EDUCATION COMMISSION OF THE STATES

POLICY BRIEF

JAN **2021**

LEADERSHIP TRAINING: A Cornerstone of P-3 STEM

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Research underscores the benefits to pre-K through third grade learners of ongoing exposure to developmentally appropriate STEM learning experiences. P-3 generally encompasses authentic, project-based and playful experiences that can immerse learners in STEM activities and instruction when implemented well. As highlighted in Education Commission of the States Policy Guide, **Enhancing STEM in P-3 Education**, integrating STEM into ongoing instruction in the early grades promotes developmentally appropriate practice, achievement and engagement in STEM and non-STEM subjects, executive functioning and 21st century skills.

To ensure all P-3 learners in a building are regularly engaged in high-quality, ongoing early STEM learning experiences, **school leaders** need training that provides insights into how STEM supports developmentally appropriate and authentic learning experiences, how to differentiate high-quality STEM experiences from less effective activities labeled as STEM, and how best to support and evaluate the P-3 educators under their leadership. Principal preparation, certification and professional programs often do not provide principals with specific preparation in early education, much less with the preparation needed to lead a pre-K program or elementary school that embraces STEM integration.

Drawing from the expertise of leaders of state and national STEM organizations and agencies (identified at the end of this brief), this Policy Brief identifies the current status of state policies supporting P-3 leadership, highlighting the importance of explicit training that elementary building administrators need for effective STEM leadership. The brief sets forth the key knowledge, skills and dispositions that such training can provide P-3 leaders in supporting high-quality STEM experiences. Finally, it identifies promising practices from state and federal early STEM leadership training initiatives.

State-level P-3 STEM leadership training ...

... is critical to ensuring STEM equity in the early years by equipping instructional leaders to **support learners' engagement** in **ongoing**, **high-quality**, **developmentally appropriate** STEM experiences.

... supports administrators and **teachers** on such issues integral to STEM leadership as **developing school vision**, **effective resource allocation** and **supporting professional learning**.

... best practices include applying **problem-based approaches**, exposing leaders to STEM integration models in **diverse settings** and encouraging leaders to **customize STEM approaches** to local contexts.

The Current State of P-3 Leadership

States are making steady progress in developing supports to help P-3 administrators provide better instructional leadership. In addition to the **13 states** that offer pre-K through 12 principal certifications and/or endorsements, **five states** award multiple principal credentials spanning various early learning configurations, such as birth through third grade, P-3 and kindergarten through sixth grade. Nine states **require principal preparation programs** to provide courses on early learning and/or child development. **Illinois** is the only state that requires early childhood principles to be integrated throughout principal certification programs, rather than in stand-alone courses.

Some states, such as **Alabama** and **Minnesota**, have integrated the National Association of Elementary School Principals' standards or curriculum into regulations. NAESP's curriculum, including its P-3 **leadership guide and training**, is used to enhance pre-K and elementary administrators' instructional leadership on competencies critical to effective P-3 learning experiences, such as developmentally appropriate instruction and personalized learning environments.

Training targeted at what building leaders need to know and do to ensure access to high-quality, ongoing STEM learning experiences is critical to successful STEM integration in the early grades. While adoption of the above mentioned P-3 supports is encouraging, they do not provide pre-K and elementary school leaders with the specific knowledge, skills and dispositions they need to effectively lead buildings in which all P-3 students participate in ongoing, high-quality STEM learning experiences.

Key Terms

This report intentionally uses the following terms:

STEM: School curriculum encompassing the science, technology, engineering and math disciplines, which are focused on real-world application.

STEM EQUITY: A condition in which all early learners — regardless of geographic location, student demographic or academic background, designation as an English learner or student with special needs, or other attributes — have access to ongoing, high-quality STEM learning experiences.

TRANSDISCIPLINARY: Learning experiences that cross the boundaries between STEM subjects, disciplines and other subject areas, including the humanities and the arts. Examples of a transdisciplinary approach include integrating instruction in literacy and math, or engaging students in problem-based learning. "Encourage Transdisciplinary Learning" is one of nine objectives under the federal, five-year **STEM strategic plan** released in 2018.

EXPERIENCES: Meaningful and relevant lessons, both formal and informal, that generate both broad and deep learning for students.

ACTIVITIES: Isolated STEM lessons that may or may not yield significant benefits to learners.

EDUCATORS: Indicating a broader set of education providers beyond teachers, including parents and others providing out-of-school learning experiences.

LEADERS: Building leaders who support instruction and other processes, including principals and center directors.

Considerations for P-3 STEM Leadership Training

Building an effective P-3 STEM education system requires multiple parts, such as resources for supplies, training for teachers and assessments for students. Principals are a key piece of the puzzle, from developing the knowledge, skills and dispositions to touring STEM schools, there is a lot to consider.

Knowledge, Skills and Dispositions

To transform a traditional school into one that embraces STEM integration — and to sustain that transformation — building leaders need to learn how to foster and lead change. P-3 STEM leadership training is a cornerstone to ensuring center directors, principals and other building leaders are equipped with the knowledge, skills and dispositions critical to effectively creating and leading school-level STEM integration. The unique knowledge, skills and dispositions include:

STEM leadership knowledge, skills & dispositions	After training, building leaders are *better* equipped to ...
STEM AWARENESS	Understand what STEM and schoolwide STEM integration approaches are (and are not); understand the research base supporting ongoing, transdisciplinary early STEM learning experiences; and understand that STEM benefits all learners.
SCHOOL VISION, CULTURE/CLIMATE	Create and sustain a school or center's vision for all P-3 learners to be engaged in meaningful STEM experiences on an ongoing basis and foster the school culture/climate necessary to ignite and maintain that vision.
HIRING	To the extent that state or district policies afford principals hiring authority, hire educators committed to the vision of all P-3 learners being engaged in ongoing, meaningful STEM experiences.
RESOURCE ALLOCATION & FUNDING SOURCES	Identify how STEM integration schools allocate resources differently from traditional schools; gain grant-writing experience; and learn about state, federal and private sector STEM funding opportunities.
TEACHER PROFESSIONAL LEARNING	Identify and secure the professional learning experiences educators need to integrate developmentally appropriate STEM experiences across the curriculum.
SUPPORTING AND EVALUATING EFFECTIVE STEM INSTRUCTION	Identify the tenets of effective instruction in each STEM discipline as well as in interdisciplinary STEM environments; be equipped to conduct meaningful teacher observations and evaluations; and provide the feedback needed to enhance instruction.
COMMUNITY COMMUNICATION & COLLABORATION	Communicate the value of transdisciplinary STEM to parents, district leadership and community members; secure the involvement of STEM ecosystem members — including local businesses, museums, zoos, science centers and community-based organizations — to offer their expertise and in-kind support to in-school and out-of-school STEM learning experiences.

Early STEM leadership training programs can also offer building leaders a much-needed community of support. Becky Ashe, director of professional learning and innovation for the **Tennessee** STEM Innovation Network, was initially engaged with her state's Innovative Leaders Institute as a school administrator: "As a building-level principal doing this work, I cannot overstate how much I needed [leadership training] to reduce the sense of isolation and constant energy to swim against the current (it felt like) of my district to establish quality STEM instruction at my school."

Common Features of Early STEM Leadership Training Initiatives

Idaho, **Nevada**, **Ohio**, **Tennessee** and **Utah** are among the states that have developed STEM leadership initiatives that train administrators and school staff to direct and support school-level transformative change in STEM. Although these states' STEM leadership training programs are not geared exclusively to P-3 administrators, leaders of these state initiatives noted that most participants come from elementary schools.

These states' STEM leadership training initiatives share some common features:

- **APPLICATION PROCESS:** Applications typically require a letter of commitment from the building principal. Such requirements can reserve training slots for individuals with the necessary commitment from administrators and local stakeholders, at the expense of those who lack school or district backing.
- **SCHOOL TEAM APPROACH:** High principal turnover rates pose a challenge to creating and sustaining STEM integration in the early grades, particularly as federal data point to higher attrition rates among elementary principals than their secondary school counterparts. Leadership training programs that require an administrator and one or more classroom teachers to participate can build both a critical mass of individuals supporting the STEM approach, as well as continuity of leadership to help teachers sustain STEM integration if the principal moves elsewhere. As Carol O'Donnell, director of the Smithsonian Science Education Center noted, "Leadership development isn't done in isolation but done in collaboration."

Variation in States' STEM Leadership Training Programs

- States vary in the size and composition of each participating school's leadership training team. **Idaho** hosts three- to four-person teams that include an administrator, a classroom teacher and another educator; for example, a special education instructor. **Nevada** school teams comprise five to eight school staff, including two administrators and a minimum of three teachers. Rather than a school-level team, the Smithsonian Science Education Center hosts five-member district-level teams reflecting both district staff and community members, such as science centers, museums or local businesses. **Ohio** typically hosts two-person teams, including a principal or assistant principal, plus one other identified leader in the building; for example, a lead teacher.
- There is quite a bit of variation between states' STEM leadership training programs. Cohorts in **Nevada** meet five times per school year, with **Idaho** meeting 10 times, under their former model. Additionally, cohorts in **Nevada**, **Ohio** and **Tennessee** are for one year, while Idaho is two years.

- **COHORT APPROACH:** States' STEM leadership training initiatives by and large have applied a cohort approach in which a group of school teams from across the state and across grade levels (elementary and secondary) share ideas and experiences throughout the duration of the program. States vary, however, in the number of schools in a cohort, the number of times a cohort meets and the duration of the cohort. These cross-state differences are driven in part by program budgets and capacity (e.g., number of mentors available to support school teams). The COVID-19 pandemic is forcing some states to revisit their cohort strategy. For example, in 2020-21, Idaho is replacing its cohort approach with individualized support to a handful of schools seeking the state's STEM school designation. The state hopes to return to its former model when the program budget allows.
- **CLEAR UNDERSTANDING OF STEM INTEGRATION AND ITS BENEFITS TO LEARNERS:** Across states, individuals leading STEM leadership training programs underscored the importance of helping participants understand what STEM/STEM integration is (and what it isn't). They stressed that participants need to comprehend that STEM integration isn't including a bit of STEM in social studies and reading, but rather starting with STEM and then integrating social studies, reading and other disciplines. Individuals leading STEM leadership training programs also noted that such training needs to communicate how learners benefit from STEM integration across the curriculum and equip participants with the critical dispositions, knowledge and skills to develop and sustain a school climate of innovation, and to provide effective instructional leadership for STEM integration.
- **SITE VISITS:** Site visits to model STEM schools were a key feature of programs across states with early STEM leadership training efforts. The visits allow participants to see building infrastructure and instruction firsthand, and to interact with administrators, teachers and other school stakeholders on-site. As a leader of one state's STEM leadership training efforts observed, it's one thing for a building leader to say in a training program application "I want to do this," and another thing to witness what the classroom teacher's daily routine looks like.

COVID-19 has moved STEM leadership training programs online, either eliminating site visits altogether in the 2020-21 school year or replacing all-day, in-person site visits with brief virtual site visits.

Lessons Learned

Leaders of state early STEM leadership training initiatives and the Smithsonian Science Education Center highlighted several lessons that have emerged from their efforts.

APPLY A PROBLEM-BASED APPROACH

Several states' early STEM leadership training programs use a problem-based approach by asking participating teams to develop a project to address a specific STEM challenge within their school or to create a strategic STEM plan based on a state-level STEM rubric or framework. **Nevada**'s STEM Leaders Academy uses a problem-based approach by asking participants to develop a strategic plan for achieving a Governor's STEM School Designation based on the state's STEM Framework. Many teams participating in the

STEM Leaders Academy applied for but were not awarded the Governor's STEM School Designation. The STEM Leaders Academy supports these schools in successfully reapplying to be awarded the designation. Ohio's Innovative Leaders Institute invites each school team to identify a STEM integration challenge at their school and to create a project to address it. During and between each training session over the course of the school year, ILI supports the team in implementing that project in their school. This approach helps focus participants' thinking during sessions and provides a tangible project for participants to work on after completing the yearlong program.

The Smithsonian Science Education Center's leadership summits invite district-level teams to work with mentors over the course of 12 to 18 months to identify solutions to specific problems, such as "How do you provide equitable STEM access to all students?" Or, "How do we ensure we're using universal design approaches to make STEM accessible to all students?" As the center's director, Carol O'Donnell, notes, leadership training programs should not only be effective in what they're doing, but also clearly communicate why they're doing what they're doing.

INCLUDE MORE ADVANCED AND LESS ADVANCED SCHOOLS IN EACH COHORT

Some individuals heading up state-level STEM leadership training programs advised against establishing separate cohorts or tracks for teams from more advanced and less advanced schools. These individuals observed that participants at all stages of STEM integration value the opportunity to network with their colleagues at other schools. More experienced schools can still learn things from the novices, and schools just starting their STEM journey can learn from more experienced schools.

EXPOSE PARTICIPANTS TO A DIVERSITY OF MODEL STEM SCHOOLS

Given that schools participating in early STEM leadership training serve a variety of students and are embedded in very different local contexts, teams benefit from exposure to a diversity of model schools, including by grade level (elementary or secondary); location (including urban and rural); student demographics; level of advancement in STEM integration (from novice to fully integrated); and diverse STEM integration approaches.

One leader of a state-level STEM leadership training initiative advised other states' programs to avoid showcasing the outstanding STEM schools everyone in the state knows about. They observed that her training program received an unexpected boost in applicants when it started conducting visits to STEM schools that are exemplars in one or more aspects but not exemplars in everything. Exclusively showcasing exemplar schools, they added, gives school teams permission to excuse themselves from the challenge; it gives them permission to think, "We could never do that."

This individual also noted that her state has experimented with splitting up cohorts and sending school teams on site visits in their region of the state, rather than sending all participants from across the state to the same school. This approach has cut overnight travel expenses and reduced the amount of time participants need to spend away from their schools.

ALLOW TEAMS TO CUSTOMIZE THEIR STEM APPROACH TO LOCAL CONTEXT

Leaders of state STEM leadership training initiatives commented that schools across their states vary greatly in the student populations they serve and the resources at their disposal. So while a state-level framework or rubric can provide invaluable direction for schools as they develop or implement local plans, it's important for leadership training programs to clearly communicate that school site visits are intended to help participants see different ways of achieving STEM integration. Furthermore, as teams develop their own school plans, they're encouraged to weigh the multitude of ways schools successfully customize their STEM integration approach to the local context.

TAP THE RIGHT PRESENTERS

Participants in STEM leadership training initiatives need grounding in the research — on change leadership, the design process, the essential components of high-quality STEM integration — as well as in how to apply the research. Individuals who have successfully started and/or led STEM integration efforts may be best positioned to deliver instruction to STEM leadership trainees. As with site visits, participants may be well served by hearing both from presenters from schools advanced in their STEM integration efforts, as well as presenters whose schools are still in the developing stages of STEM integration.

TAP A COACH OR MENTOR TO SUPPORT EACH SCHOOL TEAM

Teams can benefit from personalized guidance from a coach or mentor who meets regularly with the team as a critical friend to help with visioning, to check on progress and to troubleshoot solutions to challenges. As with program presenters or faculty, it may be helpful to tap individuals who have led (or are leading) a school-level STEM integration effort, and/or who have served as a school STEM director, to serve as mentors to school teams.

CONSIDER INTEGRATING A BOOK STUDY

Some states' early STEM leadership training initiatives incorporate a book study to center discussions on a shared experience and to provide another means for participants to discuss both the theory and practical application of STEM integration. After eliminating a book study component several years ago, **Tennessee** is reintroducing this aspect of its STEM leadership training program, in part to ensure the Innovative Leaders Institute meets professional development requirements set in state board regulation.

CREATE A COMMUNITY OF LEARNERS TO SUSTAIN THE SUPPORT

A handful of site visits and training sessions over one school year, while helpful, may fall short of providing sufficient support for P-3 leaders undertaking multiyear transformative school change. Leadership programs can provide more sustained support by creating a community of learners and providing them with a venue to share and discuss experiences and engage in peer-coaching exercises that can lend them critical support beyond the year or more of formal leadership training. This community of learners can continue their professional learning by meeting both online and in-person (e.g., at the state's annual STEM summit) after the formal training program concludes.

Other Leadership Approaches to Consider

States may consider any of the following approaches to train P-3 leaders to identify and support high-quality early STEM learning experiences:

- Provide exposure to high-quality early STEM learning environments in elementary principal preparation programs: Emulating **Illinois**' requirement that principal certification programs include early learning knowledge development, states could encourage or mandate integration of early STEM content, pedagogy and practice into P-3 principal certification requirements. Some P-3 teacher preparation programs, including at the **Regents' Center for Early Developmental Education** at the University of Northern Iowa, provide opportunities for all P-3 preservice teacher candidates to experience high-quality early STEM learning environments.
- Create a STEM microcredential for elementary principals and lead teachers: States such as **Illinois**, **Louisiana** and **Michigan** have launched efforts allowing current or aspiring building leaders to **earn digital badges** demonstrating their **acquisition of essential skills** for **effective school leadership** writ large. States could expand upon these digital badging options and offer microcredentials certifying acquisition of knowledge, skills and dispositions critical to effective P-3 STEM leadership.
- Develop a communications strategy to help state and local STEM leaders understand the importance of engaging P-3 leaders in any STEM effort: States may conduct these efforts in partnership with professional organizations, such as the National Association of Elementary School Principals state affiliate, through the state education agency or another state agency that administers pre-K programs.

Final Thoughts

Evidence for the **positive impact** of science, technology, engineering and mathematics on young children's development makes a compelling case for engaging all P-3 learners in regular, **high-quality** STEM experiences. And yet explicit STEM training is missing from P-3 administrator preparation requirements in many states. The experience of several pioneering states — and new innovations yet to be scaled — can provide valuable guidance for states considering using principal leadership to enhance equitable access to quality STEM experiences for the youngest learners.

Acknowledgments

The authors thank the following individuals, whose valuable insights informed this brief:

- **Becky Ashe,** director of professional learning and innovation, Tennessee STEM Innovation Network
- **Tami Goetz,** executive director, Utah STEM Action Center
- **Stephanie Johnson**, senior relationship manager, Battelle
- **John McFarlane**, partnerships coordinator, Idaho STEM Action Center
- **Melissa Mendenhall**, elementary science/STEM specialist, Utah State Board of Education
- **Brian Mitchell**, director, Nevada Governor's Office of Science, Innovation and Technology
- **Carol O'Donnell**, director, Smithsonian Science Education Center

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