Using Classroom Video and Technology to Blend Teachers' Learning in Independent and Collegial Contexts

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Abstract: This paper reports on a professional learning (PL) program blending independent and collegial contexts. The program was supported by classroom video and technology to notice and respond to students' thinking. Two cohorts of teachers used software and paper supports to plan, capture and study video of their own classrooms, and to develop and share video cases. The research explored what teachers notice about their students' thinking during independent and collegial studies of classroom video. This paper highlights a case of one teacher's PL. Video cases, transcripts of independent study, collegial study and of an exit interview were analyzed. Doing the independent study first, the teacher identified problematic student thinking to discuss with colleagues. Collegial discussion subsequently clarified students' thinking and explored next steps in teaching. Affordances of independent and collegial learning contexts and the role of video, technology, and related supports in fostering teachers' PL are discussed.

Keywords: teacher professional learning, classroom video, video analysis

Major issue addressed and significance of the work

A key purpose of classroom video in teachers' professional learning (PL) is to help them reflect on students' thinking. Advances in video annotation technology make it possible to support teachers' reflection (Rich & Hannafin, 2009). For example, after using a video analysis software emphasizing noteworthy events like issues in students' thinking and pedagogy, teachers developed skills in explaining their students' ideas and the influence of particular teaching moves on students' thinking (van Es & Sherin, 2002). Teachers may conceivably use such technology for independent study. Additionally, Video Clubs where teachers share and discuss video of their own classrooms with colleagues may promote teachers' PL. Research shows that collegial discourse bolstered with video and questions about students' conceptions helps teachers examine the meaning behind students' ideas (Luna & Sherin, 2017), and discuss pedagogy in light of students' thinking (Sherin & Han, 2004). But there is little understanding of how one may blend independent and collegial contexts to support teachers' learning, and how classroom video and technology may serve this end. The issue of blended PL anchored in classroom video and technology is critical because learning involves both individual and social aspects (Salomon & Perkins, 1998). By integrating independent and collegial learning, educators may thus leverage the strengths of the two contexts in fostering teachers' PL. This paper presents a video-supported blended model of teachers' PL designed to foster their skills in understanding and responding to students' thinking in science.

Theoretical approach and research questions (RQ)

The PL model and the associated research draw on a framework for teachers' professional noticing, which comprises three inter-related processes: focusing on students' disciplinary understandings; analyzing or making sense of these understandings; and deciding how to respond to the understandings (Jacobs, Lamb, & Philipp, 2010). Specifically, in science instruction, teachers need to attend to students' science ideas, interpret the ideas in light of the learning goals, and use these interpretations to plan next steps (Barnhart & van Es, 2015). This research explored two questions to understand how independent and collegial studies of classroom video contribute to teachers' PL. RQ1 was: During independent study, what do teachers notice about their students' science thinking? RQ2 was: During collegial study, what do teachers notice about their students' science thinking?

Methods

Research approach, participants and context

This paper reports on teacher learning in the context of a video-supported PL program. Two cohorts of four cross-grade, upper elementary school teachers participated in the program. The cohorts were from different school districts. The paper highlights a case study of PL of one teacher (identified with the pseudonym Ms. Collins) from one of the cohorts. The program aimed to help teachers develop abilities to notice students' science ideas and reasoning, and to use these understandings to inform next steps in teaching. The teaching experience in the cohort ranged from five years to 22 years. The case study focused on Ms. Collins because she had spent the fewest years teaching (and teaching science) compared to the rest of her cohort. The study will thus clarify how video-based blended PL can support teachers with limited professional experience to notice and respond to students' thinking.

The study took place in a suburban school in Northeastern U.S. The cohort participated in a four-part sequence of PL activities: Plan-Enact-Study-Meet (PESM). Teachers first used hardware, software, and paper-based supports to plan, enact and videotape whole class discussions from their science curriculum on matter, and study these videos independently. A paper-based discussion planner prompted teachers to craft student learning goals and discussion questions, and anticipate students' ideas and teacher responses. A paper-based study tool prompted teachers to note students' actual ideas and reasoning heard on video, and generate questions and insights about students' thinking. The software provided an organizing frame called *Science Lens* to help teachers study students' thinking. The *Science Lens* presented a set of tags to annotate students' ideas and reasoning: *Idea related to Goal*, and tags about students' reasoning based on key scientific practices like making sense of data, and constructing explanations based on evidence and scientific principles (NRC, 2012). Teachers also used the software and paper-based guidelines to develop and share video cases in Video Club meetings with their cohort. They crafted focus questions for the meetings and selected and presented relevant video clips of students' thinking. Each teacher implemented the PES parts four times, and a total of five Video Club meetings were conducted.

Data collection and analysis

Multiple data sources were used. First, Ms. Collins' commentary was audiotaped and transcribed four times during the (independent) Study part of the program (for RQ 1). The first author used generic prompts (e.g., 'what are you noticing?') to elicit the teacher's commentary after studying every two minutes of the videos. The teacher was not prompted to make any specific observations. Second, Ms. Collins' video cases were examined for her focus questions (for RQ1). Third, Video Club meetings were audiotaped and transcribed (for RQ2). Ms. Collins shared video cases at three of these meetings. Finally, a post-program interview was conducted and transcribed (across RQ). This paper reports on a subset of the data from the first year of implementing the program. The independent study and Video Club transcripts were coded based on a rubric derived from literature (e.g., Sherin & Han, 2004) and data from the program. The categories and sub-codes were: topic/focus of attention (e.g., *students' science thinking*); analytic stance (e.g., *interpretive*); and pedagogy (e.g., *pedagogy connected to students' science thinking*). The exit interview transcript was examined to confirm and extend findings from the other data sources.

Major findings

The key findings were that independent study first of her own video, assisted by software and paper tools, allowed the teacher to focus on and make meaning of her students' science thinking, and in the process, raise questions about students' thinking and pedagogy. Collegial study subsequently yielded different perspectives, broadening the teacher's understandings of these ideas and of next steps in teaching. Specifically, in a fourth-grade earth science lesson on comparing the weights of equal volumes of different earth materials (sand, soil, water, and mineral oil), she noticed *students' science thinking*, attending to their idea that air pockets (space) between grains of soil made the soil weigh less. In *interpreting* this idea, she believed it distracted the students from the goal of understanding that for equal volumes of samples of different materials, some materials are heavier than others. The teacher also remarked that most students ignored how their idea about air pockets did not account for sand – another granular material – having the most weight; the students simply did not apply this idea to a new context.

> So for some reason, this idea of the pockets and the chunks is just like coming back up again. I think it's good because we had just talked about that, so they remembered it. But at the same point, I think [they're] almost getting stuck on it. But no one brought up, in this whole discussion besides [student name] just now, that sand and soil are the heaviest and the lightest. But they both have the air pockets. So that theory doesn't really hold up, which I think [student name] is trying to say. But nobody really got there, which is interesting.

Further, with respect to *pedagogy connected to students' science thinking*, Ms. Collins saw it important to probe students for explanations to help them go beyond stating basic observations.

> A lot of them were talking about, it's just heavier. So I was trying to push them into why is it heavier, which they had a harder time with.

For the video case, she focused on questions about students' thinking and implications for pedagogy. She wondered why students believed the amount of holes a material had made it weigh less, and how she may respond to this belief. She also asked for strategies to help students explain why some things are 'heavy for size'.

In a Video Club meeting, Ms. Collins posed these questions and shared video clips showing her students' thinking about why different materials of equal volumes had different weights. In *focusing on* and *interpreting students' science thinking*, the collegial discussion clarified which aspects of students' thinking were problematic and needed to be addressed, whilst revealing other aspects that were promising yet overlooked by the teacher.

> *Colleague 2:* So was [student] saying, because I didn't quite hear it, that he's not surprised that people got different measurements for soil? Or he is surprised that people did? [different student groups were working with different soil samples during the science lesson]
>
> *Ms. Collins:* He's surprised that about similar measurements for soil.
>
> *Colleague 2:* Because the amount of space in between might differ. That's a pretty sophisticated thought.
>
> *Colleague 3:* Yeah, I think that is, yeah, having the chunks, so maybe it gives it some more space, but-- well, and then you would expect that there be different amounts, like holes.
>
> *Colleague 1:* Yeah, it wouldn't be uniform. It's not uniform.
>
> *Colleague 3:* You could take a soil, sample of soil, and have it have different amounts of holes.
>
> *Colleague 1:* I don't really know if their holes idea is really a misconception. I think, in fact, it's a strength that they understand that it's that empty space that's causing it to weigh less.
>
> *Ms. Collins:* I guess now talking about it, I wish they would have said something about the sand, the thing that nobody…They're all fixated on the soil.

Informed by this analysis, the teachers discussed *pedagogy connected to students' science thinking*, exploring strategies for redirecting the science discussion and for engaging students with counter-examples.

> *Colleague 1:* So how could you redirect the conversation in that way [to discuss why sand was the heaviest] if that's where you wanted it to go? I guess that's the question.
>
> *Ms. Collins:* Yeah, I guess we could start the next lesson by saying, you talked a lot about the soil last time. But no one addressed this idea of sand. So why do you think that weighs the most? Because they clearly know that the soil weighs the least and because--
>
> *Colleague 3:* Well, once they put them on the weight line –
>
> *Colleague 2:* From heaviest to lightest, you could say, oh, look the soil. The sand is the heaviest. It's way over here. Why?
>
> *Colleague 3:* I want to bring it back to the liquid when you're having that conversation - if there aren't bubbles in the oil and bubbles in the water, so there are no holes. Why would there be any difference? It seems like a counter example. If they can talk about sand is more densely packed together than soil is, and that explains some difference between the two. And then go back to water-- Does it explain the whole difference? Hm, so do you think that there's a difference in how tightly packed the oil is in a container compared to how tightly packed the water is? Now, I guess you'd have to have two samples in front of them without bubbles.

Additionally, *connecting pedagogy to students' science thinking*, Ms. Collins recognized she had developed a better understanding of her students' ideas and the missing pieces she needed to address:

> I feel like (colleagues) helped a lot figuring out what the next thing should be, making me realize that [students] do know more than I maybe gave them credit for at the beginning, which I feel is just because I know them. But they do have a better understanding than I thought about this idea of the soil having those air pockets. I want them to connect it to why. Why is [soil] the lightest compared to the other three? I think that's the connection that I was missing.

In the exit interview, the teacher pointed to affordances of independent study of classroom video, namely the repeated opportunities to listen to and examine students' ideas in relation to the learning goals, and to use the software and paper-based supports to inform video cases and discussions with colleagues:

> I was able - when we watched [the video] together - to take notes. And then I feel like when I was at home, then I looked at those notes. And I found those points and watched what I wanted to again, based on our conversation first. So I really liked the way that was laid out [the paper-based discussion planner and study tools], to think about it and then be able to look back at - what were the [learning] objectives? What did I think [the students] were supposed to say versus what they actually said? And I think that helped, having watched it and taken just notes the first time, and then going into the software and really pinning things and taking things apart [referring to annotation tools]. I think once I did that it got a lot easier making the [video] cases.

She also emphasized affordances of collegial study occurring after the independent study, namely that diverse interpretations from colleagues helped her notice students' thinking from a different perspective:

> I feel when you watch it by yourself, you pick up on things. But I think it's also really helpful to have other people-- if you notice a problem or a misconception. I really liked being able to show somebody else. Because I feel when you sit there and watch it-- I feel sometimes I focus on such a small thing. And somebody else would get it, even when I'm questioning it. So I think it's helpful to talk with colleagues about the video, once you've seen it yourself.

Conclusions and implications

This case study is a first step in exploring how a blended PL model of independent study and collegial study, anchored in teachers' own classroom video, can support them to notice their students' thinking. The findings lend preliminary evidence that doing independent learning first, assisted by video analysis software and paper tools, allows teachers to engage deeply with their video, and to revisit their students' thinking related to the learning goals. Teachers gain initial insights into their students' thinking and generate questions to pursue in their practice. These insights prepare them for subsequent collegial learning which, in turn, enhances the initial sense-making. Diverse perspectives from colleagues broaden teachers' understandings of their students' thinking and inform their teaching. This study speaks to the ICLS 2018 theme of exploring technology-facilitated learning in the real world. The study reveals how a blended PL model, supported by video, software and paper supports can situate teachers' learning in their own practice, help them develop greater awareness of their students' thinking, and shape instruction. To further explore the potential of this model, future research will examine the learning of this and other teacher cohorts and compare the learning of teachers with varying professional experience in the cohorts.

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