National Research Council Workshop on Exploring the Overlap between "Literacy for Science" and the Practice of Obtaining, Evaluating, and Communicating Information

Next Generation Science Exemplar System (NGSX) for Professional Development

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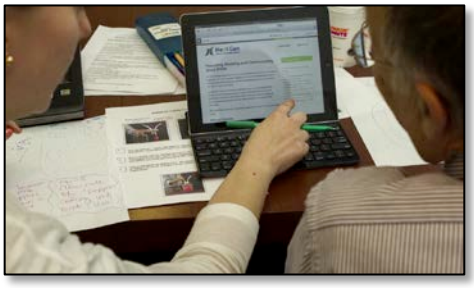
Overview and Research Base

NGSX[1] 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. NGSX is a unique model of cyber-enabled professional learning designed around learning pathways, each composed of eight units or 24 to 30 hours of engagement. Pathway participants, generally 15 to 20, come together in a study group format to form a face-to-face learning community and take part in this on-line, web-based system using individual laptops, a tablet, or even a smart phone. Each unit in the pathway contains embedded content and pedagogical expertise presented in TED like talks, classroom video cases, and an embedded library of supportive tasks, tools, and resources. The first prototype NGSX pathway focuses on the physics of air pressure, and the practices of modeling and reasoning, making reasoning with evidence public through productive classroom talk.



There is no "leader," that is, no external PD provider, discussion-board moderator, or course instructor. NGSX is designed to locate expertise and knowledge building in the participants themselves. A rotating "facilitator of the day" – a volunteer from within the group assumes this role. This person has specific responsibilities that are intended to enable the group to make meaning together (mediated through tasks, tools, videos, images, and texts), but has no special "science expertise" or specifically recognized "pedagogical expertise." Facilitation resources and instructions are embedded in the web-based pathway.

NGSX can be accessed asynchronously as well. Participants have continuous entrée to the website to revisit videos, to look at uploaded reflections from group activities, drawings, as well

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[1] The co-designers of NGSX are Sarah Michaels (Clark University), Brian Reiser (Northwestern University), Jean Moon (Tidemark Institute), and Cynthia Passmore (University of California-Davis). Development and piloting of the prototype pathway was supported by an NSF grant awarded to Michaels, Moon, and Reiser.

as to complete "On Your Own Activities" between sessions. These post-session asynchronous activities are designed to reinforce major ideas covered in a current unit or an upcoming unit as well as provide a continuous connection to resources in the NGSX learning environment.

In situating expertise in the learning system we are drawing on the literature on "communities of learners" and "learning ecologies," examining how the role that participation, tool use, and learner roles contributes to the development of teacher identity, learner agency, knowledge, and skill (Lave & Wenger, 1991; Michaels, Sohmer, O'Connor, & Resnick, 2009; Sawyer, 2011).

Importantly, the designed features built into the web-based platform that forms the NGSX system are shaped by three agreed-upon tenets of PD, the product of high quality research studies (Moon, Passmore, Reiser & Michaels, 2013).

- PD needs to be embedded in subject matter (Garet, Porter, Desimone, Birman, & Yoon, 2001; Wilson, 2013) and the challenges students face in making sense of subject matter (Putnam & Borko, 2000).
- PD tasks need to involve active sensemaking and problem solving (Garet et al., 2001; Wilson, 2013). 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.
- PD should enable this active sensemaking through tools, tasks, and resources connected to issues of teachers' own practice (Ball & Cohen, 1996; Borko, 2004; Garet et al., 2001; Wilson, 2013). To accomplish both the understanding of the reforms put forward in NGSS and CCSS and specific knowledge about how to apply it requires "sustained, job-embedded, collaborative teacher learning strategies" (Darling-Hammond & Richardson, 2009).

Our current 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 (Moon, et al, 2013)[2]. While the high level of functionality offered by a web-based environment like NGSX 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 and, in particular, to guide design decisions about learning environments focused on specific learning outcomes.

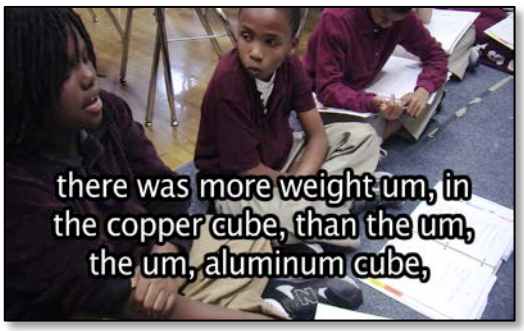
New Realities of Teacher Professional Learning

ALL the standards — mathematics, ELA and science — require teachers to focus much more attention on reasoning and thinking practices. These high level "thinking practices" ask that students participate in making their thinking public and clear. Terms vary. Instead of "practices" used in NGSS the ELA Standards identify the "capacities" of the literate individual: The literate individual builds strong content knowledge. The literate individual comprehends as well as critiques. The literate individual values evidence. Reasoning is the key across these

[2] Currently, the initial NGSX pathway on the physics of air pressure is being piloted in seven states.

standards – with tasks, tools, and resources. Making one's thinking visible, through talk, text, and constructed representations, is at the **core**, in science and ELA.

NGSX Unit 4: How Do I Build a Classroom Culture that Supports Public Reasoning?



Arguably, to support students' growth in and use of these new knowledge-building strategies teachers will need to work with new pedagogical practices as well and transfer those practices to the classroom (Jimenenez-Aleixandre, Rodriguez & Duschl, 2000; Windschitl, Thompson & Braaten, 2008; Alozie, Moje, & Krajcik, 2010; Moon, Michaels, & Reiser, 2012). Having the capacity to connect one's classroom to one's professional development experiences is consistently supported in literatures on effective PD, likewise it is coming to be seen as an essential part of teachers gaining facility with these complex, often improvisational pedagogical skills needed in response to learning outcomes specified in NGSS and CCSS.

Cyber-Enabled Learning Environments

With advances in network technologies, the Web is evolving as a unique community-based learning environment for teachers. It has the capacity to support active participation, "trying things out" with colleagues in meaningful contexts, connecting learners to classrooms like their own via high quality video and student work, uploading audio and video of one's own classroom engaged in "trying things out", and interacting in an environment that allows learners to continuously connect with image-rich resources, tools, and tasks. In the instance of NGSX, web-based technologies make possible access to rich video cases of classrooms engaged in trying out complex teaching practices, supportive materials, and scaffolding tools to guide participants' work.

While a web-based environment professional development is promising in its capacity to provide learners with a highly functional, social, relational, and image and media-rich environment, to date it is under researched as a professional development context. Much more high quality empirical work is needed. This is work that must focus on questions that ultimately will advance our knowledge on the affordances of a cyber-enabled environment in support of specified PD learning goals aligned with the major shifts in teaching and learning called for in the Next Generation Science Standards and Common Core State Standards.

For example, empirical studies on different kinds of PD learning environments can explore promising ways to frame various tasks that will position participants to do analysis using embedded video classroom cases that provide ongoing opportunities to listen to children making their thinking public. As a design team we are exploring both face to face (discussions during weekly meetings) and technology-enabled approaches (teachers posting reflections) to mediate conversations about listening and the actual analysis involved in listening and working with children in their sensemaking activities. The bridge between science literacy and the practice of obtaining, evaluating, and communicating information is visible. The work ahead of us involves identifying the progressive learning goals and environments in which teachers and students can practice navigating this bridge effectively.

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