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Insight Into How Professionals Develop: Examining Teachers' Reflection and Sensemaking During Professional Development

Problem

Recent reform efforts within science education aim to create environments where students make sense of phenomena using science content and practices simultaneously (NGSS Lead States, 2013). Teachers are given a “carnival of options” in regards to professional development (PD) which might support them to facilitate new reform efforts focused on students' sensemaking (Wilson, 2013; p. 310). One such way that teachers can promote students' sensemaking is by using an array of student's ideas to create explanations from evidence while remaining attentive to disciplinary concepts and practices embedded in the task (e.g., Tekkumru-Kisa et al., 2022; Cartier et al., 2013), thereby fostering Productive Science Talk (e.g., McNeill & Krajick, 2012; Osborne et al., 2019). Teachers must be supported to design and facilitate lessons that support productive science talk. However, designing and implementing this kind of lesson is difficult for teachers, even after participating in professional development (PD) targeting such instruction (Sandoval et al., 2018). If we are to create classroom environments described by the recent reform efforts, we need to understand what happens in PD and how that affects what teachers are taking away from PD. Examining teachers' sensemaking allows us to analyze how teachers work to integrate concepts and techniques presented in PD in their classrooms (e.g., Allen & Penuel, 2015; Marco-Bujosa et al., 2017). The literature on teacher sensemaking suggests that engaging in reflection *might* support teachers' sensemaking about changes to their practice (e.g., Marco-Bujosa et al., 2017; Senzen-Barrie et al., 2020), but prior research has not connected teachers' reflections to their sensemaking. *This study builds on the previous work in the field and explores connections between teachers' engagement in reflection to their sensemaking during a teacher PD.*

Theoretical Framework

Sensemaking describes how a person forms an understanding of something unknown (Waterman, 1990). It accounts for how groups and individuals derive different meanings from the same event. Broadly, sensemaking can be defined as a way of describing how the actors in a given situation make meaning and respond to change within their environment (Weick, 1995). Current research on teacher sensemaking investigates how science teachers make sense of recent reform efforts presented to them as part of PD, how PD affects their practice, and how their practice impacts their ideas and beliefs about teaching and learning (e.g., Allen & Penuel, 2015; Marco-Bujosa et al., 2017). In this work, we use sensemaking as a framework to understand how teachers organize and give meaning to events in PD. Specifically, we are interested in how teachers sensemaking about the facilitation of productive talk in science classrooms (Weick, 1995). Thus, by examining how teachers participate in sensemaking, what they sensemake about, and what supports teachers' sensemaking, teacher educators can better understand how to support teachers' learning. Current research suggests the importance of certain features within PD design which might support teachers' sensemaking, such as ‘active learning’ opportunities (i.e., collaboration and lesson design) (Allen & Penuel, 2015), artifacts (i.e., lesson plans, pacing

guides, classroom video) (Allen & Heredia, 2020) and reflection (e.g., Marco-Bujosa et al., 2017; Senzen-Barrie et al., 2020). While each of these three features is important, in this work we focus squarely on reflection as a feature of PD. Reflection *might* be an important feature that supports teachers' sensemaking around improving their practice (e.g., Marco-Bujosa et al., 2017; Senzen-Barrie et al., 2020).

Reflection can support teachers to consider their past instruction and decisions that guided their subsequent practice (i.e., Killion & Todnem, 1991; Moore-Russo & Wilsey, 2014). In light of this, prior research has focused on *how* teachers reflect (e.g., Fund, 2010) and *what* teachers discuss during moments of reflection (e.g., Davis, 2006; Loughran, 2002). Current research suggests that teachers must move beyond simply recounting their practice to participating in reflection that focuses on sharing their viewpoints, connecting to personal experiences, or connecting to literature around teacher practice to learn the skills and practices presented in PD (Moore-Russo & Wilsey, 2014). However, research has not connected teachers' engagement in reflection to their sensemaking.

This investigation is structured to answer two research questions: *During instances of reflection embedded in a professional development experience designed to support teachers' facilitation of productive science talk: (1) How do different categories of reflection influence the type of sensemaking? (2) How was sensemaking facilitated by specific PD design structures?*

Design

The data for this study comes from a project which focused on supporting teachers to facilitate productive science talk (Southerland et al., 2017). The PD for this project included an intensive summer institute followed by four in-school cycles of follow-up conducted throughout the 2018-2019 school year. The in-school cycles were structured around designing, teaching, and analyzing cycles targeting specific science lessons. The design sessions focused on teachers collaboratively designing a lesson focused on providing students with opportunities to engage in productive talk. Each teacher was partnered with another teacher or one of the research team members for these sessions to refine a lesson mindful of their students' teaching context and needs. In the Teach part of the cycle, the teachers enacted the designed lesson, and that enactment was recorded. In this work, we examined teachers' efforts during the Analyze Sessions because of the emphasis on reflection seen in these sessions. The "analyze" sessions allowed teachers opportunities to reflect on classroom videos of themselves and their colleagues' practice, participate in discussions around these video clips, and redesign their lessons based on their reflection. Each Analyze Session focused on a different facet of productive science talk. Cycle 1 discussed how anchoring phenomena could support productive talk; cycle 2 focused on using student ideas to facilitate productive talk; cycle 3 centered around the role of evidence in productive talk; cycle 4 was about using students' ideas towards an end goal.

Data examined in this work include recordings of the Analyze sessions and artifacts from the PD facilitation (e.g., PD planning outlines—with related teaching objectives, powerpoints, related readings, and teaching video clips). Participants were four science teachers working at secondary schools within the same district in the southeastern United States. Their teaching experiences varied from three years to over two decades. Kate and Jerry taught middle school biology. Monica and Daniel both taught high school—AP biology and chemistry, respectively.

Analysis

Videos of all four of the Analyze Sessions were examined to identify instances where teachers reflected on their facilitation of productive talk regarding the lesson that they had just taught as a part. These instances lasted from approximately 30 seconds to 5 minutes. Each

instance of reflection begins when the teacher discusses one concept concerning their practice and ends when they change the subject or the conversation dies out.

We draw on three types of analysis. The first two types of analysis informed the answer to the first question and the third type of analysis informed the second research question. First, we determined the type of reflection the teachers participated in. All instances of reflection were coded concerning into one of four ‘Categories of Reflection’ (Moore-Russo & Wilsey, 2014): 1) *simple recounting* focusing on moments where teachers provide a “play-by-play” of what happened in their enactment; 2) *individual viewpoint* focusing on moments where the teacher offers their perspective using their personal opinion. 3) *personal connection* building on an individual viewpoint and links to other resources or moments in the previous discussion; 4) *community connection* focusing on moments when teachers connect to the educational community's commonly accepted theory. Note that the first two categories do not connect to any other resources or previous points in the discussion, while the latter two categories require such connections.

We then examined these instances to determine the process of reflection teachers were engaged in, informed by the analytical approach of Robertson and Richards (2017). For this, we analyzed each teacher’s sensemaking about facilitating (productive) talk by identifying instances in which they did one or more of the following: *raised a question or concern* about facilitating students' talk in science classrooms, explicitly made an effort to *articulate the meaning (AM)* they were making of some aspect of productive science classroom talk, *considered* aspects of talk in relation their *context (CC)*, *negotiated* something about productive science classroom talk with others in the PD (N), and/or displayed an *affective or identity-laden* response to science talk (A/I). Building on this analysis, this coding enabled us to look across moments to see the sensemaking processes that the teachers use for different forms of reflection.

We examined our findings from the first research question in regards to what PD design feature was supporting the teachers' sensemaking. The design features were separated into three categories: 1) *General discussion*, which was focused either around questions that were designed to support teachers' sensemaking around the cycle's theme or teachers describing what they had changed in regards to their redesigned lesson; 2) *Redesign*, which were opportunities for the teachers to work with their co-design partner to consider how they designed and facilitated their lessons regarding opportunities for productive science talk; 3) discussion around *video* of their teaching or their colleagues' instruction that exemplified concepts around facilitating productive talk in their classrooms.

Findings

We revealed trends in how teachers reflect and sense make in PD settings, as well as nuances in the PD design structures that supported different categories of reflection and sensemaking. As displayed in Table 1, our analysis shows that during PD teachers use *simple recounting* (47 instances, 20%) when *negotiating* something concerning their or their colleague's practice (SR: N, 27 instances 57%). Most often teachers tended to reflect by sharing their *individual viewpoints* (IV: 135 instances, 57%) using *multiple processes of sensemaking* (IV: 2 or more processes, 64 instances, 47%). When teachers were reflecting using *personal connections* (PC: 55 instances, 53%) teachers were most often sensemaking by either *negotiating* (PC: N, 21 instances, 38%) or using *multiple processes of sensemaking* (PC: 2 or more processes, 21 instances, 38%). There were no instances of *community connection* found in our data set.

As shown in Table 1, when we compared categories of reflection teachers participated in with the process of sensemaking in regards to the structures designed as a part of the PD,

interesting patterns emerged. During teachers' participation in *general discussions*, they most often reflected by sharing their *individual viewpoints* (IV, 19 instances, 70%) by *articulating meaning* about something related to the theme of the PD cycle (IV: AM, 6 instances, 22%). *General discussions* were seen in all categories of reflection to have the potential to support teachers to use more than two processes of sensemaking (3 instances, 11%). When teachers participated in the *redesign* of their lessons, they typically reflected by sharing their *individual viewpoints* (IV, 86 instances, 59%) by *negotiating* something regarding the design of their lesson (IV: N, 33 instances, 23%). Teachers often used multiple processes of sensemaking to *redesign* lessons (64 instances, 44%). One such example seen commonly in the *redesign* was reflection using teachers' *individual viewpoints* around *questions or concerns* they had with the lesson design and then *negotiating* how they might fix them (IV: RQ & N, 22 instances, 15%). During moments where teachers were asked to reflect on either their own video or their colleagues' video, they tended to share their *individual viewpoints* about what they noticed in the video (50 instances, 59%) or provided a *simple recounting* of what happened when they facilitated the lesson (23 instances, 27%). Whether teachers were sharing their *individual viewpoints* (IV: N, 22 instances, 26%) or *simply recounting* their lesson (SR: N, 13 instances, 15%) they most commonly used *negotiation* to sensemake about the video. Taking a step back, we see that all features designed to facilitate teacher sensemaking as a part of the PD have the potential to support teachers to use more than one process of sensemaking (98 instances, 41%).

Conclusions, Implications, and Scholarly Significance

For in-service science teachers in the 21st century continued teacher education can come in the form of teacher PD focused on supporting teachers' sensemaking about reformed styles of teaching and learning (e.g., Allen & Penuel, 2015). PD experiences can be essential opportunities for teachers to improve their practice because they support them in learning about innovative or nontraditional instructional approaches (Southerland et al., 2016). Specifically, reflection has long been described as a practice that teachers should participate in to support their learning (e.g., NASEM, 2015). Our findings suggest that PD settings provide opportunities for teachers to participate in forms of reflection that support their sensemaking and begin to shed light on which design features enable specific categories of reflection and how that reflection, in turn, supports opportunities for teachers to participate in different processes of sensemaking.

By taking into account what categories of reflection teachers use most often to engage in specific processes of sensemaking, as well as what might support them in this effort, PD facilitators can design more effective structures for teacher learning. For example, if we hope to support teachers to move beyond *simply recounting* to participate in more robust forms of reflection, PD facilitators might consider questions, tasks, or design features that will support teachers to share their *individual viewpoints* or *personal connections*. When teachers *simply recount* what happened in a lesson, they are often *negotiating* something in regards to facilitation. However, this is not always clear to the larger group. PD facilitators can support teachers to move beyond *negotiation* and utilize *multiple processes of sensemaking*, such as *sharing their concerns/questions* and/or supporting teachers to *articulate meaning* regarding their ideas. As the field is seeking to understand what happens in PD and how it affects what teachers are taking away from PD, taking into account what categories of reflection teachers use most often to engage in specific processes of sensemaking as well as what might support them in this effort will allow facilitators to design more effective structures for teacher learning.

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Table 1. Teachers' Reflections and Sensemaking Processes during Analyze Session

All Instances of Reflection Across Analyze Sessions				Design Features					
				General Discussion		ReDesign		Video	
Reflection		Sensemaking		Reflection	Sensemaking	Reflection	Sensemaking	Reflection	Sensemaking
Simple Recounting (SR)	47 (20%)	Raise a Question or Concern	3 (6%)	2 (7%)	1 (50%)	23 (16%)	2 (9%)	23 (27%)	1 (4%)
		Negotiation (N)	27 (57%)				14 (61%)		13 (57%)
		Considering Context	4 (9%)						3 (13%)
		Affect and Identity	1 (2%)				1 (4%)		
		2 Processes	10 (21%)				5 (22%)		5 (22%)
		3 or More Processes	3 (6%)				1 (4%)		1 (17%)
Individual Viewpoint (IV)	136 (57%)	Raise a Question or Concern	6 (4%)	19 (70%)	1 (5%)	86 (59%)	2 (2%)	50 (59%)	3 (6%)
		Negotiation	46 (34%)		3 (16%)		33 (38%)		22 (44%)
		Considering Context	8 (6%)		2 (11%)		4 (5%)		2 (4%)
		Affect and Identity	0 (0%)						1 (2%)
		Articulate Meaning	12 (9%)		6 (32%)		2 (2%)		6 (12%)
		2 Processes	55 (41%)		5 (26%)		39 (45%)		15 (30%)
		3 or More Processes	9 (6%)		2 (11%)		6 (7%)		1 (2%)
Personal Connection (PC)	55 (23%)	Raise a Question or Concern	4 (7%)	6 (22%)	3 (50%)	37 (25%)	1 (3%)	12 (14%)	
		Negotiation	21 (38%)		1 (17%)		16 (43%)		4 (33%)
		Considering Context	7 (13%)		1 (17%)		1 (3%)		5 (42%)

Affect and Identity	0 (0%)			
Articulate Meaning	2 (4%)		2 (5%)	
2 Processes	16 (29%)	1 (17%)	12 (32%)	3 (25%)
3 or More Processes	5 (9%)		5 (14%)	
Total: 238		Total: 27	Total: 146	Total: 85

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