

## **Complex pictures behind the scene: How identities and affects shape epistemic practices in science teaching**

**Abstract:** This study explores the roles identity and affects play in shaping epistemic practices in teaching. The focal case is an in-class debate between two science teachers on what count as evidence. While the conflict appears to be straightforwardly epistemological, our analysis showed the more complex pictures behind the scene. By associating the teachers' epistemic practices with the rationales and reflections they provided through interviews and other sources, we identified the identity and affects elements at work, demonstrating how their interactions with epistemological understandings give rise to the teachers' epistemic practices. We also traced the teachers' lived experience to understand the potential origins of these elements. Implications for personal epistemology research and teacher education are discussed at the end.

### **On the identity and affects elements behind the epistemic practices**

Studies on personal epistemology (PE) have suggested its entanglements with identity and affects from early on (Perry, 1970; Belenky, Clinchy, Goldberger, & Tarule, 1986). Later work, however, largely ignored such entanglements, treating PE as a purely cognitive structure on knowledge and knowing (Elby, Macrander, & Hammer, 2016). Recent studies looking into such entanglements produced complicated and promising findings. They showed how epistemological understanding can trigger affects (Boaler & Greeno, 2000; Mius, Chevrier, & Singh, 2018) or shape identity (Osbeck & Nersessian, 2017), how affects or identity can serve as agency for engagement in certain epistemic practices (Bang & Medin, 2010; Conlin, Richards, Gupta, Elby, 2013; Jaber & Hammer, 2016), and how epistemological stances and affects, or epistemic values and identity, can feed into each other (Berzonsky, 2004; Gupta, Elby, & Danielak, 2018; Radoff, Jaber, & Hammer, 2019). While these studies enhanced our understandings of the entanglements, they also have limitations: first, they take on either identity or affects but not both; second, they all focus on learners. Little has been done to understand such entanglements behind the epistemic practices in teaching.

The purpose of this case study is to explore whether and how identity and affects play significant roles in shaping epistemic practices in teaching. Our focal case is an in-class debate between two science teachers on whether students can draw upon their prior knowledge as evidence when constructing arguments. While the conflict appears to be epistemic in nature, our analysis showed that some identity and affective elements did play significant roles in molding or motivating the teachers' epistemic practices in the debate. We also illustrated how such identity and affective elements could have developed through the teachers' lived experience.

### **Understanding epistemic practices from a complex dynamic system perspective**

We started with the ontological position that PE consists of manifold, context-

dependent resources. Such understanding lends itself to a complex dynamic system (CDS) perspective (Brown & Hammer, 2009; Brown, 2014). From this perspective, epistemic practices should be taken as system-level structures emerging from interactions among the mental elements constituting PE. In some cases, such emergent structures shift dramatically over element-level fluctuations triggered by subtle contextual cues (e.g., Rosenberg, et al., 2006), demonstrating the *chaotic* characteristics. In some other cases, locally coherent epistemological frames emerge repeatedly across contexts, representing the *attractor* situations (e.g., Elby & Hammer, 2010). The fully belief-based and the fully resource-based view of PE are seen as two ends of the spectrum rather than a dichotomy.

Being aware of the critical role identity plays in disciplinary participation and affects plays in rational thinking (Immordino-Yang & Damasio, 2007; Lee, 2017), we expect these elements to be part of the complex system affording epistemic practices. Incorporating such elements renders the system less rational but more realistic. It also expands the mechanistic account on how personal experience shapes PE.

In this study, our notion of *affects* encompasses what Jaber and Hammer (2016) called “affects *toward* the discipline” and “affects *within* the experience of science” (p.166). The former denotes dispositions one associates with science in general. The latter refers to feelings “connected to epistemic experience and objectives in the doing of science (p. 161).” Largely aligning with positioning theory (Davies & Harré, 1999), our notion of *identity* refers to the way one positions him/herself in reference of the generalized others. We also consider such *identity* as dynamically constructed through the internal dialogue among voices representing different positions.

### **The case**

The case occurred in Ms. Trunk’s eighth-grade science classroom, when her mentee teacher Ms. Ricci introduced the *Purple Loosestrife* task. The task illustrated through a graph the abundance changes in local marsh species upon the introduction of purple loosestrife, an invasive species. After guiding the students to identify major trends from the graph, Ms. Ricci instructed them to generate evidence-based arguments to answer the question “what is happening in reaction to the purple loosestrife being introduced into the ecosystem?” It is at this point Ms. Trunk intervened, asking where the evidence should come from. In short, while Ms. Ricci wanted students to draw on data presented in the graph and their prior knowledge about plants and ecosystems, Ms. Trunk insisted that the students should not “making inference” from their prior knowledge but should focus on the given data only. The debate reemerged a few times over two lesson periods, getting more intense each time and causing great student confusion on whose instructions they should follow. The two lesson periods have been observed and videotaped. The debate episodes were then identified and transcribed.

### **The interviews and other material**

We used stimulated recall interviews (Lyle, 2003) to explore how Ms. Ricci and Ms. Trunk experienced the classes and rationalized their epistemic practices. Such

interview data, coupled with the classroom interaction data from the focal case, serve as the primary sources that inform us about the mental elements at work behind the scene. Besides, the interview for Ms. Trunk also explores her lived experience related to science learning and teaching. For Ms. Ricci, similar information is obtained through material she provided when attending the program, including her positioning paper, her program entry interview, and a case study she did. To justify the stability of the teachers' epistemological frames, we also drew evidence from their teaching practices beyond the case.

### **Data Analysis**

Following the categories proposed by the epistemological resource theory (Hammer & Elby, 2002), we first interpreted from the classroom data of the focal case epistemological features of the two teachers' practices. We then looked across the other data to see if such features also presented in their teaching practices beyond the focal case. The next step is to detect the involvements of identity and affects elements from the rationales the teachers provided in reflection. To identify identity elements, we followed the guidance of positioning theory (Davies & Harré, 1999), looking for instances where a teacher positions herself either in alignment with or against some generalized (or specialized) others. To identify affects elements, we looked for instances where the teachers talked about their feelings and attitudes, either towards science or science teaching in general, or associated with particular practices of science and science teaching. Finally, we traced the life stories collected from the two teachers, looking for potential connections between their lived experience and the identity and affects elements identified. Following the tradition of biographic study, such analysis focused on using the past to explain the present (Creswell, 2016).

### **Results**

While both teachers seemed to view *knowledge as fabricated stuff* in the context of the argumentation task, their discursive actions showed significantly different understandings about the *epistemic form* of the knowledge to be fabricated, and in correspondence, about the *epistemic activities* that should be allowed when fabricating such knowledge. For Ms. Trunk, the task is a game of generating justified *statements* through the process of *accumulating* and *applying* "hard data", which distinguishes from other information and qualifies as evidence because of its empirical nature. For Ms. Ricci, the task goal was more about fabricating possible mechanistic *stories*, which would allow *accumulating* and *applying* "hard data", but would also open space for the activity of *formation* through connecting with personal prior knowledge. Such features are not limited to this case but presenting consistently in their teaching practices, respectively, suggesting that both of their epistemological frames are relatively stable. Our full paper will elaborate on that.

To fit the word limits, here we only present with some details a chunk of analysis on one of Ms. Trunk's identity elements, and summarize the rest of the findings.

*Positioning as the "things person"*

At the opening of the interview, right after the interviewer mentioned Ms. Ricci's internship and before he raised any question, Ms. Trunk made a spontaneous comment, positioning Ms. Ricci as "natural," or having "a kind of engaging demeanor" with student. In contrast, she positioned herself as "things person," emphasizing the importance of "physical things," or "content," as she explicated later:

*I think that, um, good teachers relate more to the person, which is not my natural tendency. So she has that, and then the content kind of comes second. But with me, it was always the content was first, and then the humanity came second.*

A core difference between Ms. Trunk's position of "things person" and the "people person ('relate more to the person') position she assigned to Ms. Ricci or "good teachers" in general, is what comes first in teaching. The "things person" identity, in this context, took on dual meanings: prioritizing "content," and consequently, being less attentive or related to the students. Her later comments suggested that epistemological understanding about the nature of science, such as "science is not really science unless you're actually observing the cause-and-effect relationships of nature," is also part of the "content" she wanted to prioritize.

There is interview-based evidence that Ms. Trunk's "things person" identity is involved in shaping her epistemic practices in teaching. After looking at a debate episode, an initial feeling Ms. Trunk shared with the interviewer is "maybe, me more than her, like we forgot the students." When further probe, Ms. Trunk expressed a two-fold understanding of the in-class debate. For one thing, she identified Ms. Ricci's task setting as "appropriate for the students," which foregrounds student engagements. For another, she attributed her intervention with her being "kind of obsessed with the way science works," which, while not being useful "for the student," foregrounds a piece of content, that is the "philosophical approach to the way scientific method is practiced." Interpreted this way, their in-class debate is not a straightforward epistemological disagreement, but reflecting the identity contrast between the "things person" and "people person."

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#### *Summary of the findings*

Our data evidenced the involvement of identity and affects elements in the emergence of the teachers' epistemic practices. For Ms. Trunk, the "things person" position drove her to focus more on "content" than students' needs. Her "purist" position took on the epistemological stance that empirical data is what makes science scientific, which is rooted in her love of eternity and how she values science and quantitative data as eternal. Such affects-based epistemological understanding then became the piece of "content" to be prioritized in the focal case. For Ms. Ricci, we argue that her stably expressed epistemological frame is supported by the teaching ideal she identified with, that is, bringing in students' natural instincts to wonder and leveraging their prior knowledge as resources for idea generation. Aligning with this teaching ideal, "worry about shutting students down" is an affective element that motivates Ms. Ricci to argue for the right to bring in prior knowledge. Her practices have less to do with her epistemological understanding of argument and evidence, but more to do with what

she sees as a necessary condition for realizing her teaching ideal.

Both teachers' identity and affects elements identified are closely related to their lived experience. Ms. Trunk's love of science since childhood, her experience of failing and boning up on math, and her ten years of EPA working experience all shaped her "things person" and "purist" positions; whereas Ms. Ricci's babysitting experience, high school science learning experience, and undergraduate learning experience of science teaching all speak to her teaching ideal. Our data also showed how the mentor-mentee experience may contribute to the dynamics of the complex systems behind their epistemic practices.

### **Significance**

Theoretically, our work raises CDS as a new framework for understanding epistemic practices. The analysis shows how identity and affects elements can contribute to the emergence of epistemic practices in teaching, and how such complex pictures behind scene can be easily missed when one only attends to personal epistemology on the cognitive level. Practically, we argue that teacher educators should take teachers' individualized identity and affects into consideration when engineering teacher learning experience for transforming their classroom epistemic practices.

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