

## **Reflections from the Rising Doctoral Institute: Undergraduate Research as a Site of Agentic Orientation Development - A Work-in-Progress Study**

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# **Reflections from the Rising Doctoral Institute: Undergraduate Research as a Site of Agentic Orientation Development - A Work-in-Progress Study**

## **Abstract**

This work-in-progress paper explores how participation in Research Experiences for Undergraduates (REUs) and/or Undergraduate Research Experiences (UREs) contributes to the relationship between agentic orientation and agentic capabilities among participants of the Rising Doctoral Institute (RDI), a transition program for incoming doctoral students in STEM. Guided by Klemenčič's Student Agency Model, which conceptualizes agentic orientation as students' internal lens shaped by prior background, dispositions, and experiences, this study examines how URE contexts interact with that orientation to shape emerging agentic capabilities.

Drawing on qualitative interview data from RDI participants, preliminary analysis investigates how students described navigating ambiguity, autonomy, and evolving expectations in research environments prior to doctoral study. Early findings suggest that UREs may serve as a developmental context in which students' existing orientations are activated, challenged, and refined through sustained engagement with authentic research. Through these interactions, participants appear to develop and strengthen capabilities related to decision-making, help-seeking, and self-directed engagement. As a work in progress, ongoing analysis seeks to examine further how these developmental processes are later enacted during the transition into engineering doctoral programs.

**Keywords—Undergraduate research, agency, career development, doctoral pathways**

## Introduction

Research on graduate education and engineering pathways suggests that navigating doctoral study involves more than disciplinary preparation or technical expertise [1], [4]. Early doctoral students encounter evolving research expectations, increased independence, and participation in research groups where norms and standards are not always clearly articulated [2], [3]. Prior scholarship on doctoral socialization indicates that successfully engaging these environments requires students to interpret expectations, manage autonomy, and position themselves within academic systems [1], [3], [4]. How students respond to these demands can shape their early engagement and adjustment during their doctoral study [4], [5].

Experiences with research during undergraduate education may provide one of the earliest opportunities for students to encounter similar conditions in a lower-stakes setting [6], [7]. Through sustained involvement in research groups, students may engage with uncertainty, autonomy, mentorship dynamics, and responsibility for shaping aspects of a project [6], [8]. Existing literature has documented that such experiences influence how students understand research work and prepare for advanced study in STEM and engineering fields [7], [8]. However, less attention has been given to how undergraduate research contexts interact with students' existing orientations to shape the development of agentic capabilities over time.

This work-in-progress study examines how undergraduate research experiences may contribute to the developmental relationship between agentic orientation and agentic capability among participants in the Rising Doctoral Institute (RDI), a transition program for incoming STEM doctoral students. Guided by Klemenčič's Student Agency Model, this study asks: *How do undergraduate research experiences interact with students' agentic orientations to shape emerging capabilities that support their transition into engineering doctoral programs?*

## Literature Review: Agency, Engineering, and Undergraduate Research

### *Agentic Orientation in Engineering Education*

Student agency has been described as learners' capacity to act intentionally and shape their educational pathways [9]. Brandt's [10] review situates agency within social-cognitive theory and emphasizes its multidimensional nature, including forethought, self-regulation, and reflection. Building on this foundation, Klemenčič conceptualizes student agency as emerging from the interaction between agentic orientation, students' internal lens shaped by prior experiences and background, and agentic capability as developing through engagement with institutional structures [9]. Agency is the result of ongoing interaction between individual dispositions and contextual affordances [9].

Within engineering education, qualitative research has illustrated how students interpret and respond to disciplinary norms and expectations. Secules et al. [11] demonstrated how narrative sensemaking shapes how students position themselves within engineering cultures, while Jiang et al. [12] showed how engagement with authentic, open-ended tasks prompts students to develop planning and reflective practices. Together, this scholarship suggests that

educational environments provide contexts within which students' orientations are activated, challenged, and reshaped over time.

### ***Undergraduate Research as a Context for Agentic Development***

UREs, including NSF-funded REUs, are widely associated with gains in research skills, confidence, and interest in graduate education [6], [7]. Syntheses further suggest that sustained research engagement supports persistence and career decision-making in STEM fields [8], [13]. Engineering-specific studies similarly report that participation increases exposure to graduate pathways and strengthens research self-efficacy [14]. While this body of work establishes the value of undergraduate research, it primarily emphasizes outcomes rather than examining how students engage with research environments.

From an agency perspective, UREs can be understood as a context in which students encounter autonomy, uncertainty, mentorship dynamics, and responsibility for shaping research work [6], [8]. These conditions provide opportunities for students' existing orientations, shaped by prior experiences and background, to interact with authentic research structures over time. Through such engagement, students may begin to develop and refine capabilities related to navigating expectations, seeking guidance, and managing independence. Research on engineering identity provides additional context for understanding this process. Studies suggest that more integrated identities support students' confidence in navigating graduate expectations [17]. UREs may represent one context in which students' interpretive lenses are activated and reshaped through participation in research communities [17], [18]. Despite extensive documentation of the benefits of UREs, less is known about how these experiences interact with students' agentic orientations to shape emerging capabilities across educational transitions.

### **Theoretical Framework: Klemenčič's Student Agency Model**

#### ***Agentic Orientation and Capability***

This study is guided by Klemenčič's Student Agency Model, which conceptualizes student agency as emerging from the interaction between individuals and educational structures [9]. Central to this model is the distinction between agentic orientation, which is students' internal lens shaped by prior experiences, background, and dispositions, and agentic action, the observable behaviors through which students enact agency within institutional contexts [9]. Klemenčič's [9] framework emphasizes how students' perceptions of possibility, responsibility, and constraint shape their interpretations and responses to educational environments.

This distinction is relevant in examining transitions into engineering doctoral education. Doctoral pathways require students not only to engage in concrete behaviors, such as seeking mentorship or managing research responsibilities, but also to interpret evolving expectations, understand implicit norms, and position themselves within hierarchical research systems [1], [4]. UREs may be understood as contexts in which students' existing orientations interact with authentic research structures, potentially shaping the development of agentic capabilities over time.

Klemenčič's Student Agency Model was selected for three primary reasons. First, it allows for analysis of how students' orientations and capabilities develop in interaction with institutional structures, aligning with this study's focus on UREs as a developmental context [9]. Second, the framework supports retrospective qualitative inquiry by facilitating analysis of how participants interpret prior experiences in light of current doctoral expectations [9]. Finally, its attention to structure and agency dynamics makes it well-suited for engineering environments characterized by autonomy, ambiguity, and hierarchical research norms [1], [4].

## **Methods**

### ***Research Design Context***

**Rising Doctoral Institute.** This study draws on data from a broader qualitative project examining the transition experiences of first-year engineering doctoral students who participated in the Rising Doctoral Institute (RDI). The RDI is an early doctoral transition program designed to support racially and ethnically minoritized students entering engineering PhD programs by providing structured exposure to research expectations, advisor relationships, funding structures, and professional socialization [20], [21]. Prior research indicates that early doctoral experiences are critical for shaping belonging, competence, and persistence, for students navigating historically exclusionary environments [2], [5]. The RDI emphasizes reflection, proactive engagement, and peer community building at the start of doctoral study.

In this study, the RDI functioned as a reflective context in which participants articulated how prior educational experiences informed their transition into doctoral programs. It provided a setting in which UREs were discussed in relation to doctoral expectations, because the program encourages participants to examine earlier academic and research experiences. This framing enabled examination of how participants' agentic orientations interacted with undergraduate research contexts to inform emerging agentic capabilities enacted during doctoral transition.

**Participants' prior REU experiences.** The analytic focus centers on participants' prior REU experiences. Thirteen first-year engineering doctoral students across three RDI cohorts who had completed at least one URE were included in this analysis. Nine participants engaged in academic-year research, five participated in summer REU programs, and one completed both. Experiences varied across institutional contexts, engineering subdisciplines, mentoring structures, and levels of autonomy.

### ***Data Collection***

Data were collected through semi-structured interviews conducted approximately monthly during participants' first year of doctoral study. Interviews (45–60 minutes) were conducted via videoconference, audio-recorded with consent, and transcribed verbatim. Protocols prompted participants to reflect on their pathways into research, the nature of their undergraduate research responsibilities, and the mentorship and autonomy they experienced. Participants were also asked how these experiences informed their approach to doctoral coursework, research expectations, and advisor interactions. These retrospective reflections

provided insight into how participants interpreted and made meaning of their UREs while navigating early doctoral demands.

### ***Data Analysis***

Analysis followed a deductive-first qualitative approach guided by Klemenčič's Student Agency Model [9] with attention to agentic orientation as the primary analytic focus. An initial codebook was developed using the agentic orientations (e.g. cultural background, socioeconomic status) as lenses for identifying how participants described their internal interpretations of research environments during their UREs.

During the deductive phase, transcripts were examined for segments where participants described how their prior experiences shaped their beliefs, assumptions, or interpretive frameworks about research and graduate study. This phase focused on identifying how agentic orientations were activated, challenged, or refined through engagement. Analytic memos were written throughout to document emerging interpretations regarding how orientation appeared to interact with contextual conditions.

Following this orientation-centered coding, thematic analysis was conducted to examine patterns across participants. This phase explored how shifts or refinements in agentic orientation were associated with the emergence of agentic capabilities later enacted during doctoral transition. Through iterative comparison, themes were developed that captured how URE contexts contributed to the evolving relationship between orientation and capability.

### ***Positionality***

The lead author identifies as an engineering-trained scholar and doctoral student whose academic and professional experiences inform an understanding of URE and early doctoral transitions in engineering. While the lead author didn't participate in a formal doctoral transition program or a URE, their familiarity with research socialization and graduate education contexts shaped the development of interview protocols and the interpretation of participants' accounts.

## **Preliminary Findings**

### ***Theme 1: Transfer into Doctoral Contexts***

Preliminary findings suggest that for some participants, UREs established orientations toward research work that aligned closely with doctoral expectations. Participants characterized the transition as a continuation of prior engagement. This continuity appeared to reduce uncertainty and support early confidence in navigating doctoral research structures. One participant reflected:

*"I did all this similar stuff in undergrad. I did undergrad research, so it was a pretty easy transition since I already worked my PhD advisor and my summer in undergrad. So, it was a really simple transition, so I just continued it."*

This account suggests that prior research engagement shaped how the participant interpreted doctoral expectations. The participant had previously worked within similar research structures and with the same advisor which led to the norms of autonomy, mentorship, and responsibility already being familiar. The participant described extending an existing orientation

toward research work into the doctoral context. UREs may have functioned not only as preparation, but as a context in which agentic orientations became aligned with doctoral research environments, facilitating smoother enactment of agentic capabilities during the first year of PhD study.

### ***Theme 2: Refinement of Agentic Orientation Through New Contexts***

One of the prevalent themes suggests that UREs served as contexts in which participants' agentic orientations were not only activated but also refined through exposure to unfamiliar environments. For some students, research participation involved navigating new linguistic, cultural, or institutional contexts that prompted shifts in how they perceived their role, capabilities, and independence within academic spaces. One participant described their summer research experience in the United States:

*"I was a little anxious and nervous because English is not my primary language and it was a little scary if I didn't express myself or didn't make friends or, kind of communicate well with other people from here. But I found that I have made a very good development in communicating with other people, making friends, communicating with my mentor, with my partners from my research summer program, and also right now here in my PhD. It allowed me an opportunity to be more independent of myself. So I will say that it was an experience of personal growth for me."*

This account reflects a shift in how the participant understood their capacity to engage within research environments. Initial uncertainty regarding communication and belonging gave way to increased confidence and independence, suggesting a refinement of agentic orientation. Rather than simply acquiring technical research skills, the participant described developing a different perspective on their ability to navigate academic spaces. Ongoing coding indicates that for participants, experiences involving autonomy, cultural adjustment, or new mentorship dynamics prompted similar re-evaluations of self-perception and responsibility. In these cases, UREs functioned as a setting in which students' internal lenses were challenged and reshaped through engagement with new structures and expectations.

## **Discussion**

Preliminary findings suggest that UREs may function as contexts in which students' agentic orientations are activated and refined through sustained engagement with authentic research environments. UREs appear to provide settings where students interpret ambiguity, autonomy, and mentorship structures in ways that shape how they later approach doctoral research [6], [7], [13]. Participants' accounts indicate that continuity between UREs and doctoral study is interpretive, reflecting how students understand their role, responsibility, and capacity within research systems.

From a theoretical perspective, these findings support conceptualizations of agency as cumulative and contextual, emerging through the interaction between students' internal orientations and institutional structures [10]. UREs may represent one site where this interaction becomes visible. For some students, research experiences reinforced existing orientations toward

independence and responsibility; for others, unfamiliar contexts prompted refinement of how they perceived and navigated academic spaces [10], [11], [12]. As a work in progress, this study contributes to process-oriented understandings of doctoral preparation between agentic orientation and capability across educational transitions.

## **Conclusion**

This work-in-progress study suggests that UREs may serve as early contexts in which students' agentic orientations interact with authentic research structures, shaping how they later interpret and engage doctoral expectations. Participants' accounts indicate that the transition into engineering PhD programs reflects the transfer of prior behaviors and the continuation and refinement of internal orientations toward autonomy, responsibility, and research engagement. Framing UREs as a developmental site where orientation and structure intersect shifts attention from outcome-based measures of preparation to the evolving relationship between agentic orientation and capability across educational transitions. Recognizing this continuity may inform the design of research and transition programs that intentionally build upon, rather than replace, students' prior interpretive frameworks and experiences.

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