

PROFESSIONAL IDENTITY DEVELOPMENT OF MATHEMATICS TEACHING ASSISTANTS

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This study examined how the social interactions that mathematics teaching assistants (TAs) have within their institution influenced their professional identity development as early-career undergraduate instructors. We drew on a sociocultural perspective of professional identity development in higher education to examine TAs' interactions with students, faculty, and other TAs. We qualitatively analyzed five mathematics TAs' responses to semi-structured interviews and found that some dimensions of their identities were more frequently situated within specific relationships, while others were evident in multiple relationships. Overall, the social interactions were sites for professional identity development. Identity is a complex construct, and a better understanding of how professional identity is developed can inform higher education institutions on ways to support positive identity development of future mathematics instructors.

Keywords: Professional Identity, Teaching Assistants, Higher Education

Introduction

Research on classrooms and pedagogies in recent decades has elucidated the central role of professional identity in teachers' learning and development (Beijaard et al., 2004). We draw on this research, particularly the notion that identities are complex, dynamic, social, contextual, multi-faceted constructions (Solari & Ortega, 2020) and that they underscore teachers' pedagogies, affect their motivations to teach, inform their instructional approaches, and guide the way they navigate their profession and execute their roles (Berger & Lê Van, 2019; Sachs, 2005). A large body of research has explored the identity development of mathematics teachers in teacher education programs and K-12 contexts (e.g., Sachs, 2005), however, there is still limited work examining the professional identity development of individuals involved in higher education mathematics instruction - particularly mathematics teaching assistants (TAs).

Mathematics TAs play a crucial role in undergraduate instruction and are, in many ways, early-career mathematics instructors. After their graduate studies, many TAs continue to teach in higher education, but historically, STEM graduate programs have inadequately prepared their students to teach and have done little to help them develop their identities as educators (Hancock & Walsh, 2014). Thus, examining graduate students' development of their professional identities is especially important and can inform the ways mathematics departments, and broadly, institutions, prepare their graduate students to be future educators. We drew on a sociocultural perspective of professional identity (Beauchamp & Thomas, 2009; Solari & Ortega, 2020) development in higher education (Clarke et. al, 2013) to frame this study. A sociocultural lens accounts for the institutional contexts that TAs navigate, the social domains that exist, interactions with members of their community that occur, the roles individuals perform, and the intrapersonal domain, or identities they assigned to themselves. Our research questions were: (1) How did mathematics graduate students reflect on their developing professional identities? (2) How did TAs' professional identities develop within social interactions?

Framing and Literature Review

Researchers have previously defined and classified the construct of identity in numerous ways. Identities can be institutional, based on an affiliation with a group, or even discursive (Gee, 2001). Additionally, identities can be independent or interdependent (Fryberg & Markus, 2003), and they can be based on others' perceptions (Markus & Wurf, 1987; Sfard & Prusak, 2005). Drawing on these notions, we view identity as: "a dynamic view of self, negotiated in a specific social context and informed by past history, events, personal narratives, experiences, routines, and ways of participating" (Bishop, 2012, p. 38). Framing these ideas in a professional environment, we define professional identity as an ever-changing view of one's obligations, role, and attitudes situated in institutional, social, and cultural contexts. A professional identity includes emotional components such as attitudes and beliefs (Wenger, 1999), which are often left out when considering one's self-perceptions. Factors that influence professional identity include the direct work environment, the wider context of higher education, interactions with students, and professional development activities (van Lankveld et al., 2017), which serve as a basis for examining how situated contexts can affect graduate students' professional identities.

More specifically, we drew on a sociocultural perspective of professional identity development in higher education to frame this study (Beijaard et al., 2004; Gee, 2001; Clarke et al., 2013). The formation of professional identity in higher education is a social and contextual process, and the other actors with whom an individual interacts play salient roles in helping an individual build identities and meanings for themselves as a professional (Solari and Ortega, 2020). Mathematics TAs navigate a complex interpersonal network that involves students, faculty, and other TAs, all situated within a broader institutional context and the mathematics discipline. The expectations of this community, the institution, and the discipline can shape the roles that TAs perform, thus affecting their professional identity development as higher education instructors. Situated within a specific institutional context and the mathematics discipline, we examined emerging professional identities that resulted from four key relationships (See Figure 1). We acknowledge that factors outside of the institutional context, mathematics discipline, and the four key relationships we have identified here (e.g., family, relationships, stress of the profession, etc.) can also affect professional identity.

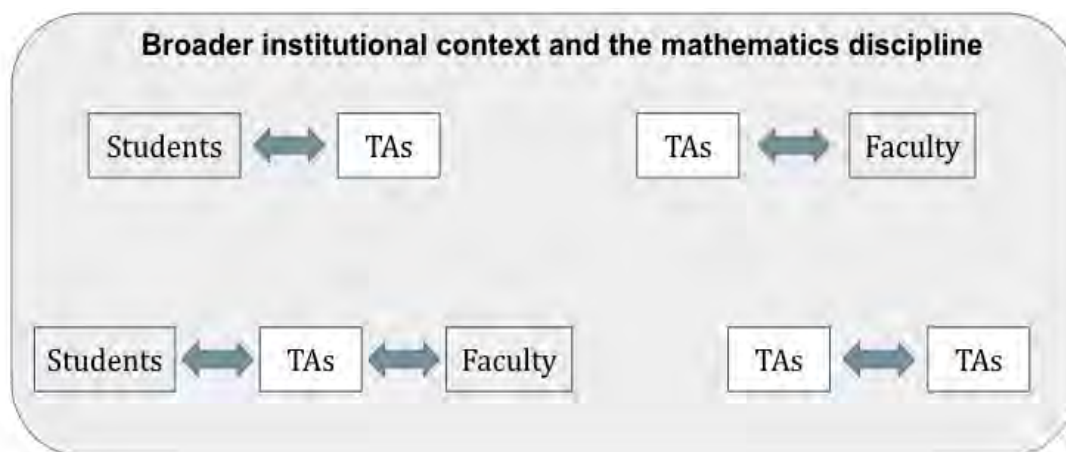


Figure 1: Teaching Assistants' Relationships within an Institution

Method

This study was conducted at a Minority-Serving Institution in California. It was a part of a larger project that examined the experiences of transfer students enrolled in a set of courses designed to develop proof-construction competencies and support transfer students' transition to a four-year university. Purposeful sampling (Creswell, 2013) was used to recruit five PhD students in the mathematics department who served as TAs for an introductory proof course, which was situated in number theory and set theory. All participants facilitated online sections of the course, were in the 2nd or 3rd year of their doctoral program and had prior experiences as TAs. Three self-identified as male and two self-identified as female. We use the pseudonyms Federico, Nestor, Wyatt, Kaitlyn, and Lisa to refer to the five TAs interviewed for this research project. We conducted semi-structured interviews (Rubin & Rubin, 2011) over Zoom that focused on the TAs' experiences enacting sections remotely, the ways the course supported underrepresented and non-traditional (i.e., transfer) students, and the TAs' perceptions of their identities and roles as TAs and early-career educators. The research team first open-coded the TAs' responses and identified themes in the TAs' reflections. The team recoded the corpus of data using the following second round codes to describe the complexity and multidimensionality of their professional identities: *content-deliverer*, *sensemaker*, *community-builder*, *assistant*, *supporter*, *mentor*, *resource sharer*, *learner*, *beliefs and values*, and *demeanor*. The research team discussed and wrote memos about emergent themes in how the TAs described their professional identities, and also coded for the individuals that TAs described as salient to each facet of their identities (i.e., students, faculty, and other TAs).

Findings

We found that graduate students reflected on their developing professional identities in a number of different ways, with their professional identities developing within certain social contexts (e.g., Student-TA relationship, TA-Faculty relationships, Student-TA-Faculty relationships, TA-TA relationships) in which the TAs were situated (e.g., *content deliverer* was most associated with the Student-TA relationship). It is important to note that professional identity is a complex construct, and all interactions and relationships are influential in developing identity. However, we only present the most salient professional identities that emerged from the TAs' reflections on the four relationships.

Professional Identities That Developed from the Student-TA Relationships

In this section, we highlight the important aspects of the TAs' professional identities most situated in the relationship between students and TAs: *content-deliverer*, *sensemaker*, *community-builder*, *supporter*, and *beliefs and values*. The TAs noted that they were engaged in these different relationships with students as part of their roles. We describe each aspect of their identity and highlight examples of instances when the TAs revealed their perceptions of their identities as it relates to students.

Content-Deliverer. As *content-deliverers*, the TAs viewed themselves as individuals who delivered mathematics content to students, whether presenting the same content professors lectured on or reviewing material from previous classes. For instance, Wyatt explained, "I found that I'm more effective as a TA when I can just cover a lot of material, because my strength is being able to explain it in a digestible way." Here, Wyatt identified himself as someone who delivers content and he saw his effectiveness in this role. Another TA, Nestor, described his identity as a *content-deliverer*, saying that "I should just be like a - not literally but, like a bit of a copy paste of what the professor has said in lecture. Sometimes just repetition." Nestor believed his role is to reinforce the same content to students in section that the professor delivered during

lecture. We found that *content-deliverer* was an important aspect of TAs' professional identities illustrated by all participants.

Sensemaker. The professional identity of *sensemaker* emerged as TAs described engaging in sensemaking efforts of the circumstances and individuals around them. In the social context of Student-TA relationships, the TAs engaged in sensemaking to better understand their students' experiences including students' content knowledge, emotional well-being, challenges related to their university experiences, and difficulties associated with the remote-instruction brought upon by the COVID-19 pandemic. For instance, Kaitlyn made sense of the challenges the students in her class faced noting: "There's also an intensity that comes with Math A that maybe make students feel a little bit more, I don't know fearful about doing perfect in the class or whatever." In another instance, Lisa remarked about the unique challenges students of a particular gender face when she said, "The people who speak out are male, but there [are] definitely a few female students who were talkative. But yeah so that's all I really noticed." In this moment, Lisa made sense of the gender and social dynamics in her classroom and how those affected their participation. We found many instances of sensemaking centered around students' experiences and this illustrates that a salient part of TAs' professional identities involved how they noticed, made meaning, and took action to attend to their students.

Community-Builder. *Community-builder* referred to the instances when TAs described taking action to build community with students or among students. Most instances of a TA building community took on one of two forms. The TA either worked to create community among students or the TA would talk with students about non-mathematics related topics during office hours. For example, Lisa commented, "I tried to do a lot more of like breakout sections and like try to get students to talk to each other, because I was like you don't ever see each other, trying to talk to each other." Lisa engaged in community-building efforts to get her students to interact with one another on Zoom and to become more familiar with one another. Later, Lisa commented that she often tried to start class with a question to get to know what and how her students were doing outside of the class. She expressed that she was able to best engage with students on a personal level during office hours: "I'll mostly be, like 'Anyone do anything fun on the weekend?'" and then usually be met with silence. But in office hours, I had students like linger around and talk to me, so that was fun." Many of the efforts related to building community were in response to the challenges presented by the pandemic, as TAs would often express difficulties with building community in the online learning environments in which they taught.

Supporter. TAs reflected on how they supported students through encouragement, offering emotional support, and advocating for their students; these encompassed the professional identity of *supporter*. TAs reported capitalizing on the interactions with students in office hours and sections to support their students. They recognized that part of their professional identities and roles included attending to students' affect and emotions, and they were cognizant of providing students with support throughout the quarter. For example, during the remote instruction brought upon by COVID-19, TAs recognized that it was an extremely difficult time for students and described themselves as being someone to whom students could talk, beyond just discussing the mathematics content of the course. For example, Nestor described an interaction during one of his synchronous office hours when he conversed with a student about aspects of each other's lives that did not directly relate to the mathematics content. He said, "I don't know exactly how we ended up there, but I guess she just needed someone to talk to that night, and I was the one for whatever reason, because in Zoom you can't really reach out to anybody else. Right?" He recognized a student's need and was able to provide her with some emotional support. Other

ways that TAs provided support for the students was to advocate for them. Federico described listening to students' requests and complaints during office hours and relaying that information to the faculty. Through advocacy, offering encouragement, and overall, showing care, we found that TAs were active *supporters* of their students.

Beliefs and Values. As they reflected on their relationships with students, we also found a set of *beliefs and values* that described what TAs believed about their students, how they understood their students learned, and how TAs thought they should help their students engage with mathematics. Federico, for example, shared that his students did not learn in the same ways, and TAs should be able to support and teach all students. This belief affected his approach to teaching. In another example, Wyatt described how in his past experiences as an undergraduate student, he was taught mathematics through a narrow lens, and he believed that students needed to be allowed to be creative in mathematics for them to learn well. A common belief that many of the participants held was that a TA should help students engage with mathematics by creating learning spaces where students would feel comfortable to participate, make mistakes, ask questions, etc. This idea of fostering a comfortable space for students was the most prevalent belief that the TAs held. For example, Kaitlyn said, "I think there's a little bit of gaining that trust in your students. That they could come, they feel like they can come to you with all their questions... You want them to feel comfortable." This belief about how TAs should teach mathematics can influence their pedagogies and the ways they interact with students.

Professional Identities That Developed from the TA-Faculty Relationships

Next, we focus on the interactions between TAs and faculty. In this social context, faculty were the instructors on record for the sections the TA managed. The three key facets that TAs reflected on related to their professional identities that were most evident in this relationship were *assistant*, *learner*, and *sensemaker*. Evidence of these professional identities included the TAs assisting with grading, answering students' questions, sharing their own learning of content (and enjoyment in learning this content), and making sense of their relationships with faculty. The professional identities of *assistant* and *learner* only occurred in the TA-Faculty relationship, while *sensemaker* also occurred in the Student-TA relationship.

Assistant. Quite frequently, the TAs would position themselves as individuals whose purpose and role was to assist the faculty. This notion underscores the professional identity of *assistant*. The TA used words like "helper" or "grader" to signify their role as an assistant to the faculty member with whom they worked. For instance, Lisa shared, "[I] just do some of the grunt work of the grading and background work that needs to get done. You know, it shouldn't lie fully on the professor's hands. Just a helper, a solid helper." In this instance, Lisa identified and gave merit to helping and assisting the faculty she was working with through grading exams and doing background work. Additionally, Kaitlyn, reflected on her role and expectations as an assistant and said, "As far as the professor goes, you know, they expect you to go through homework problems and answer questions that students have and grade a little bit." In this moment, Kaitlyn acknowledged that many faculty members had specific expectations of their teaching assistants. Additionally, Federico described his relationship as an assistant to his faculty member, noting, "He told me things to do. That's what I did." The consistent use of language, such as "He told me things to do," and "grunt work," and the description of TAs' self-described roles frequently occurred across the data set. The professional identity of an *assistant* was only observed in the context of TA-Faculty relationships.

Learners. We observed another dimension of professional identity that only appeared in the social context of relationships involving TAs and faculty: *learners*. TAs described their

experiences as learners, both past and present. This illustrated that they were not only teachers and individuals meant to deliver content or support students. TAs saw themselves as learners of content, learners of pedagogical methods, and learners of resources. Nestor described his experience of learning content in a new way, explaining, “I feel like every time I revisit a concept... I always learned something new, just for myself or like a different perspective, different angle, because the professor looks at it from a different, in a different way.” Nestor identified himself as a learner through his exposure to former content through a new lens, expressed his enjoyment of having the opportunity to be a learner, and engaged with the content differently from how he previously learned it. This professional identity signifies an important role that TAs can take up and it is their capacity to see themselves as both instructors and learners.

Sensemaker. TAs reflected on their professional identity as *sensemakers* within Student-TA relationships in instances when the TAs tried to better understand students’ experiences. Within the social context of TA-Faculty relationships, *sensemaker* describes how TAs noticed and made meaning of their relationships, interactions, and experiences with faculty. For example, Wyatt made sense of a faculty’s pedagogy and instructional practices, saying, “Well, you know, in an ideal world, of supposing that they had more time to concentrate, I think one thing they could do is just help TAs better know how to grade assignments.” This moment highlighted Wyatt making sense of how a faculty member interacted with him and could support him as a TA. He was forming thoughts on the pedagogical practices of faculty from past and current experiences while making sense of what could be done to better assist TAs. In another instance, Lisa commented on her experience with faculty and what she felt would best benefit her as a TA. She explained, “I think just more communication of like what is actually expected of us. Sure, you’re supposed to teach four sections, do certain amount office hours, work the math lab, but, how do you do all those jobs?” Lisa was actively making sense of her past and current experiences with faculty, while also considering how to improve that relationship. She identified areas where faculty could improve their practice through understanding TAs’ challenges and reflecting on their experiences working with these students. Broadly, the professional identity of *sensemaker* entails the active process of understanding, making meaning, and taking action within a TA’s social context.

Professional Identities That Developed from the Student-TA-Faculty Relationships

We distinguish the Student-TA-Faculty relationship from just the Student-TA relationship and the TA-Faculty relationship because we observed that TAs often described themselves as individuals who bridged students and faculty. Therefore, these aspects of their professional identities and roles were the result of understanding how they mediated the various expectations, perceptions, and needs of both students and faculty. As Kaitlyn noted, “it’s kind of exactly what it seems: like you’re this middle ground between the professors and the students.” TAs identified two aspects of their professional identities in relation to *both* faculty and students: *content-deliverer* and *demeanor*. TAs delivered content in order to meet their students’ needs, in light of what the faculty member had taught, and they presented themselves to students often in response to how they understood their students perceived the faculty.

Content-Deliverer. Although TAs reflected on their professional identities as *content-deliverers* within the Student-TA social context, TAs revealed that faculty delivered content in one way, but as TAs, they should deliver the content differently to better attend to the needs and expectations of students. Often, TAs reflected that offering the content in ways that were different from the faculty would be beneficial to the students. Nestor shared, “If you revisit the...same concept, maybe through a different angle, then you can understand it better.”

Demeanor. The second aspect of TAs' professional identities within the Student-TA-Faculty social context was *demeanor*. TAs acknowledged students' perceptions of faculty (usually in a negative way), and TAs portrayed themselves in ways that differed from faculty. When asked about her primary role, Lisa said, "Just to be someone who is less scary than the professor. My job is just to be approachable." Here, Lisa noted that approachability was an important consideration for TAs because of the common perception that professors were "scary." Similarly, Kaitlyn shared, "I think part of our role as a TA is just to, sort of, be that middle ground between the scary professor and any intimidation." The ways in which Lisa and Kaitlyn portrayed themselves, particularly as caring and approachable to students, shed light on their understanding of *demeanor*. How TAs presented themselves to students was an important part of their professional identities, particularly in relation to mediating students and faculty.

Professional Identities That Developed from the TA-TA Relationships

Lastly, the ways that TAs navigated their responsibilities and roles alongside other TAs highlighted their capacities to be *resource sharers* and *supporters* of each other. Reflecting on her experiences with remote instruction, Kaitlyn revealed how the TAs in the mathematics department supported each other by giving advice, and they used various online platforms to share resources that may be useful to address the challenges of conducting sections online. She explained, "I think we gave advice to each other, and we have a Discord [online platform] for our math grads, so people talked about teaching advice and...what programs they like to use, apps they like to use to teach." TAs supported each other by offering advice and directing each other to teaching resources. These relationships illustrate the dimensions of their professional identities best described as *resource sharers* and *supporters*.

Discussion

Through a sociocultural perspective on professional identity development, we found that the relationships and interactions that TAs have with members of their mathematics community and institution were sites for identity development. Beauchamp and Thomas (2009) wrote that identity "is shaped and reshaped in interactions with others in a professional context," and we found that TAs reflected on a range of professional identities. Certain aspects of their identity were more frequently situated within specific relationships such as *supporter* most often occurring within the Student-TA relationships, and *resource sharer* most often occurring within the TA-TA relationships. However, other dimensions of their professional identities such as *content-deliverer* and *sensemaker* were evident in multiple relationships such as the Student-TA, TA-Faculty, and Student-TA-Faculty relationships. We found that the Student-TA relationship was not only the most frequently mentioned interaction but also through which multiple dimensions of their professional identities were revealed.

While the key tenets of each professional identity remain the same across the relationships (e.g., *sensemaker* refers to noticing, making meaning, and taking action), the ways TAs perceived themselves as such depended on their company (e.g., the student or the faculty). For example, in the context of a Student-TA relationship, being a *resource sharer* may look like a TA providing resources to students to support and engage learning. However, in the context of a TA-TA relationship, being a *resource sharer* may entail a TA sharing instructional resources with other TAs. This is consistent with existing research that acknowledges that the construction of professional identity development is complex, and that different relationships and interactions influence different aspects of their identity (Berger & Lê Van, 2019). Moreover, as the TAs reflected on their experiences and interactions, we noted how their professional identities were linked to their instructional practices and pedagogies. Each TA exhibited a unique set of

identities, and this was revealed through the ways they individually reflected on their roles and interactions.

We extend the literature on professional identity development in higher education by examining mathematics TAs as early-career undergraduate instructors. A sociocultural perspective on professional identity development affords an exploration of the key interactions that TAs engage and the dimensions of their identity developing and intersecting across these relationships and interactions. Limitations of this study include the limited number of participants (five) and that the participants of this study served as TAs for the same introductory proof course. In addition, all five participants were TAs for online sections of the proof course and this environment could elicit different aspects of TAs' professional identities than in-person instruction. Future research can examine more mathematics TAs across a broader range of courses, such as calculus, linear algebra, etc. Furthermore, for this study, we only focused on four key social context relationships, but TAs professionally interact with many other individuals including peers in other departments, staff, various organizations, and professionals outside of the institution. Future research can more closely examine the larger, complex network that TAs navigate and how identity is developed within this network, can focus on just one type of interaction (e.g., TA-TA), or can focus on one aspect of professional identity (e.g., *community-builder*).

Conclusion

The professional identities of mathematics instructors in higher education is still a largely under-researched area of mathematics education. With many mathematics graduate students continuing to become teaching faculty themselves, it is imperative that we examine how their professional identities are developed, particularly related to their experiences as TAs. The professional identities that mathematics TAs develop through their social interactions and relationships with members of their professional community not only influence their current positions as TAs but provide a foundation for their future careers, pedagogies, and practices. Identity development is a constant process throughout the careers of mathematics educators, and it is important to acknowledge that even prior to formal appointments as a teaching faculty, their experiences – such as serving as TAs during their graduate programs – have already shaped their professional identities. A sociocultural perspective of identity development affords a lens through which researchers can identify and examine the extent to which experiences related to being a teaching assistant impact the development of professional identity as a mathematics instructor. Understanding the nuances and complexities of how professional identities of future educators are developed can inform higher education institutions on how to better develop positive professional identities of mathematics graduate students.

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