Towards Onto-Epistemic Justice: Making Identities and Agencies of Bilingual/Multilingual Learners Visible in Science Education

Shakhnoza Kayumova, University of Massachusetts Dartmouth, skayumova@umassd.edu
Akira Harper, University of Massachusetts Dartmouth, aharper@umassd.edu

Abstract: Science learning is not limited to knowledge and skills. This research draws on the expansive theories of learning, which recognize students' identities and their cultural and epistemic agencies as critical resources for learning. To this end, we examine how positioning students as cultural and epistemic agents helps them to recruit their diverse cultural, epistemic, and linguistic resources and in turn support students' developing identities.

Introduction

The field of science education continues to grapple with how to make science more equitable for students from nondominant communities, such as black and brown learners (e.g. African American, Latinx, Indigenous, etc.), who have been historically underserved in formal learning settings (National Research Council, 2012). National Frameworks (2012) conceptualize science and science learning as a "cultural accomplishment" and defines student engagement as the process of students becoming full participants of science learning communities (p. 283). However, the question remains, whose cultural and epistemological practices are positioned as legitimate and valuable in learning settings and how does this positioning influence what epistemic agencies and identities students have access to in science learning settings?

Theoretical framework

In this study, we draw upon onto-epistemic perspectives of learning (Lemke, 1998; Wortham, 2009) and utilize a positioning lens to explore how students come to understand their relations to science, as realized in local fields of actions, through roles and positions made accessible to them in science learning settings. Specifically, we focus on emergent bi/multi-lingual learners (more commonly identified as English Learners). Research in science education shows that due to language differences an overwhelming emphasis is placed on emergent bi/multilingual learners' academic language development, with an assumption that language is the primary and the principal mediator of science learning (Kayumova et al., 2018). However, the deficit attributed to the students' linguistic background may not only refute their "capacity as a knower," but also influence their developing science identities in negative ways (Flicker, 2007, p. 20). To this end, we examine how and when emergent bilingual students are afforded the opportunity to gain their own epistemic authority and are positioned as knowledgeable others, it allows them to recruit their diverse cultural, epistemic, and linguistic resources, to accomplish learning tasks. We draw on Rudolph (2003) to define epistemic authority in science as treating "certain knowledge claims as reliable" (p. 67). Positioning diverse learners and their cultural backgrounds as legitimate means expanding the epistemic boundaries of science and transforming the image of science, science people, science practices and tools.

Methods

Data collection was based on ethnographic methods such as participant observations, field notes, structured and semi-structured interviews, personal and group dialogues with students, video and audio-recordings of classroom events, extensive artifact and document collections in two seventh-grade science classrooms during one academic year and later in two-week longitudinal summer science program. In this paper we utilize video and audio data from the classroom and summer science program. For our video analysis, we employed Gutiérrez and her colleagues (2017) notion of "learning to see differently" (p. 30) examine how roles, positions, and tools afforded to the emergent bi/multilingual learners influenced how they expressed their epistemic agencies and science identity development. Gutiérrez and her colleagues (2017) describe the notion of "learning to see differently" (p. 30) as a way to "work with youth and communities' (p. 30) to embrace their strengths and creativity. Our learning to see differently approach also included inviting our research participants to become a part of our program development as we considered them to be our research partners.

Findings

Studies in learning sciences (Bang & Medin, 2010; Rogoff, 1984; Roseberry et al., 2010), demonstrate how young people can make-meanings of science using cultural and heterogeneous ways of knowing and being in the world, with everyday objects and practices. Positioning students as epistemic agents within our program meant providing

access to space, tools, and opportunities for students to shape what it means to do science or know science without questioning the validity or legitimacy of the approaches or cultural perspectives presented and enacted by students. Our observations showed that students took ownership of their learning and used various cultural, linguistic, and epistemic resources as their differences were celebrated within the context of our learning spaces. Although many of the students came from various multilingual backgrounds, they were able to engage and complete joint activities by translanguaging and code-switching with one another. They also deployed multiple modes (e.g. using gestures, drawing, etc.) and modalities (e.g. creating videos, artifacts, discussing, etc.) to accomplish tasks and express their knowledge to one another. The language productions (such as writing and speaking), tinkering with ideas, and various perspectives, became an emergent nature of their practices as they made sense of various scientific phenomenon.

Another common finding was that when students were positioned as leaders, creators, and producers of their own knowledge, this increased students' epistemic and cognitive engagement. We noticed patterns of silence and (in)activity among some the students and rowdiness in others, which traditionally could be perceived as (dis)engagement or disruptive. However, in both cases when students' bodily engagement was valued and positioned as legitimate, within the learning spaces, students developed science identities that were not in conflict with their social and cultural identities. For instance, Cristiano seems to be (dis)engaged in the first picture from the video (see Figure 1), however after a period of perceived (in)activity, he shows his engagement and understanding by sharing his thinking (observations, inferences, or questions) out loud with others, documenting it on the paper, and discussing it with his peers (Rosebery et al., 2010).

Figure 1. Cristiano.

Conclusion

Emergent bi/multi-lingual students are a diverse group of learners with varied talents and backgrounds. Our findings show that when students' cultural and language backgrounds are positioned as strengths, they demonstrate a greater investment in science learning. Moreover, language differences do not hinder these students from engaging in robust and complex science practices. We find that justice is not solely an epistemic endeavor, but also includes bodies and experiences of our students. Thus, legitimizing students' bodily engagements and epistemologies as valuable allows researchers and educators to view diverse repertoires as assets and help us to move towards dismantling dominant epistemic and cultural supremacies that continue to operate in science learning spaces.

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