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Becoming Ambitious: How a Practice-based Methods Course and “Macroteaching” Shaped Beginning Teachers’ Critical Pedagogical Discourses

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ABSTRACT

This study reports on eleven second-year teachers who were all students in the same practice-based secondary science methods courses framed around ambitious science teaching. In this qualitative embedded single case study, we examined if, how, and why novice teachers linked their current critical pedagogical discourses and instruction back to any practice-based learning opportunities from the methods courses, especially an opportunity termed “macroteaching.” We found that ten out of the eleven participants expressed similar critical discourses about what counts as good teaching, positioned themselves as “becoming ambitious,” and linked such critical discourses back to the shared methods class. One participant provides counter-examples. We conclude with lingering questions and research suggestions for the field.

KEYWORDS

Science education; teacher education; practice-based teacher education; novice teachers

The current vision of science teaching and learning, as recommended in the *Framework for K-12 Science Education* and the Next Generation Science Standards (NGSS), suggests that teachers should provide all students with rigorous and equitable learning opportunities to engage in science practices (Achieve, Inc, 2013; National Research Council [NRC], 2012). One pedagogical framework aimed at achieving such goals is Ambitious Science Teaching (AST), which includes a suite of core pedagogical practices and tools to help teachers: (1) plan complex and intellectually demanding instruction, (2) teach and adapt instruction based on students’ emerging ideas and needs, and (3) reflect about their teaching using multiple forms of evidence of student learning (Windschitl et al., 2012).

While AST appears promising for helping teachers enact rigorous and equitable learning opportunities, how teachers learn such complex instruction is not well understood. For example, there are key features of AST, such as noticing student thinking as resources (Barnhart & Van Es, 2015) and adapting instruction based on students’ emerging ideas (Windschitl et al., 2012), that are often invisible to preservice teachers (PSTs), and require time and feedback to deeply understand. We propose that practice-based teacher preparation—in which PSTs have opportunities to approximate and reflect on recurring core practices and tools (Grossman et al., 2009; Windschitl & Calabrese Barton, 2016)—can serve as settings for PSTs to learn and try out AST. In addition, practice-based teacher preparation might allow PSTs to develop *critical pedagogical discourses* that uphold the

intellectual and equity goals that underlie AST. By critical pedagogical discourses, we mean an individual's developing personal theories about "what counts" as productive teaching and learning (Thompson et al., 2013).

Initial research about practice-based teacher preparation for science teachers demonstrates that PSTs can develop critical pedagogical discourses that shape how they use resources, consider student ideas, and make and adapt pedagogical tools (Stroupe, 2016; Thompson et al., 2013). However, there is a dearth of research about whether and how the learning opportunities provided to PSTs during practice-based preparation programs result in noticeable shifts in their critical pedagogical discourses and instruction. Helping PSTs develop critical pedagogical discourses is important because as they begin careers in schools, they will encounter *contextual discourses*—explicit and implicit messages about teaching and learning promoted in setting—that may or may not align with the contextual discourses of their teacher preparation program. Often, interactions between novice teachers' critical pedagogical discourses and various contextual discourses (from teacher preparation programs and school-based experiences) result in a "two-worlds pitfall" in which there is a disconnect between how teaching is framed in different sites of teacher learning (Anagnostopoulos et al., 2007; Braaten, 2018; Feiman-Nemser & Buchman, 1985).

Given this lack of research about connections between novice teachers' critical pedagogical discourses, their experiences at the beginning of their careers, and their participation in practice-based science methods courses, this study reports on second-year teachers who were PSTs in the same practice-based secondary science methods courses framed around AST. This study has two purposes. First, we examined if second-year teachers reported using any AST practices and tools that they originally encountered in a secondary science methods class. Second, we wanted to understand whether and how the novice teachers linked their current critical pedagogical discourses and instruction back to any specific practice-based learning opportunities and contextual discourses from the secondary science methods course. We asked:

- (1) How do 2nd year novice teachers' critical pedagogical discourses and reported instructional practices reflect the contextual discourses of their practice-based science methods course?
- (2) How did learning opportunities in the practice-based science methods course shape 2nd year novice teachers' critical pedagogical discourses?
- (3) Given their developing critical pedagogical discourses, how did 2nd year novice teachers respond to their school's contextual discourses?

Background and theoretical framework

We begin by defining AST and situate the pedagogical framework in a larger effort to help novices learn in practice-based teacher preparation. We conclude by describing the conceptual framework used to frame data analysis—the development of novice teachers' critical pedagogical discourses and instruction as they move from preparation contexts to their first years of teaching.

Ambitious science teaching

Ambitious teaching has evolved in multiple subject matter literatures and studies of school reforms (e.g., Fennema et al., 1993; Rosebery et al., 2010), but all versions have similar principles focused on equity, attending to culture and equitable opportunities for all students, including: anchoring students' learning experiences in puzzling science phenomena, using students' everyday ideas, experiences, and questions as resources, legitimizing students' participation in, and co-development of, science practices to develop explanations and models, providing students tools and routines that support science-specific forms of writing, talk, and participation in activity, making student thinking public for consideration by the classroom community, and sequencing learning experiences to help students integrate ideas and revise understandings of "big science ideas." These interconnected elements provide a broad picture of teaching that helps disrupt preservice teachers' initial vision of the profession (Engle & Conant, 2002; Lehrer & Schauble, 2006; Metz, 2004; Rosebery et al., 2010).

The AST framework includes four suites of core teaching practices. By "core" we mean that they support student work that is central to the discipline, can be revisited in increasingly sophisticated and integrated acts of teaching, allow teachers to learn from their teaching, and play a role in a coherent system of instruction that supports student learning goals (Windschitl et al., 2012). The overarching practices are: (1) planning using foundational science ideas from standards and curriculum, and selecting a compelling and complex anchoring phenomenon; (2) eliciting students' initial ideas and experiences about the anchoring phenomenon; (3) supporting students through a sequence of activities involving engagement in scientific practices better explain the anchoring phenomenon; and (4) supporting students in using ideas and evidence assembled during their study to model and explain the phenomenon. Taken together, these principles and core practices provide PSTs with a foundation on which to build critical pedagogical discourses around equity as well as learnable practices that help reify the PSTs' evolving vision of professional work.

Learning AST through practice-based teacher preparation

We argue that for PSTs, a focus on the guiding principles and practices of AST is one way to make visible a core of teaching that may enable them to better understand the reality of daily professional work (Lortie, 1975). However, the field of teacher education knows very little about preparing PSTs for ambitious instruction, including the pedagogy or content of methods courses (NRC, 2012).

One challenge of designing practice-based methods courses focused on ambitious forms of teaching is that the term "practice" is complex to define. In this study, we are guided by Lampert (2010), who offered three overlapping descriptions of the term with regards to novice teachers. First, practice is thought of in a global sense—"the practice" of teaching. This perspective means that PSTs develop a vision about what teachers "do," and construct an identity as a "teacher" over time, taking on common values, language, and disciplinary tools. Second, "practice" can describe a collection of practices. PSTs, then, learn to participate in the valued daily work of teachers. Third, "practice" involves the opportunities for PSTs to rehearse daily routines and to receive feedback about how their efforts to engage in science are progressing (e.g., Arias & Davis, 2017; Davis et al., 2017).

Taken together, these three descriptions provide a foundation for designing practice-based methods courses. In this study, we built our methods course to opportunities to learn AST through “pedagogies of enactment” (Grossman et al., 2009; Lampert, 2010; McDonald et al., 2013). Pedagogies of enactment entail providing PSTs with opportunities to learn about, rehearse, and receive feedback on their work with the guiding principles and core practices. We argue that engaging in these pedagogies of enactment may help PSTs better understand AST and how to enact the core practices with students. Specifically, we designed an extended pedagogical rehearsal called “macroteaching” in a secondary science methods course (Gotwals et al., 2020; Stroupe & Gotwals, 2018). Framed as a design experiment, we co-developed macroteaching with the PSTs during methods class. We found that through macroteaching PSTs overcame a shared fear about the unpredictability of classroom talk as they used emerging science ideas from class discussion as resources for instruction, and participated in disciplinary work they are expected to facilitate with students, both of which are foundational components of AST. These findings suggest that extended rehearsals of AST provide PSTs (and the course instructors) with opportunities to advance their teaching and vision of the profession in a methods class.

Conceptual framework: critical pedagogical discourses

While practice-based methods courses built to support pedagogies of enactment hold promise, there is little understanding of whether and how features of teacher preparation programs shape novice teachers’ critical pedagogical discourses. As noted, critical pedagogical discourses describe an individual’s developing personal theories about what counts as productive teaching and learning (Flores, 2006; Rex & Nelson, 2004; Thompson et al., 2013). What makes these internal discourses critical is that they are consequential to an individual’s actions and learning. Such discourses influence how novices think about teaching and learning across contexts, mediate what problems of practice teachers choose to solve, and shape the opportunities teachers notice (or do not notice) to learn (Sfard & Prusak, 2005).

For this study, we use the framework of critical pedagogical discourses to understand how novice teachers positioned their reported instruction and pedagogical decisions with regards to multiple contextual discourses: the explicit and implicit messages about teaching and learning promoted in setting (Thompson et al., 2013). In this study, the methods course embodied contextual discourses focused on the guiding principles and core practices of AST. In many school settings, however, the contextual discourses focus on “delivery pedagogy,” which frames teaching as an individual’s ability to make decisions that are both progressively efficient (i.e., the teacher can present an increasing amount content over time) and that steer students toward curricular facts. From the delivery pedagogy perspective, students’ disciplinary ideas are treated as “correct” or misconceptions that teachers can uncover and fix over time (Papert, 1993; Sawyer, 2008).

Such potential disconnects between contextual discourses of learning settings embody the two-worlds pitfall (Anagnostopoulos et al., 2007; Braaten, 2018). Given the potentially competing contextual discourses about the purpose of teaching and learning, and the purposefully designed practice-based learning opportunities enacted in methods courses, we wanted to understand how novice teachers’ critical pedagogical discourses may align with the contextual discourse of the methods course several years later, what learning

opportunities may be attributed to this alignment, and how their critical pedagogical discourses mediated the way they responded to the contextual discourses in their school settings.

Methods

This study was a qualitative embedded single case study (Yin, 2009), which includes sub-units of analysis within the single case. We describe the case of graduates of the same teacher preparation program in a large Midwestern University. All of the graduates took part in the same two-year sequence of secondary science methods courses taught by David Stroupe and Amelia Gotwals. For this study, we contacted each teacher from the methods class (14 in total) to inquire about participation. Eleven teachers agreed to participate. Of the 11 participants in this study, nine were employed as full-time secondary science teachers, one participant was employed as a full-time mathematics teacher, and one participant—who took time off of the certification pathway—was completing his student teaching experience. Of the three teachers not participating in the study, we were unable to reach two and one was not currently teaching (see Table 1).

Participants' methods course experience

The participants' critical pedagogical discourses and interactions with contextual discourses cannot be understood without some background into their university-based science methods course framed around AST. One goal of the secondary science methods classes was to frame-shift how the participants thought about organizing instruction and to socialize them into new visions of “good teaching.” The sequence of science methods courses took place over four semesters, with one course each semester. The first two courses were during the participants' senior year of their undergraduate program. The next two courses were taken the following year during their student teaching experience, in which the participants taught in secondary science classrooms four or five days per week. During the first semester of the methods sequence, instruction included opportunities for microteaching with AST principles, which provided opportunities for PSTs to approximate small versions or features of

Table 1. Participant and demographic information.

Teacher Code & Pseudonym	Race/Gender Identification	High School Content	School Classification
T1: Marc	White/Male	Earth Science, Integrated Science	Suburban Public
T2: Allison	White/Female	Biology, Spanish	Suburban Public
T3: Emma	White/Female	Biology	Urban Public
T4: Jessica	White/Female	Physical Science, Chemistry	Suburban Public
T5: Rochelle	White/Female	Biology	Rural Public
T6: Brad	White/Male	Biology	Rural Public
T7: Charlotte	White/Female	Math	Suburban Charter
T8: Kent	White/Male	Physical Science	Suburban Public
T9: Dan	White/Male	Biology	Suburban Public
T10: Rob	White/Male	Physics	Suburban Public
T11: Cara	White/Female	Chemistry	Rural Public

T10 was completing his student teaching experience during data collection.

instructional practices (e.g, Forzani, 2014). These experiences included having the PSTs plan for, enact, and reflect on 15–20-minute lessons that provided opportunity to focus on one core AST practice at a time.

Based on PSTs' and instructors' reflection on the first semester, Stroupe and Gotwals co-planned "macroteaching," an extended teaching rehearsal, with the participants during the second semester of methods (see Stroupe & Gotwals, 2018 for specific details). In groups of three or four, based on major content area, participants co-planned and co-taught 10–12 consecutive 45–60 minute lessons to their class peers, allowing for a more authentic experience of planning, teaching, and reflecting on a *sequence* of lessons rather than on individual lessons. During macroteaching, the participants and instructors co-developed six learning opportunities used in nearly every lesson: (1) in-the-moment huddles with their teaching team and instructors; (2) calling a "time-out" for consultation; (3) real-time instructional coaching from course instructors; (4) "rewinding" to implement advice in their teaching; (5) question and answer sessions at the end of each lesson; and (6) debriefing session at the end of each unit. The participants referenced these six learning opportunities unprompted during the interviews (see Findings section for more details).

Data collection

Given the participants' experiences as PSTs in the same practice-based methods class that featured macroteaching as a learning opportunity, we wanted to find out whether the participants' critical pedagogical discourses reflected the contextual discourses of the methods courses. Therefore, we collected data during ten of the participants' second year of teaching, and one participant's student teaching experience. The main data source for this study was semi-structured interviews conducted early in the spring semester of participants' second year of teaching. Interviews lasted an average of 50 minutes, and were audio-recorded and transcribed (see [Appendix A](#) for interview protocol). Secondary data sources include personal communication (e.g., e-mails, recorded discussions) between authors and participants.

Data analysis

To analyze the data sources, we began by breaking the transcripts into response segments, our unit of analysis. Response segments were typically one talk-turn taken by the participant when answering a particular interview question. We then used deductive (a priori) codes based on the literature and inductive codes that emerged from analysis (Strauss & Corbin, 2014) to code each segment. Using the elements of AST described above as a guide, six codes emerged from the data as AST-aligned critical discourse components: 1) promoting student engagement, 2) using student ideas, 3) using model-based inquiry, 4) using engaging phenomena to guide instructional units, 5) using class discussion, and 6) building community and relationships. We also coded each segment as referencing either the methods course contextual discourses or school-based contextual discourses. The school-based contexts were additionally sub-coded as either supportive or constraining contextual discourses, when appropriate. [Table 2](#) contains a full list of our codes with examples from transcripts. Using these codes, we found patterns in the way the participants' critical pedagogical discourses

Table 2. List of codes and examples from transcripts.

Code-Subcode	Transcript Examples
AST-aligned Component–Student Engagement	<p>“... by doing engagement [sic] I’m talking about students are interested in what we’re doing, they’re asking me questions they’re asking each other questions ...” –Brad</p> <p>“So for me the students are having fun and they seem engaged and they come to me with, like, more questions, like, in more detail than we cover in the class.” –Rochelle</p>
AST-aligned Component–Student Ideas	<p>“I do use a lot of ... I try to use as much student voice as possible ... Yeah, I try as hard as I can to make sure that the student voice is, is heard in my class.”–Marc</p> <p>“I’ve gotten some awesome ideas out of the students. They’re using really cool language.”–Allison</p>
AST-aligned Component–Modeling	<p>I think that’s one reason why it [the unit] did end up going so well, because I was able to slow down a lot more this year ... and actually take the time to go through and try to hit all these like key components of modeling and make sure that these kids can describe in every way possible what’s going on in this scenario. –Kent</p> <p>“I do, I use the models for most of my units.”–Allison</p>
AST-aligned Component–Phenomena	<p>“I actually got to develop my own unit and own curriculum because the teacher that retired didn’t really have a lot of phenomena-based stuff.”–Rochelle</p> <p>I always love that unit because the phenomenon is something that we’re experiencing every single day. It’s, you know, it has to do is global trends it’s really relevant it gets kids captivated and motivated and the data that are exposed to and that they have to analyze and use is really, really eye opening for a lot of those kids. So I would probably say that was my favorite unit this year so far.–Dan</p>
AST-aligned Component–Discussion	<p>“... having the students make their predictions first and then come into a discussion and then have them commit to their claims and put that claim on their initial models.”–Brad</p> <p>“They’re like, we’re just able to get into these really cool discussions and I think, to me it seems like the kids are way more engaged ...”–Kent</p>
AST-aligned Component–Community/Relationships	<p>“I mean the first thing and foremost you have to do is establish a safe community in here for kids to talk and share their ideas.”–Dan</p> <p>“... I call it a ‘student advisory panel’ where I’m just going to get feedback from students and I’m going to help them kind of, like, give me a little more direction on what they would like to have in the class ...”–Rob</p>
Methods-based contextual discourses	<p>“But the macro teach ... one thing that was really nice is we could be like ‘OK, pause ... I’m stuck here what, what should I do here?’ and you can step out of the teacher roll for a second, return to the student role, and ask them like what’s going on or they could pause and be like ‘something cool just happened here who noticed it?’”–Kent</p>
School-based contextual discourses–Supportive	<p>“We had a teacher space that everybody meets in and it’s just like a big conference table so I co-plan with pretty much every person at some point throughout the week which is super super cool.”–Charlotte</p> <p>“... we were lucky enough to get our vice superintendent basically was like hey, you know this new curriculum you’re going to need a lot of new resources. Make a list, just tell me what you need, I’ll get everything.”–Kent</p>
School-based contextual discourses–Constrained	<p>“I’m totally isolated from the science department in STEAM ... So I don’t really have the opportunity to collaborate with other science teachers ever. So I’m doing everything planning wise and all of that stuff on my own.”–Emma</p> <p>“So currently my two actual coworkers, one of them doesn’t want to be there, so she’s not super willing to offer up too many ideas, and then the other one has a very different teaching style than me and ... we really try to collaborate but it’s, it’s tough. It’s very tough to do that.”–Marc</p>

reflected the contextual discourses of the methods courses, referenced the learning opportunities experienced during the methods courses, and how their critical pedagogical discourses shaped the way they responded to their school-based contextual discourses.

Findings

The findings are organized by research questions. Within each section, we describe and provide evidence for the claims that emerged from the data analysis.

Research question 1

In this section we examine the ways in which participants expressed their critical pedagogical discourses about good teaching and their own instruction. As discussed in the Methods section, participants expressed six components of critical pedagogical discourses that closely aligned to each other and to the contextual discourses—embedded in the principles of AST—that were promoted by the methods courses (see Table 2). Of the eleven participants, eight expressed all six components in their interview, and two participants expressed five of the components (both not including *class discussion*). The remaining participant, Jessica, only included ways to *promote student engagement* in her responses (See Table 3). Below we discuss patterns across the ten participants and then attend to Jessica in a separate section.

Not only did ten of the participants express five or six components of AST within their critical pedagogical discourses about teaching, but the components were often woven together when discussing good teaching or their units of instruction. For example, when asked to describe a successful unit they had taught, Kent stated that it was important to, “take the time to go through and try to hit all these key components of modeling and make sure that these kids can describe in every way possible what’s going on in this scenario [phenomenon described earlier in interview]. And, through that, the kids have been a lot more engaged . . .” Kent’s response combines the importance of *modeling a scientific phenomenon* in order to *support student engagement*, weaving together three of the AST-aligned components of good teaching that participants expressed. This type of response was typical of how participants expressed values as connected during planning, teaching, and reflecting.

How the participants expressed their critical pedagogical discourses, however, depended on their framing of their schools’ contextual discourses as supportive or constraining of the instruction they hoped to enact. In contexts in which participants felt supported to enact their vision of good teaching, they expressed critical pedagogical discourses that aligned with current or planned work in their classrooms. For example, Brad expressed that he felt supported by his

Table 3. Critical discourse codes.

AST-aligned component of critical pedagogical discourses	Teacher ID										
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11
(1) Student Engagement	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(2) Student Ideas	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
(3) Model-based inquiry	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
(4) Phenomena	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
(5) Discussion	✓	✓	✓		✓	✓		✓	✓	✓	✓
(6) Community/ Relationships	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓

district, saying, that he had a, “mentor teacher who . . . has been a great source of support for me as I come to her with ideas for things that can change and she says ‘good idea’ or she thinks it is a good idea but maybe it needs to be revamped a little bit.” When he described how he planned a successful unit, he expressed four interwoven components that he was considering to ensure the unit was successful: *phenomena*, *student ideas*, *discussion*, and *modeling*:

I had to figure out how I wanted to structure how I was introducing the phenomenon. So, I’m thinking ‘OK do I want to describe to them [students] what we’re doing, have them predict and then actually do the simulation or do I want to do the simulation and then ask them write their ideas down, or do we want to do simulation and just discuss and then whichever method I choose then we go into the initial models?’

Similar to Brad, Allison emphasized how she desired to use a *phenomenon* to elicit *students’ ideas* about the natural world in a unit she had planned. She noted that, “I had a hard time finding a phenomenon but then I found a new one that I used last year for the first time, just used again with my ninth graders and I loved it . . . I’ve gotten some awesome ideas out of the students. They’re using really cool language.” Given her students’ success, Allison noted that her colleagues recommended that the entire school district adopt the unit she designed, thus implying a supportive school-based context.

However, when participants discussed their critical pedagogical discourses in association with identified school-based contextual constraints, the participants often articulated planning, teaching, and reflecting in future or imagined classrooms operating within different contextual (and ideally more supportive) discourses. For example, one participant (Cara) who was teaching Advanced Placement (AP) Chemistry in her first two years identified how the structure of the course and time it took to prepare for the course limited how she was able to use *phenomena* in her teaching,

. . . I felt AP was very much like ‘here’s the content . . . this is it’ . . . you know, it wasn’t anything creative from my part . . . for [the non-AP chemistry class] I was able to do . . . two phenomenon-based units last year . . . But it was very . . . if I didn’t have AP, I would have done more . . .

One interview question asked participants to use an instructional progression—which they used during methods class—to evaluate their current teaching (see [Appendix B](#)). Regardless of supports or constraints that participants experienced, all of the participants except Jessica noted that they were enacting as much of AST as they felt they were able in their school contexts. However, they noted that their instruction was not yet “fully ambitious” (i.e., aligned with the contextual discourses of methods class and AST) and expressed frustration that their developing instruction did not match their critical pedagogical discourses nor the methods class contextual discourses. For example, one participant (Brad) said,

I’m trying out some of the things, with the phenomenon, the models, and the summary table. But I know that I could be doing so much more with that. So that’s eventually one of my goals, is to get my teaching more to that level and get these complex phenomena. There’s more out there than I can probably even think about right now and start integrating as much as I can.

Similarly, Marc noted that even though his teaching evaluations by administrators were all positive, “I got a long way to go still . . . there’s just so much to do to really truly master teaching. It’s, there’s so much to it and, you know, I’m not even close. There’s a lot of [AST] things that I do well on, but there’s so many more things that I need to get better at.” These comments were echoed by most of the participants, with one, Allison stating, “I don’t know that I think my continuum has an end because my goal is not necessarily to get somewhere like ‘oh I’m a teacher now’ . . . there’s so much to learn and so many different ways that you can tweak [your practice].” Thus, while the participants felt somewhat successful, each expressed a desire to better align their current instruction with their contextual discourses of methods class.

A counter example: Jessica

There was one participant, Jessica, whose critical pedagogical discourses did not align with the remainder of the participants. While Jessica mentioned that she attempted phenomenon-based teaching, she indicated that her students did not have ideas that she could leverage:

The gas laws unit, I tried to do something that [the methods instructors] introduced to us, which was the phenomenon-based stuff. It was difficult because, . . . these students that I have don’t have a lot of background knowledge or initial ideas about gas laws so I would start with some direct instruction . . .

Later in the interview, she noted, “my view is always kind of, well, I’m here to teach the information, they shouldn’t have to figure it all out themselves” and followed up on the idea of using phenomena in her teaching, saying, “I’m not going that route . . .” Thus, while AST components were reflected in most of the participants’ critical pedagogical discourses, Jessica developed critical pedagogical discourses that reflected something different. Rather, her critical pedagogical discourses appeared more aligned with her mentor teacher from her student teaching year. She noted that,

she [mentor teacher] would teach information to the students and they would do an activity to see how it relates to them or it didn’t always relate to them, but she would have something hands-on with the information . . . I was like, wow, she is a really good teacher because the kids are enjoying themselves . . . so that’s where I picked that up from and . . . moving into my own teaching that was something I definitely wanted to keep up with.

This novice teacher’s critical pedagogical discourses aligned with her student teaching mentor’s vision of good teaching—a contextual discourse—rather than a vision of good teaching aligned with AST as taught in the methods courses. When asked about AST in general, she noted that she was, “not going that route . . .”

When asked to evaluate her current teaching using the practice progression, Jessica placed herself on the very sophisticated end of the instructional progression, noting that she needed to work on small features of teaching. For example, she shared,

I would say I’m a pretty good teacher but I’m obviously still learning and I ask my students for feedback like I just did a little semester survey; what things are going well; what things are not going well and I love getting feedback from my evaluator. . . . I’m still looking for ways to improve . . . like I don’t think you’re ever going to be like done improving.

Therefore, while she did not express a desire to align her critical pedagogical discourses with the contextual discourses from methods class, she did note that she still needed to grow as a teacher.

Research question 2

In this study, participants reported three main contextual discourses from the methods courses that shaped their critical pedagogical discourses: (1) having a supportive methods classroom community (reported by seven participants), (2) receiving specific forms of feedback during macroteaching (reported by seven participants), and (3) developing a better sense of how to plan for and enact a coherent unit of instruction because of the macroteaching experience (reported by eight participants—see Table 4). In each of the three methods-based contextual discourses, at least one participant described how the methods-based contextual discourse directly influenced one of the AST-aligned components of their critical pedagogical discourses (see Table 4). Only one participant—Jessica—did not report any of the three methods-based contextual discourses discussed by her former classmates as being influential to her critical discourse. Therefore, we attend to participant Jessica separately at the end of the section.

Sense of community

Seven participants discussed the sense of community they felt throughout the methods course sequence. Three participants explicitly connected the sense of community they experienced in methods courses and their desires and intentional efforts to develop a similar community in their classroom. For example, Kent noted,

... in my teaching cohort, we were all just so comfortable because we had this environment that was so positive and it's like everyone is really comfortable with asking questions, and they didn't feel stupid, and that's one of the biggest things I try to do is kind of develop this like really good environment where students feel comfortable asking those questions to get the help they need.

Note that Kent's reference to the contextual discourse from the methods courses aligned with his critical discourse about his own teaching, which also aligns with one of the components of the AST framework (i.e., *community/relationships*).

Another participant, Dan, felt welcomed by his peers, noting, "I just felt immediately safe in that [methods] classroom . . . I wanted to, I wanted to echo that in my own room and I did. And I saw very similar results where the kids felt like they were comfortable around here and they shared their ideas." Similar to Kent, Dan's comments illustrate an alignment between his critical pedagogical discourses, the methods course contextual discourses, and his current actions to reify a similar classroom discourse for his students.

A final example from Ellen illustrates how the work to align and reify critical pedagogical discourses that began in methods courses continued into secondary science classrooms. Ellen noted that,

Table 4. References to methods-based contextual discourses.

	Teacher ID										
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11
Community	✓		*✓		✓		✓	✓	*✓		*✓
Macro: Feedback	✓	*✓+			✓	✓+	✓+	✓+	N/A		✓+
Macro: Coherent AST	✓	✓	✓			✓	✓	✓	N/A	*✓	*✓

✓ = Referenced as beneficial

+ = Specifically referenced one of the six co-developed feedback opportunities

* = Connected methods-based contextual discourse to their own critical discourse

The other thing I was going to say about macroteaching is, it really helped build classroom community. Like we became the group that we became and the little family . . . not only did I have this like great classroom community with these people who like became my friends and who I could like work on planning with during the internship year and stuff, but like it showed me like how that kind of thing can build classroom community, how having students talk and work through things on their own can build classroom community and how much fun it was to be a student in, in macroteaching . . . that was another really meaningful thing about it.

Note the layers of Ellen's analysis of her critical discourse development and current work with students. Ellen linked a specific learning opportunity in methods class—macroteaching—to her development of critical pedagogical discourses around building a successful community in a classroom, to her work as a current teacher to create a collaborative community with students.

Feedback during macroteaching

During macroteaching, the participants were provided with feedback as they planned, enacted, and reflected on their teaching of a full unit of instruction to their classmates. Three years later, seven participants noted the value of this feedback received during the macroteaching experience. Five of the seven participants who mentioned feedback specifically referenced one of the co-developed learning opportunities that happened during macroteaching (see Table 4). For example, Brad shared his experiences with the “pause moments,” “the huddle up moments,” and “having time at the end of each macroteaching session to debrief,” summarizing with “I really liked getting not only feedback from the professors, [but] from my colleagues as well.” Allison shared the following experience that draws the connection between one of the co-developed learning opportunities (“in-the-moment consultation”) and how it positively positioned her and supported her teaching practice:

I also got like an amazing compliment when I was student teaching . . . my mentor teacher had [a teacher leader] come in and observe me and like one of the things he said was, like, first off the bat was, ‘you don’t get frazzled. Like [students] come up with these ideas and you’re just, like, ‘alright, let’s, you know, roll with it.’” And I really feel like part of that came from macroteaching because the first time I encountered [unexpected student ideas], we got to sit down and have a discussion about it.

For Allison, this particular learning opportunity, not only meant an improvement to her teaching practice like the others in her cohort, but also shaped her critical pedagogical discourses because she was recognized for her teaching by others in a position of power.

Coherence in instruction

In addition to a sense of community and the feedback they received, eight participants who enacted macroteaching shared that the experience of rehearsing an entire unit of AST instruction provided them with a better sense of how to plan for and enact coherent instruction. For example, three years removed from the macroteaching experience, Marc noted that microteaching—which occurred in the first semester of methods class—was problematic because, “You’re asked to teach a single lesson, but the whole idea that they’re trying to teach us is that you can’t do that. Everything has to connect.” He noted that

macroteaching helped him to “visualize the coherence [his] instructors were promoting” and that he thought his teaching benefitted from this because, “throughout that year you were constantly critiquing [your own teaching] revising it and trying it again.” Thus, Marc noted how macroteaching provided a more complete picture of AST and classroom work than the microteaching experiences initially enacted in the methods course by Stroupe and Gotwals.

Similarly, Kent noted that macroteaching helped him visualize what teaching a coherent instructional unit might look like. He noted that:

It was like, yes [AST] is great and I love this, but I don't know what this is going to look like in a real classroom. And . . . getting the experience [macroteaching] . . . like these are people I'm comfortable with but I'm trying this new thing that's really uncomfortable. I think that really helped me kind of figure out like what the flow of things will look like, what kind of questions I'm going to ask, what kind of preparation I need to do, and if I need to like . . . we used to use our 'time outs' all the time. Like, OK, 'time-out'. What do I do in this situation because, like my mind is just boggled right now.

This comment combines all three of the methods-based contextual discourses, a comfortable classroom culture, getting feedback during ongoing instruction, and being able to visualize what it takes to plan for and teach a unit of instruction that was coherent and connected to individual lessons and activities.

A counter example: Jessica

Unlike her peers, Jessica identified her student teaching experience as a more influential contextual discourse than the methods courses. When asked about the methods courses, Jessica said:

I think while I was taking the methods courses they were pretty helpful. But then getting into my exact school and in a different situation in the different levels of students I haven't really been using anything from there. I'm using a lot of stuff from my mentor teacher [from student teaching].

Jessica's main takeaway from macroteaching focused on the group nature of the learning opportunity. She shared, “it was nice to have help with the lesson planning part. As a whole group getting through the phenomenon-based teaching it didn't feel quite as overwhelming because I did have other people that could help me and I could rely on so.” Thus, while she did not mention feedback or classroom community, she did value working with her classmates and she connected this experience to her current situation at school, saying that this co-planning experience, “helped in learning how to take in other ideas. . . . I'm becoming more receptive to the way that other people teach in kind of bringing those ideas into my room, so I think macroteaching and planning with an entire group was helpful in developing those co-planning skills for sure.” Thus, while she did not share the same takeaways as her colleagues, she still found a benefit from the process and made a connection to her current critical pedagogical discourses.

Research question 3

The participants also described how their critical pedagogical discourses of good teaching and their strong alignment with AST shaped the way they worked with colleagues and school-based contextual discourses focused on delivery pedagogy. For example, some

participants noted that their critical pedagogical discourses and advocacy of AST helped some colleagues shift their contextual discourses. Dan described a department meeting in which several teachers expressed concern about using phenomena as a driving feature of a unit. However, given Dan's experiences, his colleagues asked him to contribute to team planning. Dan noted that during the methods courses, he and the other participants in his methods course:

... came up with a phenomena list ... for each discipline too, that we all have access to ... which I used, I looked like a superstar at my biology meeting because they're like ... 'how do we plan phenomena for this?' So, I just opened up that document and said 'look at what me and my friends came up with'.

Thus, because of his critical pedagogical discourses and experiences learning AST with peers in the methods courses, Dan was able to start shifting his school-based contextual discourses around new science teaching and learning expectations.

Similarly, Kent stated that he was able to bring his experiences working with and revising models to his new department, and was subsequently able to "help out" other teachers as the district transitioned to NGSS regardless of his nascent teaching experience:

Some of the ... department heads were already going to modeling training and NGSS training. They were supposed to be bringing it back and when they hired me during the interview process I was like 'yeah I have experience with this already', they're like 'Great, you can help out.' So that's something I'm trying to help facilitate ... bringing in that modeling and NGSS.

Note that Kent echoed the perspective of Dan, in which he recognized that his administrators and colleagues valued his critical pedagogical discourses from his methods class. Subsequently, Kent began to shift contextual discourses at his school toward an alignment with AST.

Allison discussed how she was able to shift the contextual discourses of her school "colleagues who have been doing it one way for a very long time." She described how she wrote a unit about cellular energetics using the phenomenon of "the great oxygen catastrophe,"¹ which she shared with her colleagues. Allison noted that the unit construction and sharing was a purposeful attempt at "nudging them [her colleagues]" and she has, "... been really excited that, you know, it [the phenomenon-based unit she designed] seems to be going really well with all the other teachers. They're saying they're enjoying it and they're getting more out of it."

While some participants were able to use their AST-aligned critical pedagogical discourses to help shift their school-based contextual discourses, other participants felt tensions between their critical pedagogical discourses and the contextual discourses of their school colleagues. For several participants, this resulted in tensions during planning sessions with school colleagues. For example, Emma described planning sessions with colleagues, noting that, "last year I met with science teachers, but they all sat around [complaining] rather than actually doing anything." Another participant, Marc, shared that, "last year I just kind of did what the other teachers are doing and I really didn't like that." Marc also described how he spent the summer re-planning for his second year. When asked whether he co-planned with his colleagues, he noted that "my two actual coworkers, one of them doesn't want to be there, so she's not super willing to offer up too many ideas,

¹See: <https://thewonderofscience.com/phenomenon/2018/6/15/the-great-oxygenation-event>

and then the other one has a very different teaching style than me and . . . we really try to collaborate but it's, it's tough." Note that both Emma and Marc positioned their colleagues in opposition to the participants' values about teaching and learning.

A counter example: Jessica

In her current teaching job, Jessica and her colleagues tend to plan for their classes independently. She shared, "I don't really mind [independent planning] too much because then I get to control what's going on in my room." Therefore, her current school-based context supported her work habits and rewarded her type of teaching as evidenced by her strong teacher evaluations.

Discussion

In this section, we discuss how the shared secondary science methods experiences shaped participants' critical pedagogical discourses and reported instructional practices. We also describe how the participants' connection to the methods class community provided a foundation for their critical pedagogical discourses in terms of current and future instruction as they navigated contextual discourses in schools. In addition, we describe how macroteaching served as a valuable and shared learning opportunity for the participants to develop critical pedagogical discourses aligned with the principles of AST.

Shared methods course experiences and two world tensions

As noted, ten of the eleven participants expressed shared critical pedagogical discourses about teaching and learning, which were tied to shared experiences in their methods classes. These results align with two goals of AST, which are to provide a set of learnable, sharable, and connected instructional practices, and embed a particular set of values that emphasize equity and relational work with children. Even though the second-year teachers noted that not all of their teaching met their vision for "full" AST (i.e., they were "becoming ambitious"), they developed a coherent and similar picture of AST, not just a list of disconnected components of the pedagogical framework. For ten of the participants, their critical pedagogical discourses aligned with the contextual discourses of the methods class, serving as a core filter for how they worked with current colleagues and navigated their current school-based contextual discourses, which often focused on delivery pedagogy (Thompson et al., 2013).

For the ten teachers who had a shared and strong set of critical pedagogical discourses tied to AST (i.e., striving to be ambitious), some of their reported practice and interactions with school-based contextual discourses should be seen as agentic in their schools. For example, we unearthed inner conflict for some teachers as they expressed a desire to teach in a way aligned with the AST-framed methods class, but felt contextual constraints (e.g., colleagues and resources) hindering their emerging professional identity as a teacher striving to be "ambitious" as defined by their sequence of methods courses. However, not all conflict presented itself in relation to contextual factors preventing one from teaching in a way that pushed against this emerging identity. Jessica argued that the practices and values of AST conflicted with her perception of success, as well as the perspective of her mentor teacher and current school.

As noted in literature about the “two worlds” pitfall (i.e., Braaten, 2018), learning to successfully navigate competing contextual discourses while developing critical pedagogical discourses as a teacher can lead to conceptual, instructional, and practical compromises. In this study, the ten participants wanted to be seen by the researchers as “ambitious,” while being seen by their colleagues as “good” at their job. While the definitions of success between AST and instruction found in many schools may differ, the participants reported their attempts to be seen as successful by both worlds. Jessica navigated the two worlds problem differently, developing critical pedagogical discourses that positioned her mentor and school’s contextual discourses as more important than the contextual discourses of methods courses.

The role of practice-based learning opportunities

Across participants, we found evidence of teachers being purposeful in valuing, seeking supports for, and implementing or modifying instructional practices related to the AST-aligned, practice-based learning opportunities they experienced in their methods classes. This implication is significant because the practice-based learning opportunities in the methods classes may have shaped how the participants saw the purpose of teaching and learning, and may have influenced how they noticed and interacted with their schools’ contextual discourses. Such a finding suggests that practice-based methods classes may help novices develop critical pedagogical discourses as professionals—those who focus on relational work, the exercising of judgment in the face of uncertainty, the desire to help others grow and learn—rather than a set of sterile technical procedures that can be memorized and performed in any setting (Philip et al., 2019).

Conclusions and limitations

As more teacher preparation programs consider practice-based learning opportunities, research is needed to understand how PSTs learn in such settings. In this study, we focused on PSTs’ developing critical pedagogical discourses, and noted how they linked their vision of science teaching and learning to specific practice-based opportunities in methods courses. However, we have four limitations, which lead to lingering questions moving forward.

First, we report only teachers’ critical pedagogical discourses, and not their actual instructional practices. We are left wondering: how do their critical pedagogical discourses as “ambitious teachers” (or not) appear as they plan, teach, and reflect on lessons? Second, each participant noted tensions between the contextual discourses valued in the methods courses and those valued in their schools. How, then, can we better support novice teachers to develop and grow critical pedagogical discourses *across* contexts that have better alignment between contextual discourses? How can we support other teacher educators, such as mentor teachers, to help PSTs make sense of their learning across sites of preparation? Third, we note that most participants felt constrained by their schools, and decided to temper their initial pedagogical expectations and instruction to mitigate tension with their contexts at the beginning of their careers. While understandable, how can we work with schools to provide novice teachers with a context that supports pedagogical risk-taking, innovative instruction, and learning with and from students? Fourth, Jessica provided a counter-narrative to the other participants in the study in terms of her critical pedagogical discourses. How can we use the example of Jessica to provide preservice teachers with opportunities disrupt and rebuild a new vision of teaching? Each of these questions provides

connected pathways for future research around practice-based teacher preparation, AST, and examining novice teacher learning in and across multiple contexts.

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Appendix A. Abridged Interview Protocol

Part 1: Flavor of the First Year

1. First Year: Tell me about your first year of teaching. *If hesitating*, pick three things from the year that stood out to you. Why do these things resonate with you? (Why did you pick these things?)

Part 2: Units of Instruction

2. Tell me about one unit from last or this year that you would say went well?
 - a. What about the unit defines it as successful to you?
 - b. Are there other features of a unit or lesson that would make it successful in your eyes?
 - c. In teaching there are science ideas and there are kids' ideas. Do you remember what kind of kid ideas you saw and/or heard during the unit?
 - d. Describe how you planned for this unit.
 - i. What factors do you take into consideration while planning? (Standards, student data, practices, content, method tools, etc.)
 - 1 Do any of these take priority over the others? Or how would you prioritize the factors given?
 - ii. Do you co-plan with anyone at your school or elsewhere?
 - iii. Do you use any tools when planning?
 - 1 Do you remember where you got this/these tools from?
 - iv. Have you used any resources from your methods courses to support your teaching?
 - 1 Have you used any plans? Phenomena? Colleagues?
 - v. Are there any factors/people, etc that hinder your planning or teaching?
3. Could you tell me about the unit from last or this year that you tried and it didn't go as well as you hoped?
 - a. What about the unit defines it as unsuccessful to you?
 - b. Can you pinpoint a reason or two for the lack of success? (e.g., was it because of common assessments, the phenomenon didn't get at what you thought it would?)
 - c. Do you remember what kind of kid ideas you saw and/or heard during this unit?
 - d. Do you plan to use this unit again, modify it or scrap it?

Part 3: Resource Tools (not people)

4. Resources From METHODS Class: Are there any resources that you use that came from your methods courses?
 - a. *If not mentioned*: Do you use anything like the big idea or the discourse planning tools from methods class?
 - b. *If not mentioned*: Do you use anything like the classroom tools from methods class, such as: explanation checklist, whole class models, small group models, evidence buckets, lists of hypotheses, summary table, back-pocket questions.
5. Have you created any of your own tools, either to help with planning or to use with students, that you can describe for me (get at how the tools either supported intellectual work, discourse, or other interactions among kids)?





Part 4: The Macroteaching Experience

6. As you may know, macroteaching was something that David and Amelia created in response to your cohort's feedback about your experiences with microteaching.
 - a. Do you remember what was problematic about microteaching?
 - b. Do you think that macroteaching addressed these concerns?
 - c. Were there any additional positive influences on you from your experience macroteaching?
 - d. Is there any feedback you could give that could be used to help improve macroteaching?

Part 5: Good Teaching

7. Now I'm going to change gears a little bit. What counts as good teaching to you?
 - a. Did you have a “ah ha” moment about this? Or Is this something that has just slowly developed?
 - b. Would you have described “good teaching” in the same way before starting your teacher education program? (Or “How has your perception of good teaching changed from when you started in the TE program to now?”)
8. Where would you put yourself on your continuum of “good teaching?”
9. Here’s a copy of the practice progression from AST. (Show) We know that you spoke about “moving to the right” on the practice progression a lot during your methods class.

Appendix B. Practice Progression

Where is my practice located? A Teacher's Performance Progression for Model-Based Inquiry		Intermediate and/or non-identification of multiple variations (connections or links) based only on what the teacher practices (does)	
Ambitious Practices		Explanatory model focus (Aim for this) Teacher focuses on unobservable processes, events, or entities, or the relationships among science concepts. Ties these to important observable natural phenomena to develop explanatory model that students will study.	References students' ideas & adapts instruction (Aim for this) Teacher develops rich tasks to elicit students' initial conceptions of a scientific idea. Within and across lessons teacher purposefully uses students' ideas to reshape the direction of classroom conversations, engineer productive classroom conversations, or pursue students' lines of thinking across multiple lessons.
1) Selecting big ideas, treating them as models 	Focus on observable processes Teacher selects as focus "what is changing" in a system or how conditions affect a naturally occurring event.	Elicits students' initial understandings Teacher elicits students' initial and on-going hypotheses, questions, or conceptual frameworks about a scientific phenomenon.	Building concepts within investigations Teacher foregrounds key science concepts and asks students to use an investigation to make sense of the concepts. Focus is on sense making between data and developing science concepts as described earlier.
2) Attending to students' initial and unfolding ideas 	Monitoring, checking, re-teaching ideas Teacher primarily delivers information to students. Teacher engages in 1-on-1 tutoring, uses mainly IRE in whole class conversations, and uses students ideas to check for understanding (gets it/doesn't get it)	Discovering or Confirming Science Ideas Teacher has students "discover" science concepts for themselves (without much background ahead of time) OR has students use an activity as a "proof of concept." Students not asked to draw hypotheses from scientific models or theories.	Model-Based Inquiry focus (Aim for this) Teacher highlights tentative or partial explanatory models as the basis for investigation and data collection. Teacher asks students to use model as a reference before, during and after an inquiry. Teacher builds in background knowledge of underlying (unobservable) science ideas and models before, during, and following an inquiry, but without doing the reasoning for the students.
3) Investigating science ideas in the classroom 	Primary focus on method Teacher asks students to identify variables and describe experimental set-ups. Science concepts are played down to afford time to talk about designing experiments. Talk with students is about error, validity, replicability.	"What happened" explanation Teacher asks students to describe relationships between variables or differences between groups.	Causal explanation (Aim for this) Teacher has students use theoretical events, processes, and entities to tell a causal story of why something happened (this may mean supporting students through "what/how explanations" with the end goal of working toward "why explanations"). Teacher also unpacks/scaffolds learning about the nature of scientific explanations with students, and "what counts" as evidence.
4) Pressing for explanation 	No press for a scientific explanation Teacher does not ask students to provide explanations; focus is on procedures of an activity only.		