



S²TEM SC Innovation Configuration (IC) Map

Total Instructional Focus: Professional Learning

Table of Contents

IC Map At-A-Glance: Professional Learning 1

The purpose of the At-A-Glance document is to provide a brief look at each addressed standard for schools and/or districts that are working towards a STE(A)M environment. The document shows an overview of indicators (by role) that need to be developed in order to achieve each of the desired outcomes. The desired outcomes support the attainment of the overall standard(s) for each IC Map.

IC Map: Professional Learning 3

The IC Map assists with determining the existing state for a school and/or district along a continuum, from Getting Started (on the far right) to Sustaining (on the far left). While the Standard is listed at the top of the page, the desired outcomes and accompanying indicators (by role) are within the map. Each indicator is specifically aligned to who is doing what at each level along the continuum. This is a tool that should be used to not only identify an existing state, but also to determine goals for the desired state. Evidence for successes should be collected throughout the use of the IC Map. *Record and update progress using the At-A-Glance document yearly

White Paper: Professional Learning 9

The white paper describes a vision for the implementation of the content of the IC Map.

IC Map At-A-Glance: Professional Learning

(Standard, Desired Outcomes, Indicators by Role)

IC Map At-A-Glance: Professional Learning

(Standard, Desired Outcomes, Indicators by Role)

Standard: Professional learning for STEM educators is a system of continuous improvement that increases educator effectiveness in preparing students for success in college, careers, and citizenship. It is sustained by skillful leaders, informed by data, based on research, and aligned with the school’s mission, vision, and goals for STEM education.

| Desired Outcome PL1: Professional learning is the collective responsibility of all STEM educators and is enhanced by active engagement in a STEM professional learning community (PLC). It is a system of continuous improvement aligned with the school’s/district’s mission, vision, and goals for STEM education. | |
|---|---|
| Role | Indicator |
| PL1.Leaders1 | Support faculty and staff in setting and implementing professional learning goals |
| PL1.Leaders2 | Set and monitor progress towards own personal, professional learning goals |
| PL1.Teachers1 | Engage actively in professional learning communities |
| PL1.Teachers2 | Align personal, professional learning goals with PLC learning goals |
| PL1.Strategic Alliances1 | Provide expertise, human, and financial resources to enhance learning experiences for educators |
| Desired Outcome PL2: STEM professional learning is differentiated, planned, implemented, and evaluated for effectiveness using a variety of sources and types of student, educator, and system data. | |
| PL2.Leaders1 | Use data to inform individual and staff professional learning decisions |
| PL2.Teachers1 | Use data to inform individual professional learning decisions |
| Desired Outcome PL3: Professional learning incorporates research on learning theories, STEM-focused pedagogy, and STEM content to build educators’ capacity to positively impact intended student outcomes. | |
| PL3.Leaders1 | Ensure professional learning for self and staff is research based and STEM-focused |
| PL3.Teachers1 | Ensure professional learning for self and staff is research based and STEM-focused |

IC Map: Professional Learning

Standard: Professional learning for STEM educators is a system of continuous improvement that increases educator effectiveness in preparing students for success in college, careers, and citizenship. It is sustained by skillful leaders, informed by data, based on research, and aligned with the school’s mission, vision, and goals for STEM education.

Total Instructional Focus – Professional Learning

Sustaining

Fully Implementing

Refining and Expanding

Progressing

Getting Started

Desired Outcome PL1: Professional learning is the collective responsibility of all STEM educators and is enhanced by active engagement in a STEM professional learning community (PLC). It is a system of continuous improvement aligned with the school’s/district’s mission, vision, and goals for STEM education.

PL1.Leaders1: Support faculty and staff in setting and implementing professional learning goals

Model and employ with fidelity ALL essential elements of a continuous improvement process school-wide, including:

- identifying STEM goals,
- planning,
- implementing,
- gathering evidence,
- self-assessing, and
- adapting.

Support and maintain commitment to personal and PLC learning of faculty and staff through observation, reflecting conversations, and feedback as aligned with the school/district goals for STEM education.

Model and employ the essential elements of a continuous improvement process school-wide, including:

- identifying STEM goals,
- planning,
- implementing,
- gathering evidence,
- self-assessing, and
- adapting.

Support commitment to personal and PLC learning of faculty and staff through observation, reflecting conversations, and feedback as aligned with the school/district goals for STEM education.

Provide ongoing support to faculty and staff through observation, reflecting conversations, and feedback as they work toward their individual and PLC STEM focused goals for professional growth.

Support faculty and staff through observation and feedback as they work toward their individual and PLC STEM focused goals for professional growth.

Collaborate with faculty and staff, as individual STEM focused goals for professional growth are set.

PL1.Leaders2: Set and monitor progress towards own personal, professional learning goals

Maintain commitment to district wide STEM focused goals based on research on STEM education.

Collaborate with other school leaders to align individual STEM focused goals with district professional learning goals based on current research on STEM education.

Collaborate with other school leaders to align individual STEM focused goals with the district’s professional learning goals.

Engage in their own professional learning to stay abreast of current research on STEM education.

Align individual STEM focused goals with the district’s professional learning goals.

Collaborate with district administration to set individual STEM focused goals for professional growth.

| Sustaining | Fully Implementing | Refining and Expanding | Progressing | Getting Started |
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| <p>Desired Outcome PL1: Professional learning is the collective responsibility of all STEM educators and is the result of active engagement in a STEM professional learning community (PLC). It is a system of continuous improvement aligned with the school's/district's mission, vision, and goals for STEM education.</p> | | | | |
| <p>PL1.Teachers1: Engage actively in professional learning communities</p> | | | | |
| <p>Engage actively in a professional learning community (PLC) by</p> <ul style="list-style-type: none"> • collaborating on instructional plans; • contributing individually using the strengths of all to support the collective goals of the PLC; • de-privatizing classroom practice; • taking action to overcome barriers to collective responsibility; and • monitoring and adjusting the PLC's vision, values, and goals through a continuous improvement process. | <p>Develop the STEM PLC's shared vision, values, and goals for STEM professional learning that impacts all learners.</p> <p>Contribute to efforts to identify and overcome barriers to collective responsibility for the learning of all students and professionals.</p> <p>Barriers may include, but are not limited to:</p> <ul style="list-style-type: none"> • lack of collaborative time and effort, • uneven distribution of resources, • vague priorities, • ill-managed change process, • lack of staff engagement, • lack of trust, and • fear of retribution. | <p>Form a STEM professional learning community (PLC) with a shared vision for student and educator learning.</p> <p>Focus of PLC may include but is not limited to:</p> <ul style="list-style-type: none"> • curriculum integration, • building a collaborative classroom culture, • project-based learning, • 21st century skills, • instructional technology, • assessment in the STEM classroom, • deeper content knowledge, and • pedagogical content knowledge. <p>Consider how individual STEM professional learning goals impact the STEM PLC's learning goals and vice versa.</p> | <p>Seek common learning goals within collegial groups based on student learning outcomes, available data and the needs of the school and district.</p> | <p>Take responsibility for their own individual STEM professional learning and meet in collegial groups to share individual learning. STEM professional learning focus may include but not limited to:</p> <ul style="list-style-type: none"> • curriculum integration, • building a collaborative classroom culture, • project-based learning, • 21st century skills, • instructional technology, • assessment in the STEM classroom, • deeper content knowledge, and • pedagogical content knowledge. |
| <p>PL1.Teachers2: Align personal, professional learning goals with PLC learning goals</p> | | | | |
| <p>Maintain commitment to personal and PLC learning and support colleagues' commitment to individual and PLC learning as aligned with the school/district goals for STEM education</p> <p>Employ with fidelity and automaticity ALL essential elements of a continuous improvement process.</p> | <p>Set, monitor, implement, and evaluate personal and PLC learning goals as aligned with the school/district goals for STEM education by employing the essential elements of a continuous improvement process including:</p> <ul style="list-style-type: none"> • identifying STEM goals, • planning, • implementing, • gathering evidence, • self-assessing, and • adapting. | <p>Align personal STEM focused goals for professional growth with those of the professional learning community (PLC).</p> | <p>Collaborate with the school administration to set, monitor, implement and evaluate personal STEM focused goals for professional growth.</p> | <p>Collaborate with the school administration to set personal STEM focused goals for professional growth (e.g., Increase content knowledge, implement new STEM-related teaching strategies or gain proficiency with instructional technology).</p> |



Desired Outcome PL1: Professional learning is the collective responsibility of all STEM educators and is the result of active engagement in a STEM professional learning community (PLC). It is a system of continuous improvement aligned with the school's/district's mission, vision, and goals for STEM education.

PL1.Strategic Alliances¹: Provide expertise, human, and financial resources to enhance learning experiences for educators

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| <p>Monitor the effectiveness of the plan through a continuous improvement process.</p> <p>Ensure the plan:</p> <ul style="list-style-type: none"> assesses the learning needs of educators and provides professional learning experiences to meet specific educator learning needs. provides active and ongoing support for educator learning that aligns with the community's, the strategic alliances', and the school's mission, vision, and goals. | <p>Collaborate with educators to develop a plan to provide active and ongoing support for educator learning that aligns with the community's, the strategic alliances', and the school's mission, vision, and goals.</p> | <p>Assess the learning needs of educators and provide professional learning experiences to meet specific educator learning needs.</p> | <p>Seek opportunities to provide educator learning experiences such as:</p> <ul style="list-style-type: none"> engaging teachers in real world problem solving, simulations, and engineering design challenges to model practices that teachers can implement with their students; funding STEM-related graduate and recertification courses for educators; hosting job shadowing, and mentoring for educators to prepare them to better facilitate STEM learning opportunities for their students; allowing their facilities to be used to host teacher learning experiences; and sharing with teachers the knowledge and skills students will need to succeed in their fields. | <p>Honor requests from educators to speak or make presentations at professional learning venues (e.g., faculty meetings, educator conferences, etc.) informing educators on how they can better prepare students for future success.</p> |
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| Sustaining | Fully Implementing | Refining and Expanding | Progressing | Getting Started |
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| Desired Outcome PL2: STEM professional learning is differentiated, planned, implemented, and evaluated for effectiveness using a variety of sources and types of student, educator, and system data. | | | | |
| PL2.Leaders1: Use data to inform individual and staff professional learning decisions | | | | |
| <p>Engage school community in developing and employing a continuous improvement process to ensure the collection, analysis and use of various data to collaboratively differentiate, plan, implement, and evaluate the effectiveness of his or her own professional learning as well as staff professional learning in STEM. Data sources may include:</p> <ul style="list-style-type: none"> • demographics of students, community and staff; • classroom observations; • perception data of students, parents, and staff; • student learning data K-16 (e.g., HS graduation rate, college graduation rate...); • work force needs; and • community needs. | <p>Collect and analyze, various data and use the findings to differentiate, plan, implement, and evaluate the effectiveness of his or her own professional learning as well as staff professional learning in STEM. Data sources may include:</p> <ul style="list-style-type: none"> • demographics of students, community and staff; • classroom observations; • perception data of students, parents, and staff; • student learning data K-16 (e.g., HS graduation rate, college graduation rate...); • work force needs; and • community needs. | <p>Use multiple sources of data to differentiate, plan, implement, and evaluate the effectiveness of his or her own professional learning as well as staff professional learning in STEM.</p> | <p>Use single source of data to plan, implement, and evaluate the effectiveness of staff professional learning in STEM.</p> | <p>Consider single source of data to plan staff professional learning in STEM.</p> |

| Sustaining | Fully Implementing | Refining and Expanding | Progressing | Getting Started |
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| <p>Desired Outcome PL2: STEM professional learning is differentiated, planned, implemented, and evaluated for effectiveness using a variety of sources and types of student, educator, and system data.</p> | | | | |
| <p>PL2.Teachers1: Use data to inform individual professional learning decisions</p> | | | | |
| <p>Partner with school community in developing and employing a continuous improvement process to ensure the collection, analysis and use of various data to collaboratively differentiate, plan, implement, and evaluate the effectiveness of personal STEM professional learning as well as that of the professional learning community (PLC). Data sources may include:</p> <ul style="list-style-type: none"> • student achievement; • demographics of students, community and staff; • classroom observations; • perception data of students, parents, and staff; • student learning data K-16 (e.g., HS graduation rate, college graduation rate...); • work force needs; and • community needs. | <p>Collaborate with school leadership and PLC to collect and analyze, various data and use the findings to differentiate, plan, implement, and evaluate the effectiveness of personal STEM professional learning as well as that of the PLC. Data sources may include:</p> <ul style="list-style-type: none"> • student achievement; • demographics of students, community and staff; • classroom observations; • perception data of students, parents, and staff; • student learning data K-16 (e.g., HS graduation rate, college graduation rate...); • work force needs; and • community needs. | <p>Use multiple sources of data to differentiate, plan, and implement, personal STEM professional learning as well as that of the PLC and evaluate the effectiveness of the professional learning in contributing to change in educator practice and increases in student achievement.</p> | <p>Use single source of data to plan, implement, and evaluate the effectiveness of personal STEM professional learning.</p> | <p>Develop STEM professional learning goals using a single source of data.</p> |

| Sustaining | Fully Implementing | Refining and Expanding | Progressing | Getting Started |
|---|--|---|--|--|
| Desired Outcome PL3: Professional learning incorporates research on learning theories, STEM-focused pedagogy, and STEM content to build educators' capacity to positively impact intended student outcomes. | | | | |
| PL3.Leaders1: Ensure professional learning for self and staff is research based and STEM focused | | | | |
| <p>Ensure all professional learning is:</p> <ul style="list-style-type: none"> • research based, • STEM focused, • differentiated (based on individual teacher learning needs), • data driven, • job embedded, and • aligned with intended student outcomes. <p>Assess continuously faculty/staff progress in the application of new approaches related to professional learning experiences.</p> <p>Evaluate, using data, the impact of the new approaches on student outcomes and teacher practice.</p> | <p>Support and coordinate school wide actions related to research- based, STEM focused professional learning goal(s).</p> <p>Assess progress in the application of new approaches related to the professional learning goal(s).</p> <p>Determine the impact of the new approaches on student outcomes and teacher practice.</p> | <p>Collaborate with staff to set their specific, measurable, attainable, results-based, and time-bound (SMART) professional learning goals based on research and STEM focused pedagogy.</p> <p>Support action taken by staff towards their STEM focused professional learning goal(s).</p> <p>Take actionable steps towards personal STEM focused professional learning goal(s).</p> | <p>Collaborate with faculty/staff to begin crafting goals for student outcomes based on research on student learning theories, STEM focused pedagogy, and STEM content.</p> <p>Set personal SMART goals based on research and STEM focused pedagogy.</p> | <p>Promote and participate in research on student learning theories and STEM focused pedagogy that may include but is not limited to:</p> <ul style="list-style-type: none"> • creating an innovative, collaborative classroom culture; • implementing project-based learning; • integrating technology purposefully; • incorporating 21st century practices; • promoting civic responsibility; and • addressing the unique learning needs of those under-represented in STEM fields. |
| PL3.Teachers1: Ensure professional learning for self and staff is research based and STEM focused | | | | |
| <p>Align research-based, STEM-focused professional learning goal(s) with intended student outcomes.</p> <p>Self-assess progress in the application of new learning related to his or her professional learning goal(s).</p> <p>Refine professional practice based on self-assessment and continuous learning.</p> | <p>Assess progress in his or her application of new learning related to the professional learning goal(s).</p> <p>Evaluate the impact of the application of new learning on student outcomes (e.g., increases in student achievement scores, performance of 21st Century skills, active student engagement, etc.)</p> | <p>Collaborate with school leaders and professional learning community (PLC) to set specific, measurable, attainable, results-based, and time-bound (SMART) professional learning goals based on research and STEM focused pedagogy.</p> <p>Apply action in the classroom related to the research- based, STEM focused professional learning goal(s) (i.e., the ability to translate research to practice).</p> | <p>Collaborate with content area and/or grade level colleagues to begin crafting goals for student outcomes based on research on student learning theories, STEM focused pedagogy, and STEM content.</p> | <p>Conduct research, individually and collectively, on student learning theories and STEM focused pedagogy that may include but is not limited to:</p> <ul style="list-style-type: none"> • creating an innovative, collaborative classroom culture; • implementing project-based learning; • integrating technology purposefully; • incorporating 21st century practices; • promoting civic responsibility; and • addressing the unique learning needs of those underrepresented in STEM fields. |

White Paper: Professional Learning

Standard: Professional learning for STEM educators is a system of **continuous improvement** that increases educator effectiveness in preparing students for success in college, careers, and citizenship. It is sustained by skillful leaders, informed by data, based on research, and aligned with the school's mission, vision, and goals for STEM education.

Continuous Process

The school's mission, vision and goals for STEM education drive the continuous process of professional learning. It is keenly focused on the knowledge, skills, and dispositions that educators need in order to produce positive student outcomes. Personal and **professional learning community** goals are aligned with those of the school and district and monitored through an iterative cycle that includes these essential elements:

- identifying goals,
- planning,
- implementing,
- gathering evidence,
- self-assessing, and
- adapting.

The workforce and the community at large benefit from a well-educated citizenry. Therefore, the **full school community**, individually and collectively make action towards ongoing improvement with purpose and self-awareness through this recursive pattern.

Data Informed

Data collection and analysis is essential to this process. STEM professional learning is planned, implemented, and evaluated for effectiveness using a variety of sources and types of student, educator, and system data that answers these questions:

- What are the needs of the workforce locally and globally?
- In what ways do the demographics of staff and community impact teaching and learning?
- What learning strengths and deficits are our students demonstrating in current grades, subsequent grades and beyond K-12 schooling?
- What strengths and areas of growth are identified through classroom observations?
- Do our **stakeholders** perceive that our school is preparing students for college, careers, and citizenship?

The school is proactive in seeking the data to address these questions and use the analysis to shape the overall professional learning plan equipping educators with standards-based content, pedagogical content knowledge, and support for implementation of current computer-based instructional technologies.

Deep Content Understanding

Teachers must have deep content understanding in the subjects they teach; therefore, they must 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.



Theory in Action – STEM Professional Learning Experience

Pedagogical Content Knowledge

In addition to deep content knowledge, teachers need to be highly competent in teaching their discipline in order to make it comprehensible to others. Pedagogical content knowledge (PCK) is a phrase coined by educational psychologist, Lee Shulman. PCK 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.” Areas of focus for STEM educators include:

- creating an innovative, collaborative classroom culture;
- aligning STEM assessments and instructional strategies with a standards-based STEM curriculum;
- implementing **problem-based learning** or **project-based learning**;
- integrating standards for computer science and technology purposefully;
- incorporating 21st Century practices;
- promoting civic responsibility; and
- addressing the unique learning needs of those underrepresented in STEM fields.

Staying Current with Technology

With the world growing in complexity at a rapid pace, it is essential teachers keep pace with the demands of ever-changing technologies. Both educators and business leaders are increasingly recognizing that computer science (CS) is a “new basic” skill necessary for economic opportunity and social mobility. President Donald J. Trump says, that “Skills in STEM—including, in particular, computer science...open the door to jobs, strengthening the backbone of American ingenuity, driving solutions to complex problems across industries, and improving lives around the world.” Thus, it is vital that professional learning experiences include preparing teachers in supporting students’ **digital fluency**.

STEM professional learning incorporates research on learning theories and STEM-focused pedagogy to build educators’ capacity to positively impact intended student outcomes. 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.

Supports Long Term Change

STEM professional learning applies current research on adult learning and provides educators with support for long-term change in practice. This support is differentiated based on the needs of the professional learner as he or she moves from novice to expert in the implementation of STEM principles. As learning goals are set and monitored through a continuous cycle of improvement, the educator engages in **self-assessment**, and receives appropriate interventions, modeling and descriptive feedback from the **professional learning community**. According to Learning Forward’s Standards for Professional Learning, “...researchers have found that it can take 50 or more hours of sustained professional learning to realize results for students.” With positive learning results for students being the primary aim of professional learning, its value must be demonstrated through collective commitment and the provision of time and resources.