The Ohio STEM Learning Network: A Study of Factors Affecting Implementation, Spread and Sustainability of STEM Schools

Jeanine Century
Director of Science Education
Director of Research and Evaluation

What is a STEM School?

Interdisciplinary Collaborative Framework

Contributions and Findings
Engineering with Implementation Profiles and Types
Refining Instruments
Learning Avenues of Practice
Conceptual Frameworks and Assessors
Unanswerable Tasks
Collaborative Environment
Facilitation of Open Research Environment

Research Questions
What are the structural and cognitive factors in STEM learning outcomes that can influence student learning?
What are the factors that influence teachers' adoption of STEM practices?
What are the factors that influence students' engagement in STEM activities?

Data Collection
Observations, interviews, surveys, and focus groups

This study is about...
The Ohio STEM Learning Network: A Study of Factors Affecting Implementation, Spread and Sustainability of STEM Schools

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Research Questions

What is the status of implementation of each Platform school's STEM school model (including innovative management and STEM teaching and learning practices) and to what extent does the model reflect the OSLN Platform School Initiative's design principles?

What factors have contributed to or inhibited the implementation of each Platform school's STEM school model?

What factors have contributed to or inhibited the spread of each Platform school’s STEM school model to other schools, hubs, and other institutions over time?
This study is about.....

Clearly articulating, describing and measuring implementation of STEM school models.

Clearly articulating, describing and measuring the presence of factors that affect implementation of innovations - in this case, STEM schools.

Facilitating collaboration and communication for collective learning about STEM schools and the factors that affect innovation implementation.

Establishing a foundation for systematic learning about the elements of STEM schools most important for achieving desired outcomes.
Data Collection

5 Platform Schools and Additional "Spread" Schools

- Teacher Questionnaires
- Teacher Interviews
- Teacher Focus Groups
- School Leader Questionnaires
- School Leader Interviews
- Student Questionnaires
- Student Focus Groups
- Partner Interviews
- Network Leader Interviews
- "School" Observations
Critical Component Identification Process
Leightwood and Montgomery, 1980

- Review Documentation
- Talk with Developers
- Talk with Users
STEM School Model Components

School Model Structures
  Educative Supports
  Staff Interactions
  School Leader Interactions
  Partner Interactions
Teacher Engagement
Student Engagement
## School Level

<table>
<thead>
<tr>
<th>Critical Component</th>
<th>Definition</th>
<th>Higher</th>
<th>DBSS</th>
<th>M3E</th>
<th>Menu</th>
<th>NHSE-STEM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structural Procedural</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advisory</td>
<td>Scheduled part of the school day that may focus on a variety of topics but the area is focused on supporting relationship building in the school.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Career Readiness Experiences</td>
<td>Experiences that provide exposure and guidance regarding career choice and preparation. Includes internships and Career Academics.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Code of Behavior and Values</td>
<td>A set of statements that describe behaviors and values to be shared by all in the school.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Collaborative Governance Structure</td>
<td>School governance structure that allows for multiple points of view and shared decision-making.</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Common Planning Time</td>
<td>Planning time specifically devoted to supporting collaborations among school staff.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Community Learning Center</td>
<td>School hosts community services in order to provide students and families access to health, safety and social services, as well as recreational, educational and cultural opportunities.</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Core Course Sequence</td>
<td>Core courses all students must complete, in some cases prior to early college and/or electives.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Depth Over Breadth</td>
<td>Implicit or explicit commitment to the ways that “less is more” including less emphasis on “coverage” and more emphasis on in-depth teaching and learning.</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early College</td>
<td>College experiences, often for credit, offered as part of the high school schedule/certificates.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Familiar Involvement</td>
<td>Implicit or explicit commitment to engage families in the school.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Flexible Schedule</td>
<td>Explicit or implicit policy that the schedule can change at any time to best meet the needs of students and staff.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

## Learning Experience

<table>
<thead>
<tr>
<th>Critical Component</th>
<th>Definition</th>
<th>Higher</th>
<th>DBSS</th>
<th>M3E</th>
<th>Menu</th>
<th>NHSE-STEM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Instructional Pedagogical</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher Differentiation of Instruction</td>
<td>The teacher customizes instruction based on ability, learning styles, and developmental levels of the students. This includes using multiple approaches to teach the same topic.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Teacher Differentiation of Instruction</td>
<td>The teacher makes accommodations in instruction in order to account for social and emotional needs.</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher Differentiation of Instruction</td>
<td>The teacher promotes a social and emotional climate that encourages trust and respectful behavior among all students.</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher Promotion of Student Autonomy</td>
<td>The teacher promotes student independence in and ownership of their learning as well as skills such as self-organization and self-regulation.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Teacher Promotion of Student Engagement</td>
<td>The teacher supports student participation in and learning from problem-solving projects.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Teacher Promotion of Student Interest</td>
<td>The teacher develops interest by relating student’s lives and experiences to a lessons or unit. This also includes a differentiation of the learning experience based on student interest.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Teacher Promotion of Student Self Reflection</td>
<td>The teacher facilitates student consideration of the strengths and weaknesses of their learning approaches and ways they can improve them.</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
</tbody>
</table>

## Students Use Community Learning Center

Students use the school hall for community services, which provides access for students and families to health, safety and social services, as well as recreational, educational and cultural opportunities.

- **Students Work With and Use Technology Appropriately:**
  - Students use technology as intended.

- **Interactional Partners:**
  - Families Monitor Student Activity and Grades
    - Families monitor student activity and achievement.
  - Partners Facilitate Student Engagement
    - Partners facilitate student engagement in the STEM learning environment.
  - Partners Help Establish and Maintain Community Presence
    - Partners are present in the STEM school community.
  - Partners Support Student Interaction
    - Partners support student interaction with others in the community.
  - Partnerships Provide Financial/Material Resources
    - Partnerships provide financial and material resources to the school.

## Students Cooperate and Work with One Another as Teams

- **Students Demonstrate and Follow Code of Behavior and Values:**
  - Students show evidence of following the school’s code of behaviors and values.
- **Students Demonstrate Attractiveness:**
  - Students demonstrate their attraction to the school.
- **Students Engage and Participate in Career Readiness:**
  - Students show evidence of being prepared for their future careers.
- **Students Engage and Participate in Problem-Solving Projects:**
  - Students show evidence of being prepared for problem-solving activities.
- **Students Engage and Participate in Service Learning:**
  - Students show evidence of being prepared for service-learning activities.
- **Students Engage in Cognitive Demanding Work:**
  - Students show evidence of being prepared for cognitive demanding work.
- **Students Make Connections Between the Content They Are Learning, the Real World, and Their Lives:**
  - Students demonstrate how the lessons they learn connect to the real world.
- **Students Participate in Demonstrations of Learning:**
  - Students demonstrate how the lessons they learn connect to the real world.
- **Students Recognize Connections Across the Disciplines:**
  - Students demonstrate how the lessons they learn connect to the real world.
- **Students Reflect on Their Learning:**
  - Students demonstrate how the lessons they learn connect to the real world.
# What is a STEM School?

<table>
<thead>
<tr>
<th>STEM School Model Components</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Academy</strong></td>
</tr>
<tr>
<td>Application Process</td>
</tr>
<tr>
<td>Impact on Student Experience</td>
</tr>
<tr>
<td>Grade Differences</td>
</tr>
<tr>
<td>College Boundaries</td>
</tr>
<tr>
<td><strong>Curriculum:</strong></td>
</tr>
<tr>
<td>Engineering</td>
</tr>
<tr>
<td>Computing</td>
</tr>
<tr>
<td>Science</td>
</tr>
<tr>
<td>Mathematics</td>
</tr>
<tr>
<td><strong>Instruction:</strong></td>
</tr>
<tr>
<td>High-Quality Teaching Methods</td>
</tr>
<tr>
<td>Differentiated Instruction</td>
</tr>
<tr>
<td><strong>Institutional:</strong></td>
</tr>
<tr>
<td>Funding</td>
</tr>
<tr>
<td>Policies and Procedures</td>
</tr>
<tr>
<td><strong>Organizers:</strong></td>
</tr>
<tr>
<td>Administration</td>
</tr>
<tr>
<td>Student Support</td>
</tr>
<tr>
<td><strong>Regional:</strong></td>
</tr>
<tr>
<td>Representing Organizations</td>
</tr>
<tr>
<td>Residential Communities</td>
</tr>
<tr>
<td>STEM Space</td>
</tr>
</tbody>
</table>

**Student Access to STEM Activities by Grade:**
- Pre-K
- Kindergarten
- Elementary School
- Middle School
- High School

**Online Training Resources:**
- Professional Development
- Scholarly Articles
- Science Space for Professional Development

**Staff Recruitment and Retention:**
- Staff succession
- Staff training
- Staff wellness

**Staff Support Needs:**
- Staff support
- Staff communication

**Student Data:**
- College readiness
- Student learning

**Student Engagement:**
- Parent involvement
- Student leadership

**Teacher Preparation:**
- Teacher effectiveness
- Teacher support

**Teacher Professional Learning:**
- Professional development
- Professional learning

**Teacher Workload:**
- Teacher workload
- Teacher effectiveness

**Student Outcomes:**
- Student achievement
- Student success

---

<table>
<thead>
<tr>
<th>Online Training Resources</th>
<th>Professional Development Resources</th>
<th>Scheduled Professional Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff Are Flexible and Open to Change</td>
<td>Staff Believe All Students Can Learn (Disposition)</td>
<td>Staff Collaborate</td>
</tr>
<tr>
<td>Staff Emphasize Code of Behavior and Values</td>
<td>Staff Establish and Maintain Partnerships</td>
<td>Staff Have a Sense of School Ownership</td>
</tr>
<tr>
<td>Staff Spread Practices</td>
<td>Staff Support Needs of Whole Student</td>
<td>Staff Treat One Another with Trust and Respect</td>
</tr>
<tr>
<td>School Leader Facilitates Staff Growth and Development</td>
<td>School Leader Models Instructional Practice</td>
<td>School Leader Models Risk-taking</td>
</tr>
<tr>
<td>Students Contribute to School Decision-Making</td>
<td>Students Demonstrate Code of Behavior and Values</td>
<td>Students Participate in Early College Activities</td>
</tr>
</tbody>
</table>
The Factors

Characteristics of the Innovation
- Complexity
- Specificity
- Scope
- Adaptability
- Empirical Effectiveness
- Results Demonstrability

Characteristics of the Organization
- Characteristics Related to People in the Organization
  - Shared Beliefs and Values
  - Lines of Decision-Making
  - Resource Sufficiency
  - Utility of Opportunities for Learning

- Descriptive Characteristics of the Organization
  - Organizational Structures
  - Financial Resource Allocation
  - Physical Equipment
  - Regulation Characteristics

Characteristics of the Individual User
- In the Context of the Innovation
  - Descriptive Characteristics of the Individual User
    - Demographics
    - Education
    - Experience
  - Not In the Context of the Innovation
    - Innovation
    - Resource Allocation and Use
    - Innovation Tools
    - Time Management and Organizational Skills

Characteristics of the Leadership
- Involvement of the Leadership
- Research Support
- Implementation Strategies

Elements of the Environment
- Political Environment
- Economic Environment
- Legal Environment
- Technological Environment
- Social Environment
- Environments of the Community
- Networks of Opportunities for Learning in the Environment
- Enacted Networks
- Interventions

Strategies
- Ongoing Improvement Structures
- Leveraging
- Dissemination
- Implementation Strategy

Networks
- Enacted networks
<table>
<thead>
<tr>
<th>Reason</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>My friends go to school here.</td>
<td>39</td>
<td>18%</td>
</tr>
<tr>
<td>My parent/guardian made me.</td>
<td>44</td>
<td>21%</td>
</tr>
<tr>
<td>I am interested in science, technology, engineering and/or math.</td>
<td>155</td>
<td>73%</td>
</tr>
<tr>
<td>Many of the kids from my old school go to this school.</td>
<td>25</td>
<td>12%</td>
</tr>
<tr>
<td>I went to a STEM school before coming to this school.</td>
<td>1</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>My family members have gone/go to this school.</td>
<td>2</td>
<td>1%</td>
</tr>
<tr>
<td>I wanted to get away from another school.</td>
<td>39</td>
<td>18%</td>
</tr>
<tr>
<td>A teacher/adult recommended it.</td>
<td>66</td>
<td>31%</td>
</tr>
<tr>
<td>Other reason</td>
<td>37</td>
<td>18%</td>
</tr>
</tbody>
</table>

Note: Students checked all that apply.
students

learning School
STEM technology science engineering mathematics
Studying Spread
Interviews
Metro Test
Contributions and Findings

- Experimenting with Implementation Profiles and Types
- Refining Instruments
- Examining Spread of Practices
- Conceptual Frameworks and Organizers
- Measurement Tools
- Collaborative Environment
- Facilitation of Open Research Environment
Interdisciplinary Collaborative Community

Welcome.

Who We Are and What This Is

Researchers Without Borders (RWB) is a home for open research in education. It is a collaborative working environment in which individuals across academic institutions, disciplines, sectors, and levels of organizational structure can direct their efforts to solve shared problems, do collaborative research and development, and build productive working relationships and collaborations.

Community
Check out the community.

Resources
Browse through the resources.

Projects
What is an RWB project?

Media & Events
Listen to the webinars.
This community is a key part of RWB. It is the place to raise and discuss emerging issues, questions and ideas about open research and the RWB projects. Browse each of the groups to see what they are about. If you are interested in creating additional groups, click "Create New Group."

### Groups

**STEM Education**
This group is a flexible community space to raise and discuss emerging issues in STEM education, as well as to share resources and experiences through collaborative discussion.

91 members
Facilitated by Sarah Rand and Sarah Wille

**Collaborative Research**
This group is for individuals interested in exploring ways to do open, collaborative research. The group will discuss strategies, concerns, and examples (if we can find them) of where cross-field, cross-sector, or even cross-hallway strategies for collaborative, open research are in use.

27 members
Facilitated by Jeanne Century

**Fidelity of Implementation and Implementation Research**
This group is for people who are interested in issues pertaining to defining and measuring FOI and exploring ways to use FOI data in research and to inform practice.

50 members
Facilitated by Jeanne Century

### Recent Projects

**Data Visualizations**
Our research team at the University of Chicago and Ohio State University has been studying the implementation, spread and sustainability of STEM schools. See the data visualizations on STEM schools that we have created here.

### Fidelity of Implementation User's Guide
The User's Guide presents the products of the *Applied Research on Science Materials Implementation: Bringing Measurement of Fidelity of Implementation to Scale* project.

### Community Members

- Wade a.s
- An Scheer
- Victoria Henkes
- Molly Yunker
- Michael Jabot
- Braden Litzinger
- Latoya Wilson
- J. Clair Witwer
- Irene McAfee

### Recent Events

**STEM SCHOOL WEBINAR SERIES:**
**Partnerships to Support K–12 STEM Teaching & Learning**
*January 10 - March 6, 2012*

Partnerships are often identified as a key element of effective STEM education. This webinar series will focus on a range of partnerships that support K–12 STEM teaching and...
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Data Collection
- Observation
- Interviews
- Surveys
- Workshop Participation
- Collaboration Levels
- Student Performance
- Teacher Feedback

Contribution and Findings
- Engineering with Implementation Profiles and Hubs
- Refining Instruments
- Learning Journeys of Success
- Conceptual Frameworks and Organizers
- Unmet Needs Taskforce
- Collaborative Environment
- Facilitation of Open Research Environment

Research Questions
- What are the critical implementation factors for STEM education success?
- How can we facilitate the successful implementation of STEM education in schools?
- What are the challenges faced by educators and how can they be addressed?
- What are the best practices for promoting sustainability in STEM education?

What is a STEM School?

Interdisciplinary Collaborative Environment

Studying Spread: Broaden the Meta Task

The Factors

Collaborative Environment
Facilitation of Open Research Environment

Unmet Needs Taskforce
Conceptual Frameworks and Organizers
Learning Journeys of Success
Refining Instruments
Engineering with Implementation Profiles and Hubs

This study is about...

- Identifying critical implementation factors for STEM education success.
- Facilitating successful implementation of STEM education in schools.
- Addressing challenges faced by educators.
- Promoting sustainability in STEM education.

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