

### Background

The NGSS ask teachers to include science and engineering practices (SEPs) in instruction. (NGSS Lead States, 2013; NRC, 2012)

The SEPs move away from vague notions of inquiry by clarifying the cognitive and interactional processes of doing science. (Crawford, 2014; Osborne, 2014)

Practices can be split into investigating, sensemaking, and critiquing. (McNeill et al., 2015)

### Research Question

How do chemistry teachers' understandings of inquiry shape their sensemaking about the SEPs?

### Context

5-day summer professional development (PD) for middle and high school chemistry teachers

PD focused on planning 3-dimensional, phenomenon-based laboratory investigations, with an emphasis on argument from evidence.

Interview data drawn from all 7 participants.

### Findings

#### Mr. T: Equated Inquiry and the SEPs

Mr. T, who had previous professional development using the term "inquiry," focused on identifying and adapting "inquiry labs."

A focus on "inquiry labs" obscures the other ways that SEPs are integral to science instruction and can be used outside of laboratory settings to support scientific thinking.

*Even at different AP workshops I've gone to ... they have transitioned to inquiry labs. ... I feel that from this one lab plus all the others we did there's no question in my mind of what an inquiry lab is now. I feel very confident to look at existing labs and tell that and also to convert the quote cookbook labs into inquiry-based labs.*

*Interviewer: And what about other practices like argumentation?*

*Mr. D: That's the thing that we didn't really explore and ... I certainly wouldn't say that I teach that. I probably don't even teach that at all unless you're gonna say, we argue about like how to approach solving this problem in a project and then we come to some consensus.*

#### Mr. D: Focused on Familiar Practices

When discussing guided inquiry, Mr. D only referenced activities that engage students in investigative practices. He did not mention learning about other SEPs.

Although the PD focused on having students make claims on the basis of experimental data, fewer supports were given for the interactional aspects of argumentation and critique.

#### Ms. K: Learned via Practical Tool

Ms. K used the NGSS planning framework provided in the PD to use the SEPs to structure to guided inquiry learning.

**NGSS Planning Framework**  
identify phenomenon, write an explanation, connect to DCI/SEPs, determine a focus question, create ideal student product, design laboratory experience to reach goals

*Guided learning ... basically was like a free-for-all for learning. That's always kind of how I saw student-centered things, like, oh, here's some stuff. Good luck. Figure it out.... But student-centered learning to me now ... there is a method to the madness .... Because of some of the tools that we've been given, I see that structure now.*

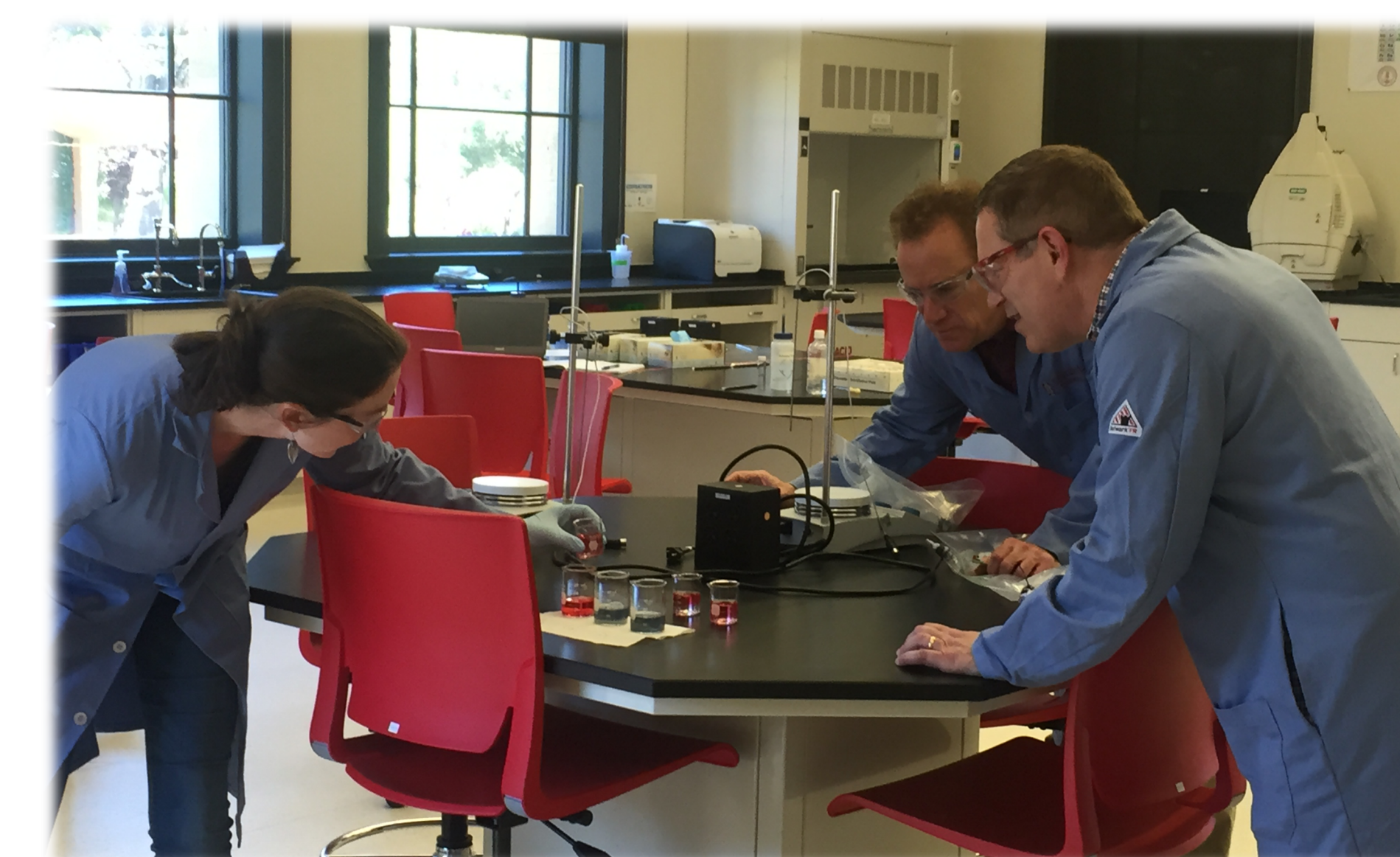
### Implications for PD

Explicitly contrast traditional conceptions of inquiry with the SEPs.

Address SEPs both in the context of laboratory investigations and in terms of other classroom activity.

Give more attention to less familiar SEPs, such as sensemaking and critiquing practices.

Connect theories with practical strategies and tools in order to support teachers' understandings of the SEPs and how to implement them in instruction.



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