

# **Some Key Findings Related to Effective Professional Development in Science: 1996-2014**

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## **Professional development should be focused on disciplinary core ideas and practices as students encounter it in science classrooms.**

- Teachers who receive professional development that is focused on improving content understandings and that is of extended duration and time span are more likely to report changes to knowledge and practice (Desimone, Porter, Garet, Yoon, & Birman, 2002; Garet, Porter, Desimone, Birman, & Yoon, 2001; Penuel, Fishman, Yamaguchi, & Gallagher, 2007).
- An important strategy for developing content knowledge in a way is to focus on anticipating and addressing student thinking: both the difficulties students encounter and productive entry points into core ideas and practices (Heller, Daehler, Wong, Shinohara, & Miratrix, 2012; Kanter & Konstantopoulos, 2010; Roth et al., 2011)
- If teachers experience these characteristics in an online environment, they can learn just as effectively online as in face-to-face professional development (Fishman et al., 2013).
- Teachers' content knowledge and beliefs about teaching shape what they take away from professional development (Johnson, 2007).

## **Professional development should be of extended duration.**

- Teachers who received at least two weeks of professional development in inquiry-oriented teaching reported changes to their practice consistent with creating a culture of inquiry in their classrooms (Banilower, Heck, & Weiss, 2007; Smith et al., 2007; Supovitz & Turner, 2000).
- When teachers who were part of the Local Systemic Initiative received professional development that is of extended duration, they were more likely to use student-centered instructional materials introduced in the professional development (Banilower et al., 2007).
- Mentoring and coaching can provide a way to support teachers' integration of ideas, models, and tools learned in professional development (Penuel, Shear, Korbak, & Sparrow, 2005; Schaverien & Cosgrove, 1997).

**The process of designing and adapting curriculum materials—when supported by subject matter and curriculum experts—can be a powerful form of professional development.**

- Engaging teachers in the design and adaptation of curriculum materials is a form of “active learning” in which teachers can effectively explore the materials through practice, investigation, problem solving, and discussion (Banilower et al., 2006).
- Developing materials provides a way for teachers to match instructional materials to student needs (Huffman, Thomas, & Lawrenz, 2003).
- Engaging teachers in design and adaptation of materials provides a way for teachers to learn about theories from research they can apply to practice (Parke & Coble, 1997).
- Teachers who begin with strong models of curriculum materials provide students with higher quality opportunities to learn (Penuel & Gallagher, 2009).
- Professional development that provides models for adapting materials and teaching effectively with them can produce greater student learning gains (Penuel, Gallagher, & Moorthy, 2011).

**Professional Learning Communities (PLCs) can extend professional development under certain conditions, namely:**

- When teachers are given authority to lead professional development (Lieberman & Grolnick, 1997).
- When leaders and faculty cultivate trust and a sense of collective responsibility for learning (Louis & Marks, 1998).
- When teachers engage in in-depth interactions around student thinking (e.g., examples of student work) (Franke, Carpenter, Fennema, Ansell, & Behrend, 1998).
- When leaders promote teacher sharing through organizational routines for sharing stories about implementation successes and overcoming difficulties to circulate (Gallucci, 2008).

**Formative assessment can be an effective focus of professional development when it helps teachers elicit, interpret, and make use of information about student thinking.**

- An important focus of professional development related to classroom assessment is improving teacher questioning strategies to elicit and make

- sense of student thinking and to foster argumentation in the classroom (Heller et al., 2012; Oliveira, 2010; Roth et al., 2011).
- Helping teachers make productive use of student diversity can promote more equitable participation in classroom activities (Tzou & Bell, 2009).
  - Professional development in which science teachers learn to provide qualitative feedback on student thinking (as opposed to grades) can improve science learning (Black & Harrison, 2001).
  - One promising form of professional development is engaging teachers in *assessment moderation*, in which teachers are asked to score assessments as part of an effort to refine criteria for judging the quality of student understanding evident in student work (Huffman et al., 2003; Roberts & Wilson, 1998).

**The effectiveness of professional development depends on vertical and horizontal coherence in systems: the degree of alignment among standards, curriculum, assessments, and PD, as well as support from leaders.**

- The perceived coherence of professional development with district and state goals for student learning shapes teachers' decisions to implement ideas, models, and tools from professional development (Penuel, Fishman, Gallagher, Korbak, & Lopez-Prado, 2009).
- Participation in professional development can generate new dilemmas of practice for teachers, especially when they perceive contradictions between goals of professional development and school and district goals (Yamagata-Lynch & Haudenschild, 2009).
- Principal support is an important predictor of the effectiveness of professional development (Banilower et al., 2007; Johnson, 2007).
- High teacher turnover can be an obstacle to realizing the returns on professional development (Shear & Penuel, 2010).

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