The usefulness of this particular identity theory to ideate strategies for integrating social responsibility into students' engineering identities has been corroborated by the empirical findings of our U.S.-based engineering education research. During this

[1] *E. Dringenberg*
Dringenberg.1@osu.edu

workshop, we utilized the theory to draw out existing or future concrete practices that each of us, given our unique global and institutional contexts, are motivated to enact in support of social responsibility as core to engineering. Specifically, our interactions culminated with answering the following question: What is one concrete way I can *be intentional* in how I participate in identity co-construction? Participant responses to this prompt are presented directly.

1 INTRODUCTION

1.1 What were session participants expected to learn?

I designed the workshop to achieve the following learning outcomes:

Participants will be able to…

1. Recognize identity as part of a complex social process
2. Reflect on their participation in this social process
3. Generate at least one concrete way to *be intentional* in how they participate

1.2 What made the session relevant and attractive for the audience?

This session was relevant and attractive for the audience because it presented Holland and colleague's theorization of identity (1998) as a framework for reflecting on the ways in which we all play an active role in the complex social process through which students learn to understand them as engineers (or not). More specifically, this theorization of identity acknowledges the complex and interrelated nature of individual agency and the broader social context. The idea is that in any given classroom context, there are rules, guidelines, and social forces that influence (but don't dictate) how people behave, speak and conduct practice within social spaces. We are all subject to the greater power structures around us, and at the same time, we have agency to resist and re-shape these norms. At the end of the day, this identity theory assumes that we are participating, along with the students and others in engineering classrooms, in a complex social process through which we co-construct shared beliefs about what it means to be an engineer and everyone's relative position in a social hierarchy. Therefore, it is through intentional and theory-based action that we can work to integrate social responsibility, or other values, into the very definition of an engineer that students are learning to identify with. Given the theme of the conference, this session was useful for any conference attendee willing to critically reflect on how their own role in engineering education fosters or counters the belief that social responsibility is core to being an engineer.

1.3 How was this work significant for engineering education?

This type of workshop was significant for engineering education because it challenged us to move beyond espousing the value of social responsibility and lean into our agency as part of the cultural production of the very characteristics that are recognized as necessary to be a good engineer. The workshop provided attendees with the opportunity to reflect on the implicit and culturally specific ways in which their own educational praxis is a local site for the co-construction of students' engineering identities. By framing engineering identity as the outcome of a cultural practice, we were prompted to generate theoretically- and empirically-based modifications to our own actions that shift culture from the ground up.

This effort was also significant for engineering education because it is a translation of research to practice. We have significant empirical findings from our research on student beliefs and identities as engineers and as smart that justify the use of this theory to guide the workshop. During the workshop, I justified our use of this framework by briefly sharing highlights of our U.S.-based research findings that corroborate the theory. These findings include: identifying as smart is a fundamental way that students identify as a "good" engineer (A. Kramer et al. 2019; Wallwey et al. 2024); as students transition from a pre-college to a college context, they are actively constructing their identities as "smart enough" for engineering (Kajfez Under Review); students articulate 11 distinct ways that they believe one can behave like a "smart" engineer (Amy Kramer, Kajfez, and Dringenberg 2024); understanding oneself as an engineer is a process of social comparison (Dringenberg, Kramer, and Betz 2022); behaviours related to social responsibility are valued more by students personally than by what they experience in engineering classrooms (with statistical significance) (Amy Kramer, Kajfez, and Dringenberg 2024). In addition, researchers have used Holland and colleagues' framework to study the complex process of engineering identity across contexts of construction engineering in Sweden (Gonsalves et al. 2019) and engineering design in the U.S. (Tonso 2007).

2 METHODOLOGY

2.1 How were session participants activated?

Survey item to assess control beliefs in the room

As participants arrived, they were invited to provide a "pre" response to the following question in a Likert-scale style (1-5 strongly disagree to strongly agree) poll: *I am capable of promoting social responsibility as required to identify as an engineer*.

Overview of workshop

Next, I presented the conference theme (How can we ensure the highest quality of technical competence while at the same time ensuring that social and environmental responsibility is core to the identity of engineering graduates?) and introduced myself by way of my focus on the "core to the identity" bit of this theme for the workshop. I also presented the learning outcomes and corresponding workshop plan to participants.

Introduction of Holland's identity theory and U.S.-based research findings

I provided a brief overview of and justification for the identity theory that I draw on (Holland et al. 1998) when thinking about how we might shift or expand the behaviours that are constructed as necessary to be recognized as a "good" engineer in the context of higher education. As multiple identity scholars were present in the room, we had a lively discussion about multiple facets of this complex theory. I introduced Table 1, which contained three theoretically-grounded entry points for us, as participants in engineering spaces, to influence the co-construction of shared beliefs about what makes a "good" engineer. The second column provides more concrete and detailed components of our classrooms. One participant provided

feedback that yet another column to provide further concrete examples would be helpful in future work, with which I agree.

Table 1. Theoretical Entry Points for Practice

We co-construct what is believed to make a "good" engineer in…	**And can therefore be intentional about the values communicated via…**
1. How we design and implement our course	• The learning outcomes we establish for our courses • Which outcomes we prioritize and assess • Our methods of assessment • The discourse within our classrooms • The content of course artifacts
2. The extent to which we understand and name the socio-historical-cultural forces of our context	• The history and culture of our educational context • The cultural landscape of engineering • The behaviours that are rewarded in our classrooms • The expertise that is modelled by our teaching team • The expectation (or not) that engineering education develops students' critical consciousness
3. The extent to which we learn and integrate students' values into our classroom praxis	• How we situate students in our classrooms with respect to knowledge production • The extent to which we work to understand students' values and motivation • The extent to which we are willing to share power with students when it comes to classroom practices

Reflection and discussion to ideate best practices and synthesize insights

Next, participants were invited to first reflect individually and then discuss with others their own ideas (current or future) for how they could be intentional in their participation in co-construction of student identity. We came back together as a group to share out, and the participants exchanged ideas.

Debrief and closing (10 min)

I closed by asking participants to write down at least one action that they are willing to commit to on a sticky note. Additionally, they were invited to respond to the same Likert-style survey question we started with (control beliefs) and provide a free response to the prompt, "Describe one concrete way you'll be intentional in how you participate in identity co-construction."

3 RESULTS

3.1 Pre and Post survey item results

The responses to the pre and post survey item on control beliefs are displayed in Figure 1.

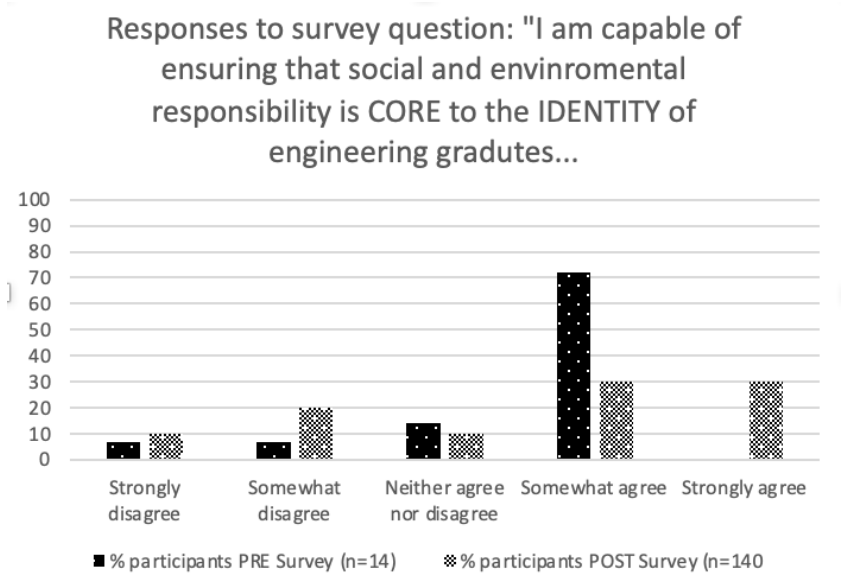

Figure 1. Survey item pre and post responses

A general observation here is that from the beginning to end of the workshop, the bulk of attendees went from "somewhat agree" to split between "somewhat agree and strongly agree," which I found encouraging. No statistics were performed as this was not a formal evaluation plan. As for the open responses, the following bullet point list captures the responses generated by participants, edited only for readability:

- Create awareness of students' own identity → values, perspectives, biases
- Make conversations on identity and perceptions a part of the classroom discourse
- Consider course artifacts as a part of the classroom design and assignments, and as a form of representation (include images that are inclusive)
- When I get students to make up an optimization problem and present the answer for peer-review, I should get them to choose a problem personally important to them and explain to others why it is important to them
- Make students aware of the notion of professional identity which is done/performed through skill demonstration (that they are not just "students")…then they recognize we "become" an engineer when practicing
- Give thought provoking assignments—ask students what kind of engineer do they want to be (instead of what they are expected to be)
- Support student collaboration in problem/practice based educational assignments
- Consider not just student identity, but also teacher identity
- Consider the pressures to conform to "figured world norms"
- Consider how to align student and other values
- Give students the tools to help them become aware of the figured world and how to interpret these artifacts/dialogues
- Didactic contract to be explicit in expectations between student & teacher to build student/teacher/class shared norms & values in class which then shapes identity via building of sense of belonging & self-efficacy
- Tell the students the learning possibility of failing
- Suggest faculty-student tandems for developing sustainability teaching to my university

- Consider classroom discourse and modelling diverse expertise in the teaching team.
- Ask students why the course is important to them and how it aligns with their professional and social values
- Provide more artifacts and discourse in my classes on this topic.

Finally, I sent a draft of this paper with attendees who indicated an interest in seeing the paper and solicited their edits or feedback before submitting the final version for publication. No edits were requested.

4 SUMMARY AND ACKNOWLEDGEMENTS

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