



S²TEM Centers SC

Solutions in Science, Technology, Engineering & Mathematics Education

TOTAL INSTRUCTIONAL FOCUS: PROFESSIONAL LEARNING

Professional learning in STEM education is adult learning that ensures a STEM curriculum is implemented with fidelity by educators who have deep content understanding and pedagogical content knowledge in the subjects they teach. This approach includes engagement in ongoing professional development and participation in STEM-related professional learning communities (PLCs).

Deep Content Understanding

With the world growing in complexity at a rapid pace, it is essential teachers have deep content understanding in the subjects they teach, and that they engage in continuous learning. The National Research Council report, *Successful K-12 Education: Identifying Effective Approaches in Science, Technology, Engineering, and Mathematics*, states, "Teaching in ways that inspire all students and deepen their understanding of STEM content and practices is a demanding enterprise." The report goes on to suggest that middle and high school teachers earn degrees and achieve certifications in the subjects that they teach. Horizon Research cites studies that indicate a positive influence of math and science teachers' content knowledge on three key areas: how teachers engage students with the subject matter, how teachers select instructional materials, and how well students achieve in those subjects.

Pedagogical Content Knowledge

In addition to deep content knowledge, teachers need to be highly competent in teaching their disciplines. Pedagogical content knowledge (PCK) is a phrase coined by Stanford University's Lee Shulman in the late 1980s. He defines the concept as the ways of representing and formulating a topic to make it comprehensible to others. "It is," he suggests, "a category of professional knowledge that distinguishes teachers from others who might know a subject well, but have no occasion to develop the knowledge entailed in teaching a subject." This type of knowledge enables STEM teachers to appropriately align teaching strategies and technology tools with curriculum concepts, placing them at the optimum point in the learning cycle.

STEM Professional Development

The focus of STEM professional development is to increase teachers' content knowledge and PCK as well as enabling them to implement a STEM curriculum with fidelity. Areas for teachers to increase their understanding include:

- aligning STEM assessments and instructional strategies with a standards-based STEM curriculum.
- integrating real world challenges.
- incorporating 21st Century practices and technology.
- promoting civic responsibility.
- addressing the unique learning needs of those underrepresented in STEM fields.

Graduate classes, workshops, webinars, and other formats are available for teachers to further their STEM learning; however, the most powerful and sustained learning occurs when professionals learn together in learning communities.

STEM Professional Learning Communities

The WestEd report, *STEM Teachers in Professional Learning Communities: From Good Teachers to Great Teaching*, states, "To meet the needs of today's learners, the tradition of artisan teaching in solo-practice classrooms will have to give way to a school culture in which teachers continuously develop their content knowledge and pedagogical skills through collaborative practice that is embedded in the daily fabric of their work." The expectation in STEM schools is that teachers share their expertise. Efforts to develop and maintain a professional learning community in STEM-minded schools are continuing and systemic. School leaders set expectations, providing the time and space for teachers to plan instruction and learn from student work and data. Participants in STEM PLCs share values, goals and collective responsibility for the learning that impacts student achievement.

The driving force behind a STEM school's professional learning plan is student preparation for success in the world of the 21st century and beyond. In STEM schools, professional learning is valued and expected of all staff. It is a coherent, continuous system aligned with the school's mission, vision, and goals. The learning is supported by appropriate time and funding, enabling staff to prepare students for success in college, careers and citizenship.

Bibliography

National Research Council of the National Academies. *Successful K-12 STEM Education: Identifying Effective Approaches in Science, Technology, Engineering, and Mathematics*. 2011. National Academies Press Washington DC. www.nap.edu Accessed August, 2012

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Guiding Questions

Use the reflection questions below to guide discussions. We recommend documenting evidence to support each question. Doing so will assist you in setting action plans, goals, and progress monitoring.

Deep Content Understanding

- What measures are in place to ensure that teachers have deep content understanding in the subjects they teach?

Pedagogical Content Knowledge

- How do teachers go about representing and formulating a topic to make it comprehensible to their students?
- What evidence do you have to ensure that teaching strategies, technology tools, curriculum concepts, and assessments are aligned?

STEM Professional Development

- Describe how the focus of your school's STEM professional development increases teachers' content knowledge and pedagogical content knowledge.
- Describe how your school's professional development prepares teachers to implement the STEM curriculum with fidelity.

STEM Professional Learning Communities

- At your school, what are the expectations for teachers sharing their expertise?
- What are the expectations school leaders have set for teachers to plan instruction and learn from student work and data?
- Describe the ways in which professional learning is valued, expected of all staff.
- In what way is professional learning a coherent, continuous system aligned with the school's mission, vision, and goals?
- What support is in place for professional learning?