

Learning to Listen: Cultivating Pre-Service Teachers' Attunement and Responsiveness to Student Thinking

Problem

Current visions of science and mathematics education advocate for K-12 students to engage in disciplinary learning in ways that go beyond simply learning canonical knowledge and procedures (Council of Chief State School Officers, 2010; National Research Council, 2012), but also allow students to actively participate in the disciplinary norms and practices of constructing and critiquing knowledge (Engle & Conant, 2002; Ford, 2008). In order to align with these visions, science and mathematics classrooms must become spaces where students are able to draw on their personal resources and meaning making repertoires—including everyday experiences and ways of reasoning—to make sense of phenomena, understand patterns, and solve problems (NRC, 2012; Warren, Ogonowski, & Pothier, 2005). If such classrooms are to be the norm, teachers must come to see the value in students' contributions and everyday ways of reasoning so that they build on the productive beginnings in student thinking (Hammer & van Zee, 2006), what some scholars have referred to as *responsive teaching* (e.g. Levin, Grant, & Hammer, 2012; Robertson, Scherr, & Hammer, 2016).

In order to engage in responsive teaching, teachers must first learn to *listen* to students in ways that attend to the substance of their ideas and move away from taking evaluative stances of correct and incorrect. Listening with the intention of understanding how students are thinking and reasoning requires that teachers make efforts to internalize and take the perspective of the students and understand how they reason (Authors, 2018). However, this act of listening is not necessarily intuitive in science and mathematics teaching due to a long-standing tradition of lecture-based and confirmatory instructional practices wherein the delivery and memorization of canonical knowledge has been privileged (Banilower et al., 2018). In such classrooms, teachers are likely to elicit and listen to students' contributions with an eye toward correctness rather than for the purpose of understanding students' ideas and identifying merits in their reasoning as a basis for their instruction.

Many pre-service teachers (PTs) may easily recognize such classrooms as resonant of their own science and mathematics experiences as learners if they have primarily received instruction that aligns with traditional approaches or delivery pedagogies (Kang & Windschitl, 2018; Lortie, 1975; Stroupe, 2016). When this is the case, PTs may come to their teacher preparation programs framing teaching as didactic and transmissive (i.e., telling students what they should know in the form of correct canonical answers and step-by-step procedures) rather than orienting to students as capable sense-makers with rich and varied experiences from which to draw and reason. With this in mind, we argue that to support PTs to enact responsive teaching in ways that honor and build on students' repertoires of knowledge, we must first cultivate their capacity for understanding and valuing students' ideas and ways of reasoning in science and mathematics, and, we contend, this begins with PTs learning to *listen*.

But how does one learn to listen in ways that support and align with responsive teaching practices? And what are some "listening" opportunities that can shift PTs' views of teaching from didactic and transmissive forms toward student-centered responsive views of instruction? In light of such questions, this work examines how one pre-service teacher (Jess) came to understand the importance of listening to student ideas for teaching science and mathematics, which in turn supported her to embrace more responsive views on instruction. Through this exploration, we aim to develop in-depth understandings of Jess' "learning to listen" trajectory,

understandings that can inform teacher education to cultivate PTs' capacity for listening to student thinking.

Design

Context. This qualitative case study is part of a larger project aimed at cultivating PTs' recognition and appreciation of students' diverse ways of thinking and feeling in science and mathematics. The case is situated in an undergraduate science and mathematics-focused teacher education program at a university in the southeastern United States. The data is from an early course in the program where PTs read articles on student thinking, analyzed episodes of K-12 student thinking in videos and transcripts, and engaged in science and mathematics activities as learners. The PTs also had multiple opportunities to interview students to elicit their thinking around science and mathematics questions as well as interact with upper elementary and middle school students through their field placements.

Participant. Of the nine PTs enrolled in the course, we focus our case study on Jess who at the time of the study was in her second year of the teacher education program. Jess was highly reflective and critical throughout her engagement in the course. In her writing and in a post-semester interview, she was articulate about her feelings, views, and stances. While Jess did not perfectly hone her practices of responding to student thinking, she demonstrated progress in her journey toward being a more responsive teacher, progress that we argue was driven by her *learning to listen*.

Data Sources. The data for this study consist of Jess' course assignments and a post-semester interview. Three of the assignments analyzed are interviews that Jess facilitated with her peers; the first at the beginning of the semester, the second toward the middle of the semester, and the third at the end. The purpose of the interviews was to elicit the interviewee's thinking about a mathematics or science question. After each interview, Jess wrote an analysis and reflection on the interviewee's thinking and on her actions as the interviewer. These written reflections and video recordings of the interview enactments are the main data source for this case study. Other data include Jess' final reflection essay at the end of the course and her tutoring logs from a field placement experience. These reflective assignments provide insight into Jess' understanding of her own progress and her awareness of her shifting views of teaching and learning. Additionally, we draw on a post-semester semi-structured interview with Jess that explores her experiences in and takeaways from the course.

Findings and Analysis

Jess began the semester with views on teaching as teacher-centered and lecture-based. These views were shaped by her own experiences as a student in science and mathematics classes, which she described as consisting mostly of instrumental learning via direct instruction. In reflecting on her learning experiences, she shared:

It's always been that instrumental type of teaching where the teacher [is] like, 'okay here's all the formulas, here's all the notes', lecture, lecture, lecture in class and then give you a bunch of problems to do on your own. And that's just how I've learned growing up, literally in almost every class that I've had.

Jess' initial views on teaching shaped her interactions with students, especially in the first half of the course. For instance, Jess noted how she was extremely focused on her own moves as a teacher or facilitator, instead of on students' own contributions, which in turn hindered her ability to closely attend to the substance of their thinking. Jess found this teacher-centered focus

to be especially apparent when facilitating student interviews, the goal of which was to elicit and respond to student thinking around a mathematical or scientific question. She reflected on her challenge to listen to students on multiple occasions noting that “the biggest weakness I have noticed...is that I have a hard time really listening to students because I am too worried about the next step of the conversation” and “I was so worried about the next question.” In her post-semester interview at the end of the course, she again commented on this challenge referring back to her first and second interviews:

I was thinking about my agenda in terms of the questions that I already had set for me and so I wasn't really fully listening and responding to the student because I was so focused on 'oh what's the next question that I have'...I was really just so worried about 'oh let me make sure I ask all my questions', and I didn't really pay as much attention or respond to students as well as I could have.

From these excerpts, it is evident that from the start of the semester, Jess was aware of and continuously wrestling with her challenge to listen. Throughout the course, Jess had multiple opportunities to hone her capacity for listening to student thinking. Through iterative cycles of interactions with students and reflections on those interactions, both in field placement and in interviews aimed at eliciting students thinking, Jess came to recognize the productive beginnings in students' ideas and experiences. She saw value in attending closely to how students made sense of phenomena in order to understand the substance of their ideas and lines of reasoning. In describing one of her interactions, she noted her excitement for having understood one of the students' thinking who had the wrong answer to a problem dealing with fractions but whose reasoning made sense.

There was also a moment where [the student] got the wrong number, but I could very clearly see why he got that number. So it was really interesting because I could see where his thoughts were coming from ... I could, literally, very clearly see where he was getting that number from. And that made me happy because ...I can tell that he's really--he is thinking about it in the right way.

Jess expressed a sense of satisfaction and fulfillment in being able to “sit with” the student's ways of thinking and interpret their reasoning. She described this moment as “a really cool experience for me” and further commented on her actions that, instead of veering the student away from his answer towards the correct one, she further elicited the student's own thinking: “I wasn't telling him 'oh this is wrong.' I was like 'okay well, how did you get this?' And 'well, what if you looked back at this one, and what did you do here?' You know, that kind of thing, so yeah. That was, that was definitely the best part of [my field experience], I think, was working with that one kid.”

Through such interactions with students, Jess came to recognize that listening with an eye towards understanding student thinking, instead of with a focus on her next steps, is a prerequisite for responding in ways that honor students' epistemic work:

I've learned that it is easier to respond to students and guide the conversation when you actually listen to what they are saying! I think in my past interview I had a hard time listening because I was so worried about the next question. But the whole purpose of this is to respond to student thinking and you can't respond without listening.

Importantly, having opportunities embedded throughout the course to reflect on and analyze her interactions with students was particularly powerful for Jess. Referring to reflections on videos of her interviews in each cycle of enactment, she noted: “Most of my productive thinking is done during the analysis” and “I found this to be a rewarding experience because I get

to analyze ways that I can improve in this type of discussion.” These reflective opportunities also helped Jess notice elements of students’ experiences that connect to and resonate with her own experiences as a learner of science and mathematics. She described how watching and analyzing the videos allowed her to be “actually inside of that experience [in a similar way] as the students” which she described as “beneficial because it really showed me how it affects the students from my own experience.”

Reflecting more specifically on her own listening skills, Jess stated: “I think it is going to take time to really get better at listening and responding to students effectively... it really makes me eager to grow in my ability to teach as I continue in the program.” That said, Jess did recognize her own growth as a listener. Referring to her third interview, she noted: “this experience was really rewarding for me because I feel like I actually made progress from my last two interviews and was consciously thinking about things we’ve learned in this class while still being able to listen.” Contrasting her earlier experiences with her last interview, she noted:

[It was] really just a lot better because I was actually responding to them and just going along with what was happening. Unlike my past interviews, I was not sitting there trying to remember what questions to ask, or not knowing what to say after a student responds... In my past interviews, I had a hard time being a facilitator... I didn’t know how to guide the conversation without leading students to the answer. Therefore, I would end up saying “okay cool,” and I would move on to a new question.

While Jess saw progress in her capacity for listening to student thinking, she also became more aware of moments when she could have been more attentive to student thinking. She noted how in her last interview, she at times slipped back into a “teaching-as-delivery” mode. Referring to a specific moment in the interview, she wrote:

I definitely guided my interviewees towards an answer I was looking for (at 30 minutes in) and I feel that I could have facilitated it in a better way without pushing so hard in one direction. I started teaching more than listening in this section of the video.

As the semester progressed, Jess’ interactions with students and her efforts around learning to listen supported her to adopt more student-centered, responsive views of teaching. During her post-semester interview, Jess said that “a whole other world” had opened up to her during the course, and that she has come to appreciate sitting with and working to understand student thinking. In her written reflection on her main takeaways from the course, she spoke explicitly of her shifting views on teaching:

Another major insight I developed throughout my time in this course is that successful classrooms are student-centered and student-driven. Teaching is not about pouring information into the brains of your students. Instead, it is about engaging students in in-depth conversations that reveal the information that you are trying to teach them. I learned that it is important that teachers listen to and understand student thinking. Allowing students to explore learning using prior knowledge and personal experience in discussion helps students draw connections between the content of the class and the world around them. A teacher could easily stand in front of a classroom and teach the content. But when you think about it, it’s the same thing as “giving the students the answers.” When students can figure out the “answers” on their own through discussion and exploration, they are more likely to truly understand and remember what they learned.

Jess’ views expressed in this excerpt were aligned with how she spoke about her future self as a teacher. For example, in her post-semester interview, Jess described a hypothetical “in-depth

conversation” in her future classroom noting that if a student were to come up with an unanticipated idea, she would give them the space to explore and discuss their idea in class, even if the idea were not explicitly related to the topic at hand. Jess also continued to express a desire “to further strengthen my ability to listen and respond to students...I would like to get better at actually responding to students’ thoughts.” Her goal in listening to students became one of understanding their ideas so that she can be responsive in her questioning and follow-up moves, rather than looking for errors and “just telling them what I think.”

Contribution to the Teaching and Learning of Science

This work contributes to efforts around cultivating student-centered responsive teaching practices by highlighting the importance of providing PTs with opportunities to listen to students as they grapple with science and mathematics phenomena. Learning to listen to the substance of student thinking, we argue, facilitated the shift we saw in Jess’ views of and orientation to teaching. More specifically, our findings show that throughout the semester, interacting with students allowed Jess (1) to see the value of listening to student thinking with an eye towards making sense of their ideas, (2) to view listening as central to responsive teaching, and 3) to develop a genuine desire to hone her own capacity for listening. In light of these findings, we argue that *listening* and learning to listen can serve as primary mechanisms toward teachers’ appreciation for and enactment of responsive teaching.

For Jess, opportunities to listen and internalize students’ lines of reasoning--along with opportunities to connect with and reflect upon her personal experiences as a learner and as a teacher--catalyzed her emergent shifts in her understanding of what it means to teach. Through various educative experiences such as video analyses and interactions with learners in multiple cycles of enactment and reflection (Kazemi et al., 2016; Zembal-Saul, Blumenfeld & Krajcik, 2000), Jess began to see teaching as centered on eliciting, recognizing, interpreting, and responding to student thinking in ways that honor students’ ways of reasoning and provides opportunities for sense-making (Hammer & van Zee, 2006; Robertson et al., 2016).

While this study offers one case of how cultivating PTs’ capacity for listening can support their development of student-centered responsive views of instruction, there are broader implications of such cultivation for teacher education. If we are to ask science and mathematics PTs to develop views of teaching and learning aligned with those advocated by current reform visions (NRC, 2012), then we must equip them to value and be responsive to students’ contributions in the classroom. We argue that the first step in this development is to teach PTs to genuinely *listen* to students’ contributions through the acts of eliciting, perspective-taking, and interpreting student thinking without judgement.

Contribution to Interests of NARST Membership

This study will be of interest to NARST membership and other stakeholders concerned with supporting pre-service science and mathematics teachers to teach in ways that respect and take up the intellectual contributions of students. As this year’s NARST theme points to a need to “Empower, Evoke, and Revolutionize” science education for the “Good of the Public”, we argue that one essential aspect of doing so hinges on the ways in which K-12 teachers develop their classrooms to be inclusive learning environments that position students as agentic and sensible thinkers. Learning to listen to students’ ideas in ways that honor and value their sense-making is a critical first step in the development of K-12 science and mathematics teachers who will be attuned to this vision, and this study offers insight into how such cultivation can occur.

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