Asset-Based Science Teaching: Supporting Pre-Service Teacher Learning in a Secondary Science Methods Course

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Abstract: This qualitative study explores experiences with one particular learning opportunity for pre-service secondary science teachers, henceforth interns, to develop asset-based pedagogies throughout a one-semester university methods course. Seven interns' coursework was analyzed to explore the following research questions: *How do interns write about opportunities to learn asset-based science instruction as articulated throughout the methods course? And, to what extent do interns reveal points in instruction where learning opportunities were widened or constrained? What is the nature of the challenges interns write about in relation to learning and enacting asset-based science instruction?* Findings include: competing discourses between interns' journal entries and reflection assignments presented both learning opportunities and constraints; curricular materials and degrees of autonomy presented challenges to enactment in the science classroom. The study has implications for teacher education design.

Introduction

Although much is known about how K-12 students learn and what supports ambitious science instruction, many students (particularly, students of color) are denied high-quality science learning opportunities (e.g., Calabrese Barton, 2003; NRC, 2012; Windschitl & Calabrese Barton, 2016). With respect to learning science specifically, disciplines that heavily reflect Eurocentric discourse norms (Lemke, 1990; Schleppegrell, 2007), it is imperative to provide incoming science teachers with necessary tools to teach from an asset-based framework that 1) recognizes science as culturally situated, and 2) recognizes students' cultural, community, and familial experiences as strong leverage points for science learning. In contrast to deficit perspectives that assume "that students who come to school not versed in the culture of Western science are 'lacking'" (Calabrese-Barton, 2003, p. 26), asset-based approaches require that teachers support students in academic success through cultural competence and scaffolding (Gay, 2000; Ladson-Billings, 1995). This perspective also requires teachers to recognize, support, and draw on students' diverse interests and identities in the science classroom. These asset-based perspectives are well-suited to serve as frameworks for designing learning experiences for pre-service science teachers.

Driving this work is a desire to better understand how we support pre-service science teachers in incorporating both rigorous *and* relevant instruction into science teaching practice (e.g., Calabrese Barton & Tan, 2009; Chinn, 2006; Rivera Maulucci, 2013). This paper documents a qualitative study that investigated a learning opportunity I designed for pre-service secondary science teachers, henceforth interns, drawing on asset-based theoretical frameworks. The goal of the design was to support the development of asset-based pedagogies throughout a one-semester university science methods course. To begin to understand how interns interacted with and took up course material the study investigated the following:

1. *How do interns write about opportunities to learn asset-based science instruction as articulated throughout the methods course?*
    a. *To what extent do interns reveal points in instruction where learning opportunities widened?*
    b. *To what extent to interns reveal points in instruction where learning opportunities were constrained?*
2. *What is the nature of the challenges interns write about in relation to learning and enacting asset-based science instruction?*

Theoretical perspectives

In thinking about developing asset-based approaches with science interns, it is important to look more broadly at teacher learning. Pre-service teachers enter the university with conceptions of what it means to teach based on a lifetime of experience as a student (Lortie, 1968, 1973). These experiences construct a continuous flow of what it means to teach well, juxtaposed by the discontinuous university space often encountered in teacher preparation (Denscombe, 1982). Accordingly, learning-to-teach settings, such as mentor teachers' classrooms and methods instruction, "affect the boundaries and directions of what can be learned through their characteristic interaction and curricula" (Feiman-Nemser & Buchmann, 1987, p.256). The secondary science methods course acted as a

site of discontinuity in two ways. First, the course was devoid of K-12 students and the complications that arise from implementing instruction. Secondly, the course was taught through an asset-based pedagogical framework, which may be discontinuous in interns' and mentor teachers' ways of thinking or approaches to practice.

Such discontinuities create the potential for pre-service science teachers to encounter and present competing discourses around practice. As laid out by Thompson, Windschitl, and Braaten (2013), competing discourses arise when learners (in this case, pre-service teachers) encounter contexts or personal theories that do not necessarily align with each other or their own personal conceptions of teaching and learning. The authors separate critical and contextual discourses as those that encompass "teachers' narratives about their current and future teaching selves" and those that "are perceptions of messages about teaching and learning communicated by actors in social situations", respectively (p.6). In the case of the methods course under study, a focus on developing asset-based science teaching could present both competing critical and contextual discourses. In the critical sense, pre-service teachers may or may not have examined the role of culture and social justice in science teaching. Contextually, mentor teachers' classrooms potentially project messages about teaching and learning not aligned with methods course materials and goals. Thus, it is important to explore how science teachers may make sense of these competing messages to create better, more-aligned supports for asset-based science teaching.

Methodological approaches

Context and participants

The study took place in a one-semester methods course at a large R1 university in the midwestern United States. The proposal author was the instructor. The course centered on interns' development of asset-based pedagogies through weekly journal prompts that explored interns' beliefs about leveraging students' assets for science learning, as well as four practice teaching experiences that explored asset-based pedagogical strategies. These microteaching episodes were rehearsed in the methods course and implemented in mentor teachers' classrooms where interns spent two days per week intern-teaching. Interns were placed in varying contexts ranging from small suburban magnet schools to large ex-urban traditional schools. The following semester, interns student-taught every day from January to June. Of the nine interns enrolled in the methods course, seven participated in the study. Participation was entirely voluntary; all interviews were conducted after the course concluded.

Data collection and analysis

Data collection began during the methods course and concluded the following semester. Focal data sources included: (a) interns' coursework, including journal entries, reflection assignments, and lesson plans and (b) audio-recorded and transcribed interviews. Contextual sources included: (a) audio-visual recordings of each class session and (b) audio-visual recordings of interns teaching in their mentor teachers' classrooms.

I analyzed data using coding methods appropriate to my research questions (Saldaña, 2014). Reflective writing assignments, journal entries, and interview transcriptions were uploaded to NVivo coding software and first read and annotated based on initial noticings. Next, I used an iterative process of in vivo, initial, then focused coding and memo-writing to construct a series of themes connected to the research questions (Saldaña, 2014). Drawing on theoretical frames described above, the following themes emerged:

1. Competing discourses emerged between journal entries and reflection assignments
2. Challenges to asset-based science teaching development:
    a. Science curricular materials
    b. Degrees of autonomy and agency in mentor teacher's classroom

Major findings

Theme 1 - Competing discourses: Journal entries and reflection assignments

The ways in which interns wrote about asset-based pedagogies appeared to connect to where they were writing about them. In journals, views of asset-based science teaching were much more positive, typically writing about such pedagogies as vital to practice. Contrastingly, when reflecting on practice, interns did not always readily make connections between theory and enactment. These apparent difference in writing, or *competing discourses*, could be attributed to the nature of the assignments themselves. Journal entries were much more "idealistic", asking interns to write about what they might do in a given teaching scenario or how they view asset-based practices as related to their teaching. Absent from journal prompts were direct reflections on interns' enactment of science teaching in the field, which was largely reserved for reflection assignments. Thus, while most interns appeared to articulate widening views of asset-based science teaching in their journal responses, reflection

assignments told a different, more constrained story.

For the sake of space within the proposal, I choose to explore one intern, Brody, as an example here. Brody's journal entries consistently made connections between equity and good teaching: "In my classroom, building a community will be key to its' equity. I love to hear and learn about students and this will be the first step in learning about them for deeper instructional methods" (Journal Entry, 9/4/18). Further, he wrote that he views culturally relevant teaching as "teaching that revolves around lesson plans oriented towards relevant community topics or issues" and that he had been "focused on public health issues such as medical insurance and vaccinations" based on topics covered in his placement classes (Journal Entry, 11/6/18). Although Brody placed importance on building community and planning lessons based on community-related issues, his reflection assignments competed with such a view, revealing points where learning may have been constrained. When writing about his enactment of a lab experience, Brody struggled to find any connection between his teaching and the public health issues he had written about in his journal just a day earlier: "In terms of community, **I feel as though the big question for this lab does not revolve around any community matter.** It is simply just techniques used in actual science labs to determine pieces of data" (Science Laboratory Reflection, 11/7/18). Further, Brody wrote, "For labs like this, **it would be difficult to relate back to student identity or community**" (Science Laboratory Reflection, 11/7/18). Although Brody's journal entry presents a point of entry for learning about and developing conceptions of asset-based science teaching, the lack of connection between content and community seems to narrow, or constrain, this perspective. It is important to note that Brody does not assign deficits to students in this case. Rather, he assigns a deficit to the curriculum in which there is seemingly no connection to students' identity or community, a theme explored further below.

Theme 2: Challenges to asset-based science teaching development

Interns identified curricular materials and varying degrees of autonomy and agency in their placement classrooms as roadblocks to asset-based science teaching implementation. In general, curricula were described as *rigid, narrow, straightforward,* and *set*, leaving little to no perceived space to include elements of asset-based frameworks. With respect to enacting relevant and responsive science teaching, Alan wrote, "I find it difficult to incorporate these practices into a **rigid curriculum**, which is what we are working off of in my classroom" (Journal Entry, 11/6/18). Further, Stella and Jordan wrote, respectively, "I think it may be more feasible for me to create culturally relevant classes when I am planning my own lessons. Right now, **following a curriculum has made that a bit difficult**" (Stella, Journal Entry, 11/6/18) and "I would like to work on how to better integrate my students' interests into my lesson plans...The difficulty with this is that **my curriculum needs to be followed to the letter** right now, so I'm not left with much space to make edits or maneuver the lessons" (Jordan, Science Laboratory Reflection, 11/7/18). Hence, interns viewed curricula as not only restrictive, but out of their control, which is something that could be attributed to their roles as teaching interns as opposed to teachers of record or even student teachers.

In addition to curricular roadblocks, interns experienced varying degrees of autonomy and agency within their mentor teachers' classrooms. How interns perceived themselves as agentic, or not, had implications for how they saw themselves as able to enact change and teach from an asset-based perspective. Given the nature of interns' roles and responsibilities in their placement classrooms, it is not surprising that almost all interns felt restricted to enact instruction in the ways their mentor teachers laid out. Out of 21 pieces of data related to interns' autonomy or agency in their mentor teachers' classrooms, only 5 exhibited a sense of interns' roles as enabling their views of asset-based instruction. Jordan, for example, viewed his role as an intern as one of modeling and emulating what his mentor teacher already practiced. When reflecting on his enactment of a demonstration of a scientific phenomenon, Jordan wrote, "I tried to largely stick to the types of science talk moves used by my mentor teacher over the course of her instruction. I did this largely because **I believe my role during the fall is to best model, emulate and fit into the classroom framework as it exists**" (10/22/18), thus not leaving much room to observe or enact frameworks as discussed in methods. Similarly, Stella wrote, "In my current science teaching it is difficult to integrate informal science experiences/learning as **I don't have too much say (or funding) for my classroom**" (Journal Entry, 10/30/18). Thus, even if Stella wanted to bring students out of the classroom and into the community, highlighting resources embedded in such a space, her role as teaching intern did not provide much by way of agency to make certain experiences possible for students.

Implications and concluding thoughts

Taken as a whole, the above findings suggest the need for more sustained and explicit interactions with asset-based pedagogical frameworks and curricular materials to support pre-service science teacher learning. Put simply, pre-service teachers need more time to learn how to teach. The competing discourses uncovered in interns' work throughout analysis might indicate that the way interns develop connections between asset-based science

teaching theory and practice is related to both time and context. Since journals were more centered on methods course readings and discussions, the journal may have widened opportunities for interns to examine and learn about asset-based pedagogies within the university context. In contrast, reflection assignments were a view of how interns experienced their mentor teacher's classrooms. Competing discourses as observed in interns' writing could have been a result of competing discourses between methods instruction and that of mentor teachers, thus constraining learning and development. If the university is to be viewed as a space of *transformative discontinuity*, wherein traditional science teaching practices are disrupted through pre-service teacher learning, then increased coherence between university coursework and field experiences must be a priority. Not only would this allow for interns to further observe and work to develop asset-based pedagogies, but it could also work to bridge a contextual divide between coursework assignments and placement classrooms.

As aforementioned, these findings suggest the need for interns' repeated and sustained exposure to asset-based pedagogies in practice, which has implications for science teacher learning across time and contexts. Perhaps pre-service science teacher education should span across contexts in the form of more intentional university-school partnerships. To this end, teacher education programs can cultivate a network of consistent and capable mentors committed to culturally situated, asset-based science teaching. More scholarship on research-practice partnerships would help illuminate best practices for teacher educators and community stakeholders. Additionally, given the immense time constraints of preparation programs, methods instructors can be more intentional in making asset-based instruction explicit for interns to support navigation across learning contexts. Furthermore, this work has the potential to bridge current divides between the learning sciences and teacher education. Perhaps we begin to frame pre-service teacher *education* as pre-service teacher *learning* to highlight the developing nature of students in the discipline.

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