How might we ensure valuable professional development and growth for STEM teachers?

THERE IS NO COMMONLY-AGREED UPON TRAJECTORY FOR TEACHER PROFESSIONAL GROWTH.

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01 CONTEXT AND TRENDS

Currently, there exists a plethora of ways and reasons that science, technology, engineering, and mathematics (STEM) teachers engage in professional development (PD), but the value of these PD experiences for teachers is questionable. At times, teachers engage in STEM PD irrespective of their professional growth needs and are not clear on how the PD will impact student learning in their classrooms (Kennedy, 2016; Mizell, 2010). Furthermore, many PD activities are implemented uniformly across sites, irresponsive to specific teacher contexts and professional growth plans (Minor, Desimone, Lee, & Hochberg, 2016).

> "At times, teachers engage in STEM PD irrespective of their professional growth needs and are not clear on how the PD will impact student learning in their classrooms."

In order to measure how effective STEM teacher PD is in improving teaching and learning, the field of education needs a coherent PD framework to map the trajectory of effective STEM teacher professional growth and resulting student outcomes. A framework is needed to "assess how effectively professional development improves teaching practices and increases student achievement" (Desimone, 2009, p. 181). Additionally, educational systems need a coherent framework that can connect teachers with the PD that they need to meet individual and collectives growth goals based on teacher evaluations.

02

DISCUSSION

Professional development research suggests the following elements for a coherent STEM teacher PD framework (Allen & Penuel, 2015; Darling-Hammond, 2012; Desimone, 2009; Garet, Porter, Desimone, Birman, & Yoon, 2001; Hill & Ball, 2004; Koellner, Jacobs, & Borko, 2011; Wilson, Rozelle, & Mikeska, 2011):

- Alignment with district, school, and professional growth goals
- Focus on disciplinary core ideas
- Extended duration of time
- Engagement in active learning with content and curriculum
- Collective participation with other teachers across time
- Focus on student thinking and learning
- Alignment with teacher growth goals established in evaluation

Putting these suggested elements of best practices for PD into action will help teachers, school leaders, and PD providers reach overall goals of improving teachers' instructional practices and positively impacting student learning. The following three strategies describe how to effectively implement these elements.

First, teachers need to engage with standards-aligned, disciplinary core ideas and curriculum in professional development settings for an extended period of time, and the time spent in PD needs to be aligned with overall district, school, and professional growth goals (Council of State Supervisors, 2015). This approach to designing and providing PD can help ensure that the PD has the intended impact and addresses the specific contextual teaching and learning needs of the district and school (Borko, Koellner, & Jacobs, 2014). Another important feature of ongoing and aligned PD is the inclusion of active learning experiences for teachers for at least 20 hours or more (Desimone, 2009). Research indicates that active learning experiences are best provided regularly during the school day, enabling teachers to "apply what they learn immediately within their workplaces so that students can benefit immediately" (Darling-Hammond, 2012; Mizell, 2010, p. 14).

> "District and school learning priorities, as well as teacher evaluation processes and results, should directly inform the design and focus of the PD that is provided."

Second, teachers need to work with other teachers from their own school and across districts in PD settings to make progress on goals that align either with district and school priorities or professional growth ones. Professional learning communities (PLCs), where teachers gather in groups to focus on instructional practices and student learning, are an example of how teachers can work together. Research states that PLCs are a central component of active and effective professional development (Borko, 2004). Finally, a focus on evidence of student learning, whether through video or student work, allows teachers to actively learn together while focusing on how instructional practices impact student interactions and learning (Borko et al., 2014).

Finally, PD opportunities need to align and intersect with teachers' professional growth needs on both individual and school-wide levels (Darling-Hammond, 2012; Minor et al., 2016). District and school learning priorities, as well as teacher evaluation processes and results, should directly inform the design and focus of the PD that is provided. Doing so will help teachers understand the value and purpose of the PD to help them achieve their goals. Research shows that the impact on student learning can vary greatly depending upon what content and pedagogical knowledge a teacher walks into PD with, how PD is linked to teacher evaluations, and the established leadership priorities in a school (Desimone & Garet, 2015; Minor et al., 2016).

03 BRIGHT SPOTS

Some systems are transforming the way they design and deliver PD to better reflect the key elements that research has proven critical to providing effective PD. Two bright spots from professional development literature and reports are described next and can serve as potential models for the field in moving this work forward. In the first example, multiple elements of the suggested coherent professional development framework are employed that, as a result, impact teachers' instructional practices. The second example highlights an effective system that directly connects teacher evaluation to PD opportunities.

Allen and Penuel (2015) outline a two-year PD experience that aimed to develop teachers' understanding of the Next Generation Science Standards (NGSS, National Research Council, 2013). In the PD, teachers practiced working together to develop instructional materials based on the NGSS to implement in their classroom during summer institutes. This PD extended throughout the school year to provide additional support in implementing and connecting new curriculum to the NGSS as the teachers were enacting it in their classrooms. This extended PD with curriculum allowed teachers to align the curriculum fully with the NGSS, meeting specific needs of teachers as they enacted curriculum in their contexts.

In the report "Linking Teacher Evaluation to Professional Development: Focusing on Improving Teaching and Learning" (Goe, Biggers, & Coft, 2012), authors describe examples of how teacher evaluation systems can and need to be connected to PD opportunities. One example is the Memphis Teaching and Learning Academy, which aligns the observation instrument with PD offerings. "When teachers receive scores from an observation, they can quickly find specific professional development offerings that linked to specific indicators" (p. 17). Teachers can create and propose PD based on their specific needs.

04 CONCLUSION

To best impact STEM teacher instructional practices and student learning in the STEM classroom, the educational field needs to come to an agreement on a coherent PD framework; one that is grounded in what research shows is best practice for designing and delivering PD. Two key steps we can take in this direction is 1) ensuring a close mapping of teacher growth and/or student learning as a result of PD to assess its alignment and effectiveness in achieving desired outcomes, and 2) ensuring the PD is attentive to and grounded in the various contexts in which STEM teaching and learning occur, thereby meeting the specific needs of the teaching and learning communities in which they are being provided (Borko, Koellner, & Jacobs, 2014; Kazemi & Hubbard, 2008).

ABOUT THE GRAND CHALLENGES WHITE PAPERS

In 2017, 100Kin10 released an unprecedented representation of the big, systemic challenges to preparing and supporting STEM teachers following over two years of extensive research alongside more than 1,500 STEM teachers and hundreds of other education experts. As a part of this work, 100Kin10 commissioned a series of short white papers from well-versed thinkers and practice-oriented researchers to synthesize the most relevant research around the specific challenge areas. Together, they compose a thoughtful and well-rounded examination of the systemic challenges currently facing STEM teaching.

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