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Using a video club design to promote teacher attention to students' ideas in science

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HIGHLIGHTS

- Presents design-based research building on prior video club work.
- Offers a new design for a science teaching video club.
- Describes two unique design features tied to teacher noticing outcomes.
- Teachers' use of wearable video technology is significant to this design.
- Results show video club design supports sustained focus on students' thinking.

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ABSTRACT

Science education stakeholders worldwide are engaged in efforts to support teachers' noticing and making sense of students' thinking in science. Here we introduce the design of a science teaching video club and present a study of its implementation. The current design extends prior research on video clubs as a form of professional development for supporting mathematics teachers. Results indicate that the current design supported science teachers in noticing and discussing students' thinking in sustained and meaningful ways.

1. Introduction

Einstein famously said that "the whole of science is nothing more than a refinement of everyday thinking" (1936). Under this premise, teaching science involves attending to the explanations students develop as they interact with the physical world and using those ideas as the basis for learning in the classroom (Barnhart & van Es, 2015; Roth et al., 2011; Ruiz-Primo & Furtak, 2007; Talanquer, Tomanek, & Novodvorsky, 2013). Indeed research on effective science teaching—including responsive teaching (e.g. Coffey, Hammer, Levin, & Grant, 2011), ambitious teaching (e.g. Windschitl, Thompson, Braaten, & Stroupe, 2012), and reform-based teaching (e.g. Schneider, Krajcik, & Blumenfeld, 2005)—finds that attention to students' ideas supports meaningful science learning.

Despite this consensus, attending to students' thinking while teaching science can be quite difficult (Barnhart & van Es, 2015; Windschitl, Thompson, & Braaten, 2011). Doing so requires many teachers to approach science instruction differently than in the past, shifting from attending to students' correct and incorrect answers or usage of science vocabulary to attending to the "initial ideas students bring to school and how they [students] best may develop an understanding" (NRC, 2012, p. 256) of phenomena in the world (Crawford, 2007; Davis & Smithey, 2009; Schweingruber, Duschl, & Shouse, 2007).

In light of this goal, the science education community is engaged in a variety of efforts to support teachers in learning to notice and make sense of students' science ideas so that these ideas become the basis of learning in the science classroom. Here we present one

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such model of professional development (herein referred to as PD). Specifically, we report on the design, enactment, and study of a science teaching video club for elementary teachers focused on noticing students' ideas and thinking. First, we present the theoretical basis and prior work informing this design. Next, we describe our design of a science teaching video club and present a detailed account of the initial implementation with a group of elementary teachers. Finally, we offer evidence that this video club model supports teachers' noticing and making sense of students' ideas and thinking in science. The work presented here follows a design-based research methodology (DBRC, 2003) with prior video club design research, particularly in mathematics education, essentially serving as previous iterations of this work and specifying the focus of investigation for this cycle of inquiry (Cobb, diSessa, Lehrer, & Schauble, 2003; Wang & Hannafin, 2005).

2. Literature review and theoretical foundation

2.1. Professional development as a context for teacher learning: a framing perspective

This study is grounded in a cognitive perspective of teacher learning—specifically the perspective that teachers' *epistemological framing* of science teaching and learning drives much of what happens in practice (e.g. Hammer, Elby, Scherr, & Redish, 2005; Hutchison & Hammer, 2010; Russ & Luna, 2013). Framing in general is a dynamic cognitive construct first offered by sociolinguists and anthropologists as a way of explaining how individuals are able to make sense of and appropriately engage in the myriad of interactions encountered every day (see MacLachlan & Reid, 1994 for review). The premise is that we are able to make sense of an interaction and behave appropriately based on our prior experiences of similar interactions even when contexts overlap.

A teacher's epistemological framing in particular is a teacher's "sense of what is taking place with respect to knowledge" (Scherr & Hammer, 2009). In a science classroom, a teacher's epistemological framing concerns how she thinks about knowledge as it relates to science teaching and learning. A teacher can frame and reframe her idea of science teaching from moment to moment—sometimes it may mean emphasizing definitions of science vocabulary, while other times it may mean asking questions about scientific phenomena. Furthermore, Levin, Hammer, and Coffey (2009) argue that teachers' different learning contexts (e.g. their schooling history, teacher education program, current teaching placement, etc.) influence how they frame their science teaching practice and this influences their instructional decisions. Thus a teacher's epistemological framing is both dynamic, responding to what is happening in the moment, and empirical, drawing on past experiences of practice.

Three main findings result from the body of work on teachers' epistemological framing are important to note as they inform this design research. First, teachers frame the knowledge at play in classroom activity in different ways at different times. Second, these moment-to-moment understandings of what kind of knowledge is appropriate to use and what kind of epistemic practices (Collins & Ferguson, 1993) are valued influence how students and teachers engage in the classroom activity (Hammer et al., 2005; Redish, 2004; Russ & Luna, 2013). And third, there exists a reciprocal relationship between how a teacher frames classroom activity and what she notices during that activity (Russ & Luna, 2013). MacLachlan and Reid (1994) refer to this relationship when they conclude that framing "creat[es] a particular kind of attention" (p. 55). It is this relationship we consider foremost when designing science teaching PD because we want to promote among teachers a particular kind of attention to students' science ideas and thinking. In other words, we want to design PD that engages teachers in noticing and making sense of ideas so that these activities become part of their science teaching experiences, and consequently inform how they frame their practice. Much of recent research on teacher noticing seeks to characterize the nature of this expertise, looking closely at the ways that teachers notice in the context of instruction. For example, Sherin, Jacobs, and Philipp (2011) describe noticing as the process through which teachers simultaneously identify significant features of instruction and work to make sense of what is noticed. In focusing here on epistemological framing, we emphasize the reasons why a teacher will exhibit a particular kind of noticing.

2.2. A need for science teacher PD creating this particular kind of attention

PD plays an important role in education reform generally (Darling-Hammond & McLaughlin, 1995; Garet, Porter, Desimone, Birman, & Yoon, 2001) and in science education reform specifically (CSMTP, 2001; Fishman, Marx, Best, & Tal, 2003). In general, researchers characterized effective PD as tied to teachers' practice, intensive and sustained, and focused on subject specific content (Garet et al., 2001; Guskey, 2003; Wayne, Yoon, Zhu, Cronen, & Garet, 2008; Wilson & Berne, 1999). More specifically, in science education, researchers characterized effective PD as being "rooted in the science that teachers teach and includes opportunities to learn about science, about current research on how children learn science, and about how to teach science" (NRC, 2007, p. 285). While there is evidence of these principles in prior PD efforts (for reviews see Wei, Darling-Hammond, Andree, Richardson, & Orphanos, 2009, 2010), the science education community has called for more science-specific PD opportunities for elementary teachers in particular (Appleton, 2013; NRC, 2007). Science education researchers have responded to this need and have developed PD contexts and tools involving video of science teaching and learning (e.g. Boehm, Brysch, Mohan, & Backler, 2012; Hiebert & Stigler, 2000; Roth et al., 2011; Wilson, 2013; Zhang, Lundeberg, Koehler, & Eberhardt, 2011). For example, Rosebery, Puttick, and Warren describe a particularly promising approach to providing such opportunities to elementary teachers. They offer an inquiry-based model of PD that engages teachers in their own scientific sense-making as well as in explorations of their students' scientific sense-making by watching and discussing video of their science teaching practice (Rosebery & Puttick, 1998; Rosebery & Warren, 1998; Warren & Rosebery, 1996). This inquiry-based model of PD is similar to another successful model of PD that Sherin and colleagues present (Sherin & Han, 2004; van Es & Sherin, 2008)—the video club model of mathematics teacher PD.

Largely familiar in mathematics teacher learning contexts, a video club is a type of PD experience in which a group of teachers watch and discuss classroom video excerpts of their instruction with a particular focus or framework in mind (Frederiksen, Sipusic, Sherin, & Wolfe, 1998). For example, in order to support teacher learning around a particular classroom issue, teacher discussions in a video club context may be intentionally focused on discourse, student work, student thinking, or management (Tochon, 1999). This model has proven to be effective in supporting teachers' attention to students' mathematical thinking in particular (van Es & Sherin, 2008; Sherin & van Es, 2009).

Like other effective models of teacher PD, both the inquiry-based and the video club models involve the design of PD that is embedded in teachers' practice, focused on the content teachers teach, and sustained over time. In addition, both models use video of practice to engage teachers in conversations around problems of practice. In the last two decades, video has become increasingly popular as a tool for teacher PD. Several affordances of video likely