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Becoming a STEM Teacher: Examining teachers' practice-linked identities through practice-based autobiographies

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Abstract: To provide equitable high-quality STEM education, teachers must be prepared to engage with the tools and practices *and* to adopt STEM identities. This project investigates the ways teachers' self-described histories and conceptions of materials and relationships embedded in their STEM experiences fostered or inhibited practice-linked STEM identities. Preliminary findings explore how practicing and pre-service educators conceptualize STEM and how their understanding of STEM both supports and challenges their teaching practice.

Introduction

Engagement in science, technology, engineering, and mathematics (STEM) disciplines continues to be lauded as a means to prepare youth for a multitude of possible futures. However, equitable access to learning environments where these skills are centered continues to be elusive, not least because many of the teachers who are expected to incorporate these skills into classrooms do not see themselves as STEM educators (e.g., Stamatis et al., 2021). In this preliminary analysis, we conceptualize STEM as a "figured world" (Holland et al., 1998). From this perspective, the ways an individual conceives of the world of STEM education has implications for how they perceive their own participation in the STEM education community of practice and how they use the material and interpersonal resources available to form practice-linked identities (Nasir and Cooks, 2009). We ask:

1. How do these teachers understand their own practice-linked identities with regards to STEM & CS?
2. What materials, relationships, and ideas do the teachers name as resources that strengthen or challenge their identities in STEM & CS?

Background

We frame this study through notions of practice-linked identities (Nasir & Cooks, 2009; see also Keiler, 2018) to build understandings of the ways educators who are learning to teach STEM subjects use material, relational, and ideational resources to adopt identities as STEM educators. Nasir and Cooks (2009) define learning and identity in practice as "shifts in the use of artifacts...for problem solving, sensemaking, or performance" and identity to be "one viewing participation in the practice as an integral part of who one is" (p. 42). We use this analytical frame within the larger sociocultural context of "figured worlds" and understand STEM as a "socially and culturally constructed realm of interpretation in which particular characters and actors are recognized, significance is assigned to certain acts, and particular outcomes are valued over others" (Holland et al., 1998, p. 52). From this framing, we see the resources identified by teachers and the ways in which they interact with these resources as informed by individual's understanding of STEM and what it means to be a legitimate participant in the STEM education community (Wenger, 1998).

Methods

This project incorporates multiple sets of data with more than 90 educators who were engaged in teaching STEM in formal educational contexts. In the first dataset, pre-service elementary teachers wrote "mathographies" about their experiences with mathematics at the beginning of a mathematics teaching methods course (Drake, 2006) and then completed a follow-up reflection at the end of the course. In the second dataset, in-service teachers seeking an add-on endorsement wrote autobiographical essays about their experiences with computer science. The final data set is a series of ethnographic interviews with pre-service and practicing teachers where questions were codesigned to elicit understandings of teachers' identities with STEM. Teachers were asked to describe their previous experiences with STEM and the ways that they identified or did not identify as STEM educators. Preliminary analysis used rounds of emic and etic coding to establish understandings of the ways that teachers described materials, relationships, and ideas and how their descriptions mapped onto their identities as STEM educators. Following Nasir and Cooks (2009), we also looked for the ways that participants across data sets described their experiences with and goals for learning STEM tools, practices, and expertise.

Findings

Across these projects the context of data collection was within programs explicitly designed to train educators to build practice-linked identities in STEM through engagement with tools and materials, specific practices, relationships with other participants, and engagement in communities of practice beyond their own institutions. While several educators used their reflections and discussions to reinforce the ways they were developing these identities, the ways participants identified with STEM varied depending upon their past experiences, the strength of the relationships they built, their access to experts and peers outside of these programs, and their feelings of agency within their schools and careers. Expertise in STEM fields was sometimes a barrier to identifying as a STEM educator because some of these individuals did not identify as "teachers." However, perceived lack of expertise with STEM was also a barrier when teachers felt their participation in the STEM community of practice was not legitimate or would always be peripheral.

For example, our initial analysis pointed to the ways that some participants described alignment with computer science education because of early experiences playing video games. These educators' willingness to see themselves as having previously engaged with STEM materials and environments meant that they saw fewer barriers to accessing and engaging with the tools and practices taught in these programs.

Conversely, participants who described negative childhood experiences with mathematics often experienced anxiety when tasked with completing time-based assessments, such as fact fluency tests, or engaging in conceptual or procedural work around rational numbers, seldom identified as "being a math person," despite speed of computation being an indicator of mathematical understanding.

In contrast, a few individuals who had transitioned into education from previous STEM careers, such as engineering, had established expectations for a STEM community of practice prior to engaging in these programs. While some of these educators leveraged that experience to suggest norms and collaborate to build relationships with peers, others expressed frustration with "teachers that don't have a ton of experience" and even used their expertise to set up barriers for participation such as refusing to engage with peers until they had mastered certain skills or computational literacies. While these teachers had framed themselves as STEM experts, their ideas about the figured world of STEM did not necessarily align with the kinds of ideas required for educators.

In alignment with Nasir and Cooks (2009), our initial analysis suggests that access to materials and relationships supporting engagement with the STEM education community make it easier to have an in-bound trajectory toward a STEM identity. Even an understanding of the discipline that might be considered illegitimate by experts can lead to an in-bound trajectory if the individual feels successful and supported in what they believe are the practices of the community. Participants' adoption of identities as STEM educators was also sometimes complicated by their other identities and by their understanding of what it meant to be a STEM educator.

Significance

Nasir and Cooks (2009) call for examining learning and identity as "intimately related to one another but also…[as] distinct processes" (p. 58). Our emerging findings align with these researchers' notions of practice-linked identities as mediated by "engagement, persistence, and goals" (p. 58). As teacher educators and researchers continue to seek ways to support more equitable access to STEM skills for students, we must also consider the ways that educators have access to the tools, relationships, resources, and ideas that will allow them to develop in-bound trajectories to communities of practice and figured world(s) of STEM (Holland et al., 1998). By continuing to develop understandings about the material, relational and ideational resources that STEM educators require to embrace these identities, we can better support them to build the confidence necessary to offer access to all students.

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