WIP: Testing an Integrated framework of Motivation and Identity in a Doctoral Engineering Context

Marissa A. Tsugawa-Nieves
Department of Materials Science and Engineering
University of Nevada, Reno
tsugawam@nevada.unr.edu

Heather Perkins
Department of Psychology
North Carolina State University
hlperki2@ncsu.edu

Cheryl Cass
Department of Materials Science and Engineering
North Carolina State University
cheryl_cass@ncsu.edu

Adam Kirn
Department of Electrical and Biomedical Engineering
University of Nevada, Reno
akirn@unr.edu

***Abstract*—The purpose of this research category, work in progress (WIP) paper is to qualitatively test and refine our motivation-identity conceptual framework within the doctoral engineering teaching assistant (DETA) population. We developed our motivation-identity framework through previous qualitative research investigating doctoral engineering students' future goals where identity emerged through their discourse. To capture multiple roles in graduate programs, we chose a DETA population to test our integrated framework for transferability. A codebook containing codes, categories, and themes that we created through our past research will be used to test our framework on a DETA population. We collected two sets of qualitative data from 16 participants: timeline and interview. These two pieces of data will be coded together to validate and expand the framework by using a directed content analysis. By understanding the ways in which identity and motivation interact and influence the doctoral experience we can target aspects of doctoral training that may serve to undercut or suppress development of these affective characteristics.**

***Index Terms*—engineering doctoral education, motivation, identity, qualitative research, transferability**

I. Introduction

A special issue of the *Journal of Engineering Education* in 2014 called for systematic strategies for transforming undergraduate engineering education to improve pedagogy [1]. Besterfield-Sarce et al. [2] and Matusovich et al. [3] in the same special issue identified the valuing of research over teaching in academia as a barrier for transforming engineering education. While this research investigated the gaps between research and teaching practices at faculty and higher levels, we will examine this barrier at the doctoral student level. We investigate this barrier in doctoral education because few teaching assistant and doctoral programs provide rigorous pedagogical training to instill the value of teaching in doctoral students [4], [5]. Thus, doctoral level teaching assistants are appropriate to investigate as graduate teaching assistantships serve as a potential mode for developing value in evidence-based teaching practices in the next generation of faculty [6]. Specifically, we seek to elucidate how doctoral engineering teaching assistants (DETAs) navigate their graduate programs through their roles as both an educator and a researcher to achieve their future career goals.

Few studies in engineering education have empirically investigated the influence of both motivation and identity on graduate [7] or teaching experiences [6], [8]. For example, the research conducted by Kajfez and colleagues on engineering graduate teaching assistants focused on engineering graduate teaching assistants' motivation to teach and their identity as a teacher to improve developmental experiences in graduate teaching assistantships. In our research [7], we found that engineering doctoral students used their identities when discussing their future-oriented motivation [7]. This finding led us to develop our integrated motivation and identity conceptual framework. Our framework considers the graduate experience as a whole and temporal aspects (past and future) as opposed to only teaching experiences in the present. We seek to qualitatively test and refine our integrated framework in the engineering graduate teaching assistant setting to conceptualize doctoral students' teaching and research experiences where our past work only considered their research experiences [7]. Specifically, we seek to answer the research question: How does our integrated framework (based on engineering doctoral students at a western land-grant institution) transfer to DETAs?

II. Prior Work

Our work builds off of the Identity-Based Motivation work of Oyserman and colleagues [9]. Oyserman's work argues that one's expressed identity is dictated by the environment an individual is in and serves to influence how one will be motivated in that environment [9]. In our work, we sought to apply this framework to the experiences of engineering doctoral students to improve graduate education practices [7], [10]. In our qualitative work exploring how Identity-Based Motivation as described by Oyserman and colleagues

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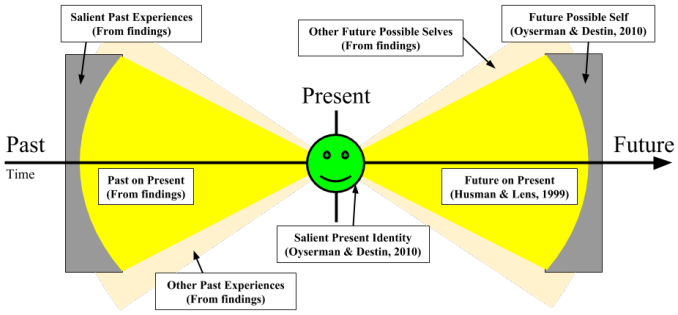

Fig. 1. Visual representation of our integrated framework where the left side represents past components and the right side represents future components. The center is the present time.

transferred to doctoral engineering contexts, we found that students utilized identity constructs as previously described in engineering and utilized future oriented motivations when describing their experiences [7], [10]–[12]. Given this new information, we created a conceptual framework integrating identity and motivation that explicitly considered the temporal aspects of each framework. Identity develops in the past while motivation comes from future goals. The present is where one makes sense of the past and future to persist through tasks. Fig. 1 represents the interaction between the past and future with the present. In this representation, the person in the center shines a light toward the past and future and important parts in each are reflected back to the present to inform the person. As such, the past serves to inform the present, the present is where one makes sense of their identity and future goals, and the future holds the goal to be attained. In the following sections we further define the framework and connect it to previous literature. Then we discuss our utilization of the framework in a new study to test the transferability of the framework to other doctoral engineering experiences, here to the experiences of DETAs.

III. Conceptual Framework

A. Past

Past experiences serve as important markers for the development of role identities (e.g., engineer [13] or physicist [14]). The developmental pieces of a role identity include finding interest in, being recognized for, and experiencing positive performance in the particular role [13], [15], [16]. Role identity development occurs as a result of students' past experiences. As such, investigating important past experiences can inform us on when and what experiences are most influential for role identity development [17]. Thus, we characterized the past based on our qualitative findings [7] and identity literature with three constructs shown on the left half of Fig. 1: past salient experiences, other past experiences, and past on present.

Past salient experiences consider important developmental experiences [18] that stand out to a student and helped them develop a particular role identity (e.g., engineer). In previous studies [7], [17]–[19], engineering students utilized engineering related past experiences, such as those experienced in high school, to justify their decision to be in their engineering program. We will use past salient experiences to identify critical events that led DETAs to enter their graduate programs.

In contrast, other past experiences include experiences not directly related to the role identity but still important to the self-concept. This construct considers the other experiences that an individual finds important to who they are, but do not explicitly relate to the present context [17]. From our past study, we found that these other experiences influenced students' decisions to enter their graduate programs and development of their future goals [7]. Additionally, as we conceptualize identity as dynamic in nature, it is necessary to consider other experiences in the development of the self to observe the interaction and navigation of multiple role identities. Other past experiences allow us to understand what experiences are important to DETAs' other role identities.

Past on present refers to how students connect their past experiences to present contexts. In particular, connecting the past and present examines how an individual utilizes their past experiences to make sense of present behaviors and actions to navigate the context [7]. Connecting the past with the present allows one to justify what they are going through (e.g., graduate program) with what they identify as (e.g., researcher). With past on present, we can observe how DETAs justify being in a teaching assistantship and graduate program based on their past salient and other experiences.

B. Present

Students make sense of and dynamically construct their identities in the present to resemble their imagined future identity [9] and perceive usefulness in tasks to achieve goals [20]. Individuals make decisions in the present to take action to pursue and persist through tasks. In particular, we considered present salient identity, such as engineer role identity, that comes to mind during their tasks. The happy face in the center of Fig. 1 represents the salient identity of an individual. The level of congruence of present salient identities with future possible selves serves as the motivator to pursue action in the present.

C. Future

Goal setting in education contexts serves as direction for students to pursue their academics [21]. Particularly, long-term career goals motivate students to pursue present academic tasks that they perceive to be necessary to attain their career goals [22], [23]. Additionally, Oyserman and colleagues showed that when students believe that present tasks align with their future career goals then they persist through difficult tasks [9], [24]. The three future constructs we use are represented on the right half of Fig. 1: future possible self, future on present, and other future possible selves.

Future possible self is an identity concept that refers to the future role identity a person imagines themself to be [9]. This construct relates to future career goals as it reflects how one sees themself in a particular role in the future [23]. Thus, we operationalize future possible self as a person's set of

future career goals. We are interested in how diverse future career goals interact with the present identities of DETAs to investigate how they find use in their teaching experiences relative to their futures. For example, a DETA may want to start up their own company and find leadership skills as important. In this situation, the DETA may find a teaching experience useful in developing leadership skills.

Other future possible selves refers to the other role identities a student imagines themself to be in the future. As we assumed identity as dynamic in nature, it is logical to also consider the other future possible selves an individual envisions being in their future [7]. These other identities may not be explicitly related to the context, they are important parts of how an individual views themself in their future. In particular, we can use this construct to investigate how DETAs incorporate pursuing other tasks outside of research and teaching to reach those other future selves (e.g., becoming a parent).

The next construct, future on present, considers how a person connects the present and future through cognitive processes such as planning [22], [25]. Literature suggests that students with a stronger connection between the present and future perceive an increased usefulness of their present academic tasks [22], [23], [26], [27]. In our study, we will investigate how DETAs connect their teaching and research experiences to plan for their future goals.

D. Vignette

To illustrate how these constructs work together, we present a vignette of Margarita, a mechanical engineering doctoral student who identifies as a Latina and cisgender female from a low socioeconomic status family. Margarita attended a science, technology, engineering, and math (STEM) high school, served as president on the robotics team, and graduated as valedictorian in addition to working a part-time job to help support her family. From her experiences in high school, Margarita decided to major in mechanical engineering at a nearby university to someday become an engineering professor so that she can serve as a role model and inspire girls like her to pursue STEM fields. In her undergraduate program, she started up a robotics club, continued to work part-time to support her family, joined a research group, and graduated in the top 5% of her class, and she was accepted to a top-tier graduate school. However, family is important to Margarita so she decided to stay at her current university. As a doctoral student, Margarita felt like her undergraduate research experience prepared her well for a doctoral program. She works hard to complete her research tasks to grow as a researcher and volunteers her spare time to outreach activities at local high schools.

Margarita demonstrates the seven constructs we defined above. Her present salient identity is that of an engineering graduate student researcher. This present role identity as a researcher makes sense to Margarita (past on present) from her undergraduate research experience (salient past experience). Additionally, her past experiences in high school and college helped her develop as a STEM person (other past experiences). Her decision to work to support her family is also other past experience as her role in her family is important to her identity, but is not directly related to her future career goal. Margarita imagined herself in the future, or future possible self, to be an engineering professor. She works hard in the present to grow as a researcher (future on present) and takes time to do outreach which relates to her other possible future self as a role model to girls like her. Overall, Margaritas past experiences helped her develop her present role identity, which led her to imagine her future possible self. Having both salient past experiences and a related possible future self helped her make sense of her present role identity.

IV. Methods

To test our framework, we will conduct a directed content analysis (DCA). DCA is a deductive coding method with the purpose of validating or extending theoretical frameworks or theories [28]. This method is appropriate for this study because testing our integrated framework will validate or extend its components. In this section, we discuss the development of our codebook and our data collection and analysis processes for testing the framework.

A. Participants

Email invitations were sent out to engineering doctoral students who are teaching assistants (TAs) at institutions with post-secondary STEM education programs. We chose this population to capture students' experiences with multiple roles in their graduate programs. Additionally, exploring multiple role identities can capture how present contexts can influence the dynamic nature of student express of a role identity. Also, institutions with post-secondary STEM education programs were chosen because students may utilize these programs to develop their educator role identity. In total, 16 students participated in one-on-one interviews across three institutions. The demographic make-up of the participants is shown in Table I that was collected through the online survey. We presented gender identity in lieu of sex to allow participants to express how they view themselves [29]. The race/ethnicity categories reflect that of the United States census. We also expanded our demographics to capture the experiences of international students who traditionally make up more than half of the graduate engineering population [30], [31] and are reflected in our sample.

TABLE I
DEMOGRAPHIC MAKE UP OF THE 16 PARTICIPANTS. OTHER GENDER IDENTITIES (E.G., AGENDER) AND RACE/ETHNICITY IDENTITIES (E.G., MIDDLE EASTERN OR NORTH AFRICAN) WERE OMITTED AS NO PARTICIPANTS IDENTIFIED IN THESE CATEGORIES.

	Domestic	**International**
	Gender Identification	
Female	2	5
Male	4	5
	Race/Ethnicity	
Asian	0	9
Hispanic, Latinx, or Spanish origin	0	1
White	6	0

B. Data Collection

To capture the interaction of identity and motivation frameworks through the past, present, and future, we collected two sets of qualitative data and one set of quantitative data. The first qualitative data is a written timeline. Participants were given a paper with a horizontal line with a midpoint labeled as "present" which represents time. The participants were prompted to mark the timeline with important past, present, and future events. We encouraged them to also include those events that do not directly relate to being in an engineering doctoral program but were still important to them. To prevent restrictions on time being conceptualized as linear, we informed the participants that they could organize the events however way they imagined their life events. The second qualitative data is a follow-up interview. The interviewer asked the participant to expand on their timeline to understand how the events influenced one another. Both these pieces of data can be analyzed together with our codebook to test our integrated framework. The quantitative data was collected through an online survey which obtained demographic information from each participant.

C. Codebook Development

As DCA requires an initial theoretical framework, we developed a detailed codebook that represents the constructs in our integrated framework. In particular, this codebook served as a record to keep emergent codes organized [32] and "provide[d] a stable frame for the dynamic analysis of textual data" [33]. Specifically, the codebook provides details such as definitions, examples, and counterexamples.

The codes within our codebook were developed from the results of our previous study [7] using Saldaña's coding guidelines [32]. Our codebook consists of three main themes (past, present, and future) and seven main categories (salient past experiences, other past experiences, past on present, present salient identities, future possible self, other future selves, and future on present). An example of a code is "academic career" which is within the future theme and future possible self category.

D. Data Analysis: Coding Process

There are two approaches to code for a DCA [28]. The first approach is to code the data by using the codebook and create new codes that describe data not captured by the given codebook. The second approach is to code the data without the guidance of the codebook and compare the emerged codes with our codebook for similarities and differences. We will use the first approach because we are testing for transferability of our conceptual framework. As such, coding the timelines and interviews will be done using our codebook.

The coding process will occur in two phases: the first phase is coding the timeline and the second is coding the interviews. The primary analyst (first author) will code one participant's data set by first coding the timeline and then the interview using the codebook. This process will consist of highlighting parts on the timeline and in the transcription to indicate a code. They will also provide descriptive annotations that note why the hightlighted text is a code from the codebook. After this initial coding process, they will go through the timeline and interview to create new codes for data not coded through the codebook. These new codes will be recorded in the codebook along with descriptive information such as definitions and which particpante the code came from. After coding each participant individually, the primary analyst will interpret the new codes to determine how they fit with our conceptual framework. These results will expand our codebook and provide clear and nuanced definitions of the framework for the engineering graduate context.

E. Process Reliability

To ensure trustworthiness and confirmability of the primary analyst's coding process, we will use the quality guideline for process reliability provided by Walther, Sochacka, and Kellam [34]. First, we will transcribe the audio-recorded interviews verbatim through a professional transcribing company. Each transcript will be checked and corrected for accuracy by the primary analyst. During the coding process, the primary analyst will provide documentation of the analysis process in which a secondary analyst can audit for clarity and to reduce interpretive bias. The primary analyst will create a brief overview of the participant that includes the codes used from the codebook, new codes, and a summary of the combined (timeline and interview) findings. Then, the secondary analyst will audit the primary analyst's process by coding the data with the codebook that includes the new codes created by primary analyst. Any discrepancies will be discussed with the research team to determine the appropriate code or refine the previous codes. Further, we consider a participant's complete data set (timeline and interview) as a unit of analysis; thus, the primary analyst will code one participant's complete data set at a time.

V. Future work

The analysis through this research can demonstrate the transferability of our motivation-identity conceptual framework. Additionally, the analysis will provide us with a context-specific model of the framework required to answer our broader research question of how do doctoral engineering teaching assistants (DETAs) navigate their multiple roles in their graduate programs to achieve their future goals? By conceptualizing DETAs' holistic experiences as educators and researchers, we can begin to develop graduate programs that help develop DETAs into educators *and* researchers to prepare them for academic roles. Further, our work can be expanded to explore generalization beyond the scope of this paper by administrating our survey to larger samples.

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