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Beyond Comparisons of Online Versus Face-to-Face PD: Commentary in Response to Fishman et al., "Comparing the Impact of Online and Face-to-Face Professional Development in the Context of Curriculum Implementation"

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With the adoption of Common Core State Standards (CCSS) in English Language Arts (ELA) and math and the release and beginning adoptions of the Next Generation Science Standards (NGSS), teachers, schools, and districts are clamoring for professional learning opportunities to refine and re-tool teaching to bring it in line with the reform visions in these documents. This increased need for professional development (PD) raises the question of the capacity of current systems of PD as well as the effectiveness of the most commonly used approaches. The nature of the new demands of these reforms and the scale of the need means that PD will have to use innovative approaches to handle the type of complex learning called for in these reforms, and will have to do so at scale (Wilson, 2013).

Many may see online learning environments as part of a solution to address the scale issues, because of the ability to use this technology to reach broad audiences across a wide range of timeframes. There is interest in online or technology-mediated environments that promise certain kinds of functionality to support teachers in the complex work they are being asked to do (U.S. Department of Education, 2010). Wilson (2013) identifies the need to "harness new technologies and social media to make high-quality science PD available to all teachers" as one of the grand challenges in science education. We argue as part of our response to Fishman et al. that a corollary to the challenge of access is the challenge of developing research-based design principles to guide the ongoing development, implementation, and evaluation efforts in online PD to meet these new, complex demands in teacher learning.

Others share this concern. Dede, Ketelhut, Whitehouse, Breit, and McCloskey (2009) lay out the case for the growing importance of online delivery of PD. At the same time, they convey unease about the scarcity of nuanced empirical work to guide the design and implementation of online PD models. Dede et al. make a twofold clarion call to funders and the field to (a) conduct empirical research to tease apart not only *what works* but *why* and (b) focus on theory building that articulates design principles that can guide effective PD, disseminated in ways helpful to practitioners and researchers alike.

In their recent *Journal of Teacher Education* (JTE) article, "Comparing the Impact of Online and Face-to-Face Professional Development in the Context of Curriculum Implementation," Fishman et al. (2013) contribute important findings to this empirical work by comparing different modalities of PD. The Fishman et al. randomized study of secondary teacher learning to support adoption of a new science curriculum makes a welcome contribution to a high need area of research. Their comparison of three critical measures of change across two different PD modalities—face-to-face and online—affirm the growing importance of studies, as Fishman et al. state, measuring "the impact of PD on teacher beliefs and practice and student learning as opposed to teacher self-report of change" (p. 2) in two different learning contexts.

The finding that online PD could produce the same impact on measures of teacher beliefs, practice, and student learning as face-to-face PD is an important step forward. For the community designing, implementing, and researching PD environments, this finding encourages design and study of online PD and provides a solid foundation on which to build. Yet, important research questions remain unanswered. While the focus of the study was a comparison of two formats for delivery of PD, the design of the PD itself was somewhat underspecified. For example, there is not enough information in their article about specific design assumptions guiding PD

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learning goals, nor is there much detail about the specific nature of their evaluation measures.

This is not intended to be critical, but to suggest that to take their findings as applicable to all online PD would be an overreach. Currently, there are many models of online learning, drawing on a range of design assumptions about what changes are most needed in teacher beliefs, teacher content knowledge, or teacher pedagogical knowledge, and different models for how to support teacher learning, as well as focus on various potential benefits of technology-mediated learning. The empirical and theory-building work now needed is to explicate design assumptions, develop principles, and investigate not only how they can be realized in face-to-face and technology-mediated PD designs, but the influences these design features and the modality of interaction have on teacher learning, classroom interactions, and student learning.

Thus, Fishman et al. have taken the first step in documenting that online PD, matched in approach, can equal the outcomes of face-to-face PD. The field can now proceed with more nuanced design questions to examine the trade-offs involved in technology support and face-to-face interaction with the elements of a PD system crafted to support learning. These elements might include resources for PD sessions, connections between the work in PD sessions, and the teachers' own classrooms, mechanisms of communication between teachers, access to expertise, and so on. Going beyond asking whether online PD can equal face-to-face PD, we need to consider how the comparison may be affected by the particular goals of the PD and the approaches to supporting learning it embodies. It may be that face-to-face interaction is more critical for some aspects of teacher learning than others. For example, it may work well for teachers to study classroom cases through an online system and begin conversations asynchronously online. Yet reaching shared understanding of the lessons to be drawn from the cases may be more productive in face-to-face meetings. The relative merits of online versus face-to-face conversation may vary across activities depending on the type of work planned for the teachers and the nature of sensemaking and collaboration required. Thus, we need to frame research questions and design principles in terms of particular functions technology affords given specified learning goals (Edelson, 2002).

This kind of complex interaction between the PD modality and design features of the PD activities is likely the rule rather than the exception. We argue the field needs to go beyond treating modality as a main effect that considers online and face-to-face as two discrete forms of PD, and needs to investigate *how* these conditions interact with design features of the PD. The field needs to build on Fishman et al.'s work by investigating the role that different PD design elements have on teacher learning and teaching practice.

To exemplify how PD design issues motivate these nuanced research questions, we draw on a set of generally agreed-upon PD tenets and consider how developing designs based on these tenets motivate specific research questions examining whether and how technology-mediated approaches could help achieve these teacher learning goals. We illustrate, using our own cyber-enabled PD project, how these design issues could be investigated empirically. We suggest that pursuing questions in this way, linking design principles, and testable empirical questions examining implementation and outcomes, should be at the heart of the research enterprise for online PD going forward.

One clear tenet that has emerged from the literature is that PD needs to *be embedded in subject matter* (Garet, Porter, Desimone, Birman, & Yoon, 2001; Wilson, 2013). Teachers' knowledge of how to support student learning draws on general ideas (e.g., building on prior conceptions), but critically depends on understanding how those general ideas play out when connected to specific subject matter issues (e.g., the nature of matter) and the challenges students face in making sense of this subject matter (Putnam & Borko, 2000).

Second, PD tasks need to *involve active sensemaking and problem solving* (Garet et al., 2001; Wilson, 2013). Teachers, like all learners, must go beyond being presented with ideas and strategies; ongoing opportunities are needed to analyze cases and practice the strategies themselves. This translates into opportunities to study examples of classroom-based interaction that reflect a particular teaching and learning issue such as teachers' questioning of student thinking.

Third, to enable this active sensemaking, the substance of the work needs to *be connected to issues of teachers' own practice* (Ball & Cohen, 1996; Borko, 2004; Garet et al., 2001; Wilson, 2013). Teachers need sufficient opportunities and support to apply the ideas to changes in their own practice (Darling-Hammond, 1995; Putnam & Borko, 2000). Teachers need to "learn in, from, and for practice" (Lampert, 2009). To accomplish the understanding of the reform and specific knowledge about how to apply it requires "sustained, job-embedded, collaborative teacher learning strategies" (Darling-Hammond & Richardson, 2009).

While these three tenets have strong empirical support, specific design principles are needed to build on these more general recommendations to guide decisions about PD design. Extending these general tenets to clarify important elements of the structure of tasks, learning environment, and supports can lead to more prescriptive design principles.

Consider some of our recent work on the Next Generation Science Exemplar System (NGSX) a web-based learning environment for teachers.[1] NGSX is designed to support teachers in learning to bring science practices, particularly modeling, argumentation, and explanation (National Research Council, 2012; NGSS Lead States, 2013), into their classrooms. Our research investigates how these tenets of PD for learning "in, from, and for practice" can be productively achieved in a coherent system that is widely available and does not require a skilled facilitator on-site. While the high level of functionality offered by a web-based environment is important, what is paramount in our thinking is how to further

refine these tenets of effective PD to guide design decisions about learning environments for teachers.

NGSX is a technology-supported environment that supports online and face-to-face collaborative learning. The participants draw on an online, web-based system that poses well-connected tasks for each session along with supporting expertise through embedded TED-like (Technology, Entertainment, Design) talks. It provides rich video cases of classrooms engaged in trying out complex teaching practices, supportive materials, and scaffolding tools to guide participants' work. In addition to face-to-face dialogue among participants, polling, and recording results of these discussions on a whiteboard, the system provides the capacity for group and individual postings of text or images of the work on the spot, as well as asynchronous postings (after hours) of assignments and reflections. In our current pilot process in seven states, NGSX participants come together in a study group or seminar format populated by between 12 and 22 participants.

NGSX is not exactly like the more common "hybrid" learning environments in that there is no fixed "leader" or professional PD provider, discussion-board moderator, or course instructor. There is expertise embedded in the system, in the structuring of tasks and discussions and in the ongoing commentary in embedded videos. In addition, much of the expertise and knowledge building is located in the participants themselves. There is a rotating "facilitator of the day" assigned from the group who supports the discussions and sensemaking activities.

In designing and investigating an intervention like NGSX, the research program emerges from questions that arise in taking the basic tenets described above and making them actionable guides for design, that is, translating the tenets into design principles. The resulting design principles are testable conjectures that can be supported or refined by empirical research exploring the system that reflects them (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003).

For example, a goal in NGSX was the third tenet described above, connecting what teachers learn about modeling and argumentation to their own practice as science teachers. To accomplish this, is it sufficient for teachers to analyze student work and classroom teaching interactions in classroom cases, or is it also important that teachers themselves attempt to work with students and learn from that experience? Starting with the general tenet of connecting to practice, we developed a more prescriptive design principle, reflected in the design of the tasks in NGSX that engage teachers in cycles of analyzing teacher moves in classroom video cases, applying these moves in their own classrooms, then coming together to reflect on the results.

Design questions also arose when considering how to support teachers in analyzing classroom examples. Analyses of rich examples could help achieve the goal of active sensemaking and connecting that work to teachers' practice. We drew on prior work that suggested a productive way to have teachers investigate records of classroom practice is for teachers to analyze video cases of teaching interactions (Ball, Sleep, Boerst, & Bass, 2009; Sherin & Han, 2004; van Es & Sherin, 2008). Technology could play a useful role in providing easy access to rich resources, and in offering tools for investigating, analyzing, and reflecting on those resources (Roth et al., 2011). Thus, in NGSX teachers analyze a series of video cases to uncover students' understandings of the science content (nature of matter) and performance of practices (developing explanatory models, supporting and refining models with argumentation from evidence). Our empirical work explores how best to operationalize this general goal of analyzing video cases, exploring various framings of tasks to motivate and make use of these analyses. We are exploring face-to-face (discussions during weekly meetings) and technology-enabled approaches (teachers posting reflections) to mediate these conversations, and investigating the challenges and advances in sensemaking that arise. Again, the comparison is not solely about the effectiveness of online versus face-to-face PD, but is about how the modality interacts with the constraints and goals of the particular learning task.

Another design question emerges from considering the implications of connecting to teachers' own practice. While the goal is clearly important, there are multiple aspects of teachers' practice that may be relevant, and specific design arguments are needed to identify which aspects and how to support them. Potential targets include teachers' proficiency in analyzing student thinking about the science (van Es & Sherin, 2008), their facility in using discourse strategies, and their ability to translate pedagogical strategies from curriculum materials (Davis & Krajcik, 2005). We are exploring the affordances of focusing on each of these elements in influencing teachers' own practice, and how technology can support teachers' analyses of these different resources. For example, NGSX provides linked representations of curriculum materials, audio recordings of classroom discourse, and links to relevant classroom video cases.

Another key design issue that emerges in supporting teachers' active sensemaking and connecting it to practice is the issue of guiding expertise. Again, this needs to go beyond deciding whether the expertise should be present in an experienced, in-person facilitator or embedded in video commentaries accessed by a group of teachers working together, or by teachers communicating asynchronously as they work through activities. We are exploring the issues that emerge in trying to provide enough expert guidance to help teachers in their active sensemaking of the classroom cases, while also avoiding undermining the problem solving and analytical nature of the task. We are examining whether teachers are able to draw on the lessons learned by analyzing learning issues such as students' science practices exemplified in cases in one subject matter domain (the nature of matter) when facing a related but different subject matter domain (flow of matter and energy in ecosystems). What happens to the conversation, regardless of whether it is face-to-face or

online, when teachers do this work together across grade bands versus grade band specific groups?

A system like NGSX enables us to explore research questions that tie comparisons of online versus face-to-face to other types of sensemaking activities. We explore questions not centered on whether technology is used, but rather on *how* it is used to help structure and support the learning interactions. For example, simple web technology makes it possible for teachers to seamlessly move between sketching out ideas on a whiteboard and capturing them for later use by their own group, as well as communication with other groups (via uploading images from a cell phone to the online environment). How then do teachers use these records of their earlier thinking in various learning tasks, such as later discussions or individual writing assignments, or in trying out ideas in their own classrooms that have clear linkages to a particular genre of learning tasks?

There are affordances of online systems that simply cannot be matched in a traditional setting. However, as a field, we know little about how these web-enabled and social media capacities interact with teacher learning and whether or how they are in line with established ideas about professional learning in general. By connecting particular design elements to the theoretical basis for the design and to a set of research questions about that design, the important work of theory building for online PD, indeed PD more generally, can proceed.

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