PREPARED BY:
Vanderbilt University
Tennessee STEM Innovation Network
PREPARED FOR:
Tennessee Department of Education

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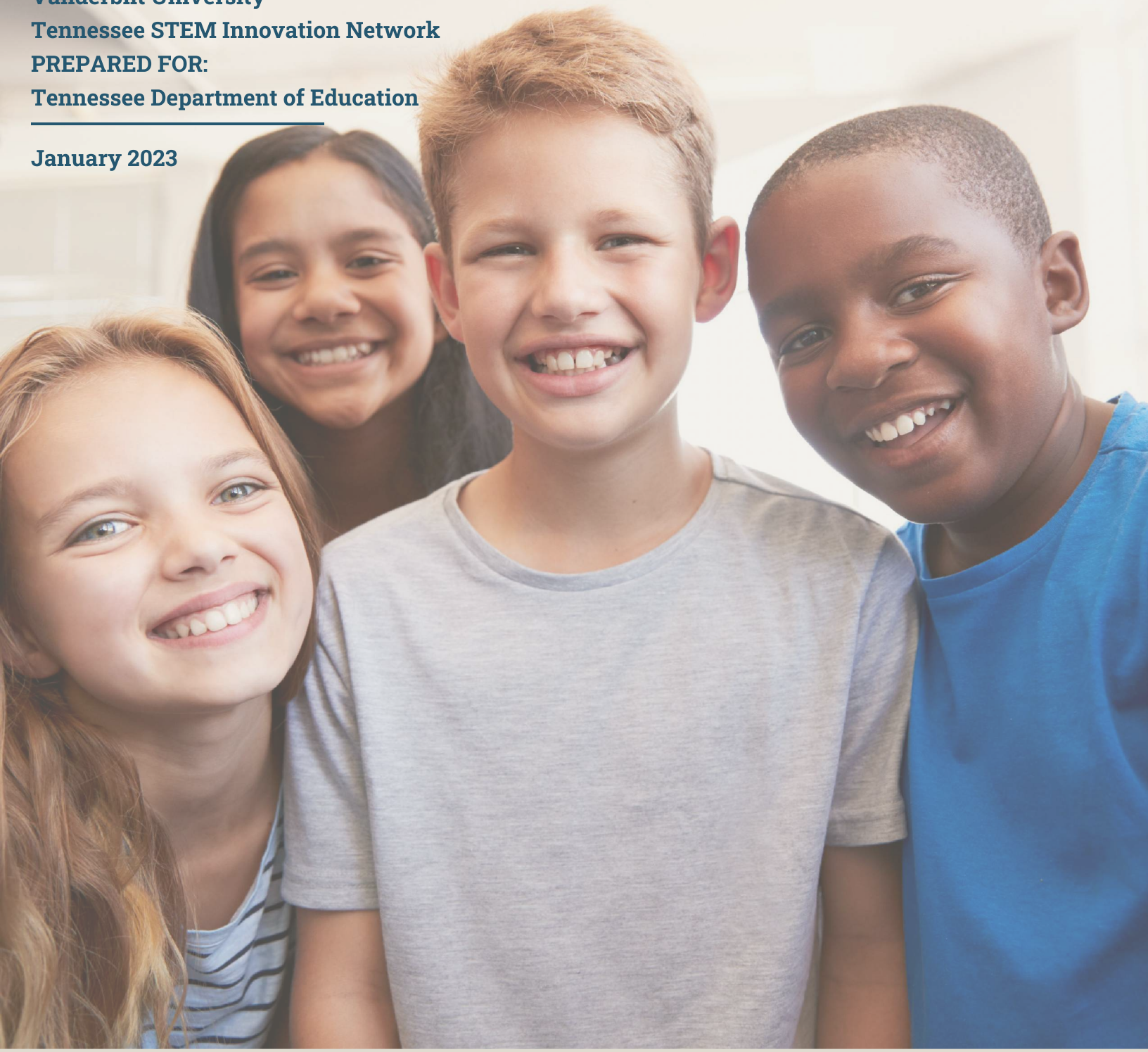
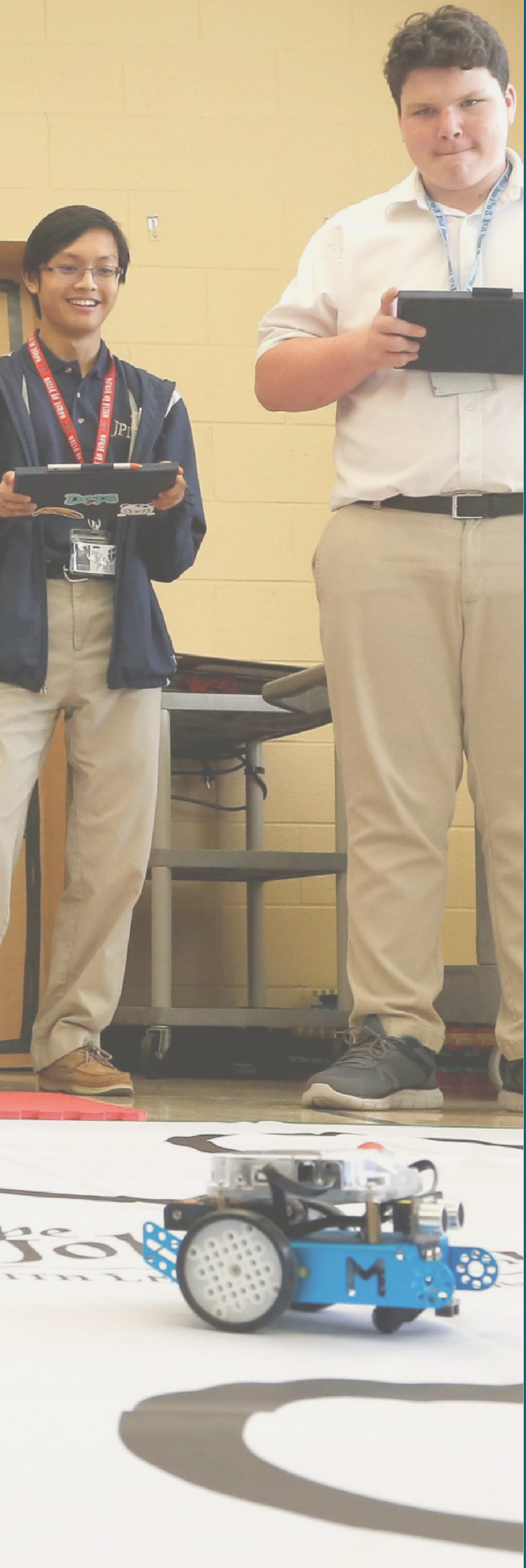


Reimagining School Culture: STEM School Designation Impact Report



Introduction

Eighty-five percent of the jobs that will exist in 2030 haven't yet been invented (Institute for the Future, 2017). School culture is a tangible, daily driver of student outcomes (LiveSchool, 2022).

These words are a call to action for schools to develop and adopt new practices necessary to stay relevant to students who live in a rapidly changing world. This culture of innovation develops in the same way as any other component of school culture; it must be communicated intentionally and fostered. Such culture also is valued highly by teachers; research shows that teachers consider professional learning opportunities to be one of the most important elements of school success.

During an independent, longitudinal study conducted from 2020 - 2022, Vanderbilt University's Collaborative for STEM Education and Outreach (CSEO), partnered with the Tennessee STEM Innovation Network (TSIN) to quantify the impact of the Tennessee STEM and STE(A)M School Designation process on creating those innovative school culture models and how that infrastructure advances all learners for the emerging future.

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A Clear Vision

This preliminary impact report will provide an introductory snapshot of the data collected demonstrating the impact of the Tennessee STEM and STE(A)M School Designation process. This report is the first part of a three-part series with each diving deeper into the research findings behind Tennessee STEM and STE(A)M Designated schools, their practices, and student outcomes.

The STEM and STE(A)M School Designation Process was crafted by the state department's STEM Leadership Council in 2018 and seeks to disrupt the status quo by providing a unique learning environment for every learner.

Tennessee STEM and STE(A)M School Designation provides a “roadmap” for schools to successfully implement a STEM and STE(A)M education plan at the local level. The tools and resources created define the attributes necessary for a school to create a comprehensive STEM and STE(A)M learning environment for its students. All K–12 schools serving students in Tennessee are eligible.

Tennessee's future innovators are in today's classrooms. The STEM and STE(A)M Designation for K-12 schools gives every student an opportunity to build a better tomorrow.

School Culture Importance

School culture encompasses the attitudes, expected behaviors, and values in a school community. A school's culture is made up of the traditions, routines, expectations and interactions that take place daily (Schafer, 2018).

National Landscape

A national survey conducted in 2022 by LiveSchool revealed that improving school culture is the dominant priority for educators because it is closely connected to the greatest challenges they face: **student behavior, staff morale, and learning outcomes.**

Administrators Agree

School culture is the top priority.

Administrators overwhelmingly view school culture as their number one priority for next school year, with 80% citing it.

Despite their many classroom-level challenges, teachers also view school culture as the top priority next year, with 69% citing it (LiveSchool 2022).

Culture Elements

The K-12 STEM and STE(A)M Designation Rubric incorporates all five interwoven elements that the Harvard Graduate School of Education identify as critical to a strong school culture.

Fundamental Beliefs that all students can excel in a STEM education-focused environment

Shared Values that STEM career awareness and integrated learning experiences are important

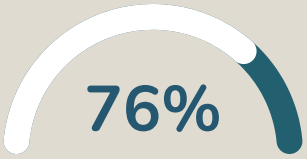
Norms of high-quality STEM environments (i.e., embedding the design cycle/design thinking into lesson planning)

Patterns and Behaviors such as crosscurricular collaboration and community partners supporting instruction

Tangible Evidence such as student work portfolios that compliment the Ready Graduate Indicator for high schools and that build an awareness of STEM-focused courses and careers for elementary/middle school students

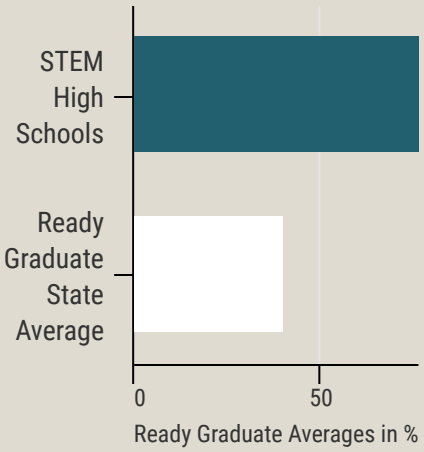
Tangible Evidence

STEM and STE(A)M Designated High Schools are Ready for College and Career



STEM and STE(A)M Designated High Schools have an average Ready Graduate score of 76% (3.04/4.0). This is 36% higher than the state average of 40% percent (Tennesseans for Student Success, 2021).

The Ready Graduate rate represents the percent of students who are ready for postsecondary education and/or career before high school graduation.



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Building a STEM School Culture

There is no one-size-fits-all school culture model. However, the Tennessee STEM and STE(A)M School Designation process and rubric provide a comprehensive and flexible framework that offers the opportunity to create a personalized school culture. The attributes within the rubric encourage critical thinking and problem-solving through the design cycle as the school culture foundation.

Tennessee STEM and STE(A)M Designated Schools leverage practices that support students with STEM learning experiences defined by rigorous academic standards and aligned performance-based assessments that open doors to opportunity.

This model ensures communities work together with schools to design learning that provides what students need to know for the world today and offers high-quality experiences, opportunities, and structures for the world of tomorrow.

When looking at current research in whole-school sustainability frameworks, we see parallels to the Tennessee STEM and STE(A)M School Designation process.

In order for sustainability to be integrated into a school's long-term operational and educational practices, organizational change is required. Organizational change (accepting a new vision for the organization, establishing new practices and policies, changing responsibilities and roles of members, etc.) is incredibly difficult (Colorado State University, 2014) without collaborative support.

Resources to support the STEM and STE(A)M School Designation process:

Action and Sustainability Plan
Administrator and Teacher Evaluation Crosswalks
Community Partnership Agreement Forms
Mentorship Model Framework
Project/Problem-Based Learning Templates

Research Questions

Achieving the goal of providing equitable access to a sustainable STEM learning experience requires answering key research questions around this school culture model, including but not limited to:

1. **Does the TN STEM and STE(A)M Designation process prepare educators to teach in a more integrated way?**
2. **Are students from STEM and STE(A)M Designated schools better prepared for secondary education?**
3. **Does the TN STEM and STE(A)M Designation Rubric build a sense of community around STEM school-wide?**

This preliminary impact report highlights Tennessee's efforts through the TSIN and Tennessee Department of Education (TDOE) partnership to reimagine school culture through the lens of the TN STEM and STE(A)M School Designation model.

This report includes:

- student, teacher, and administrator personal assessments of current school culture
- identifies themes from focus groups and school visits (ex: teacher retention, student engagement)
- offers a rubric framework for school culture redesign

Data Collection Methods

To answer the evaluation questions, Vanderbilt's CSEO aimed to get a rounded view of the implementation, which would include perspectives from administrators, teachers, and students.

Data was collected from a variety of modalities including:

- Administrator Interviews
- Teacher Interviews
- Student Focus Groups
- Classroom Observations
- Curriculum Artifacts including Student Work

This report focuses primarily on interview data. To analyze the interview data, participants' responses were broken up into thematic segments. Segment breaks were mostly determined by the beginnings and ends of responses to questions, but also by within-response shifts in the topic, the respondent was describing.

Two elementary schools, two middle schools, and seven high schools from across the state participated, including both public and private schools, as well as rural, suburban, and urban schools.

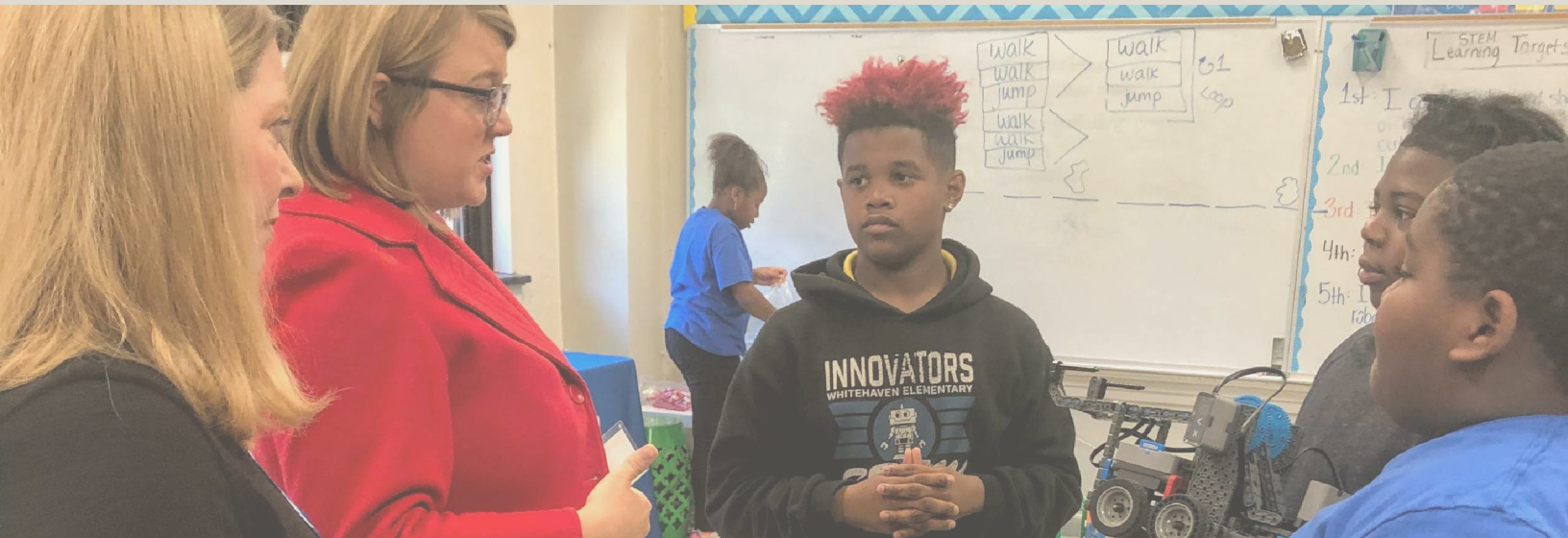
Elementary and Middle School

After analysis of the interview data, it was evident that STEM designation helps build a strong school culture and community among teachers and administrators. Educators are motivated by collaboration, increased student engagement, and the opportunity to be creative.

Key Themes

Teacher Growth Mindset	Teacher Empowerment & Administrator Support	Growth in Teacher Practice	Teacher and Student Motivation	Teacher and Student Confidence in STEM
Ability to try new things, practice self-reflection to assess learning experiences and make improvements were present	Teachers reported high levels of administrator support that fosters a safe and collaborative environment resulting in increased* teacher retention	Professional development focused on content integration is prioritized and supports growth in teacher capacity	Increase* in teacher to teacher collaboration, student engagement, and a strong bond with their school community	Increase* in factors that help build teacher/student confidence and self-efficacy (i.e., being empowered to take risks)

*Increase as measured from participants' previous experiences in non-designated school settings.



Key Findings from STEM Designated Elementary and Middle Schools

Educators at STEM and STE(A)M Designated schools noted that they:

- felt empowered to take risks through consistent administrator support
- value their school to the point of not wanting to teach anywhere else
- have a unique opportunity to influence student mindsets through modeling beneficial behaviors

These factors help build the teachers' confidence and self-efficacy.

> "the more I learn about STEM... the better I feel like I'm prepared to teach students."

Empowerment allows teachers to be active participants in the instructional decisions of the school; it is recognizing teachers as the experts on teaching and learning issues. Teacher empowerment is encouraging teachers to be involved in quality professional learning and providing it frequently (Balyer, 2017).

Elementary and Middle School Focus Group and Interview Findings

Elementary educators are in a unique position to teach students about the growth mindset at a young age. Through STEM designation, teachers are developing their mindset around making mistakes, self-reflection, consistent learning, and modeling the behavior for their young students.

Productive struggle is an important part of the design thinking process and is a helpful concept to grasp in work and life (ASCD, 2018).

A common theme was a deeper understanding of the design thinking process and the use of Project/Problem-Based Learning.

One participant noted that ***"two teachers hired this year actually [had tears in] their eyes when they found out how much they were going to be empowered to teach in [an integrated way.]"***

High School

After analysis of the interview data from teachers, it was evident that teacher self-efficacy and teacher and student motivation were positively impacted by going through the designation process.

Key Themes

Teacher Growth Mindset	STEM Professional Development (PD)	Growth in Teacher Practice	Teacher and Student Motivation	Teacher and Student Confidence in STEM
Teachers interviewed show an ability to try new things, learn from mistakes, and be open to continual learning and growth	High-quality PD provided throughout schools including teacher to teacher and community partner led learning	Increased* teacher retention by supporting changing roles of the teacher, connections to learning outside of the classroom, and building leadership capacity	Teacher-to-teacher collaboration, high student engagement, and a strong bond with their school community are present in those interviewed	Teacher confidence in STEM grew in those interviewed by broadening content knowledge and incorporating integrated design thinking

*Increase as compared to participants' previous experiences in non-designated school settings.

Key Findings from STEM Designated High Schools

Educators at STEM and STE(A)M Designated schools noted that they:

- were allowed to discover new talents and skill sets in a safe environment
- strengthened their understanding of STEM disciplines
- created new learning experiences that keep them excited about teaching

Students noted that they experienced increased engagement and felt a strong motivation to work hard and collaborate with their peers.

"[STEM Designation] made me a better teacher and has kept me in the classroom longer..."

Taking a risk and trying things is a central part of STEM design thinking, and having educators model this behavior encourages students to have a growth mindset, too (Schuman 2017).

High School Focus Group and Interview Findings

A teacher participant explained that previously she found herself changing schools every four years because she got bored and did not feel challenged, but at a STEM Designated School, ***"Every day is like a new adventure, and we are allowed to try new things."***

When asked about feeling stress or pressure about working at a STEM school, teachers noted, ***"..the stress is making learning experiences that are top-notch and student-centered."***

It is important that teachers feel confident in their STEM abilities and skills (Tao 2019). Through the STEM designation, teachers are pushed beyond their prior STEM knowledge, to be able to facilitate meaningful learning and collaborations.

A common theme was a deeper understanding of the design thinking process and the use of technology.

The Student Perspective

Students with submitted consent forms participated in a group interview with 2 to 5 of their peers. Focus group interviews ran 15-20 minutes, with the facilitator aiming to ensure that each student who wanted to respond to a question had ample opportunity to speak.

What do you think your teachers want you to learn?

"...we work through a process of questioning and [come] up with the solution on our own. Learning skills and learning how to be innovative [is most important."

Does the community support your learning?

"Yeah, the cool thing is [when] people come in from different manufacturing companies in this area. They talk to our engineering classes and give us design problems, or they'll come in and talk to us about different opportunities you can take and pathways to colleges in the area so that you [know more about] jobs."

Describe your teachers.

"...teachers are very supportive, but they're also willing to let you [learn] on your own. [In our] projects, [you] collect the data, the materials and methods, and [make conclusions]. They guide you and push you in the right direction..."

Goals for STEM and STE(A)M School Designation

Skillset Development

- Students will develop the skills and knowledge necessary to tackle the world's most pressing issues in their own communities

Integrated Instruction

- Schools demonstrate a transdisciplinary approach to teaching and learning building STEM skills including problem-solving and critical thinking

Sustainable Model

- Attainable school culture model that supports educator capacity building and local community partnership development

Effective
Taking Risks
Life-Long Learner
Attainable
Problem-Solving
Supportive
Focused
STEM
Sustainable
Culture Model
Growth Mindset
Study
Create
Collaboration
FUN
Curiosity
Framework
Integration
Measurable
Design Thinking
STEM Identity
Significant
21st Century
Innovative

Tennessee STEM and STE(A)M Designation Priority Areas

1 Infrastructure

Requires a developed STEM/STE(A)M strategic plan(s) and a leadership team that collaborates frequently about the program's design and effectiveness.

2 Curriculum & Instruction

The curriculum framework contains appropriate standards and is transdisciplinary across content areas. Project and problem-based learning activities form a substantial part of the curriculum.

3 Professional Development

Provides continuous learning based on student results, teacher development, and the short- and long-term goals of the school. Creates an environment for continued learning.

4 Performance-Based Assessments

Assessments are incorporated to measure student outcomes and teacher instruction to ensure a strong, innovative, and cohesive STEM program.

5 Partners Supporting Instruction

Provide connections between curriculum and practical applications outside of school. Creates an environment in which students develop high-level STEM skills and knowledge and increase their readiness for college and careers.

Designation Process Timeline

July - August

- Intent to Apply opens
- Resources provided to schools

Sept - Feb

- Self Assessment completed
- Initial phone interviews
- Portfolio application created

Feb - March

- Portfolios reviewed
- Schools invited to continue based upon performance

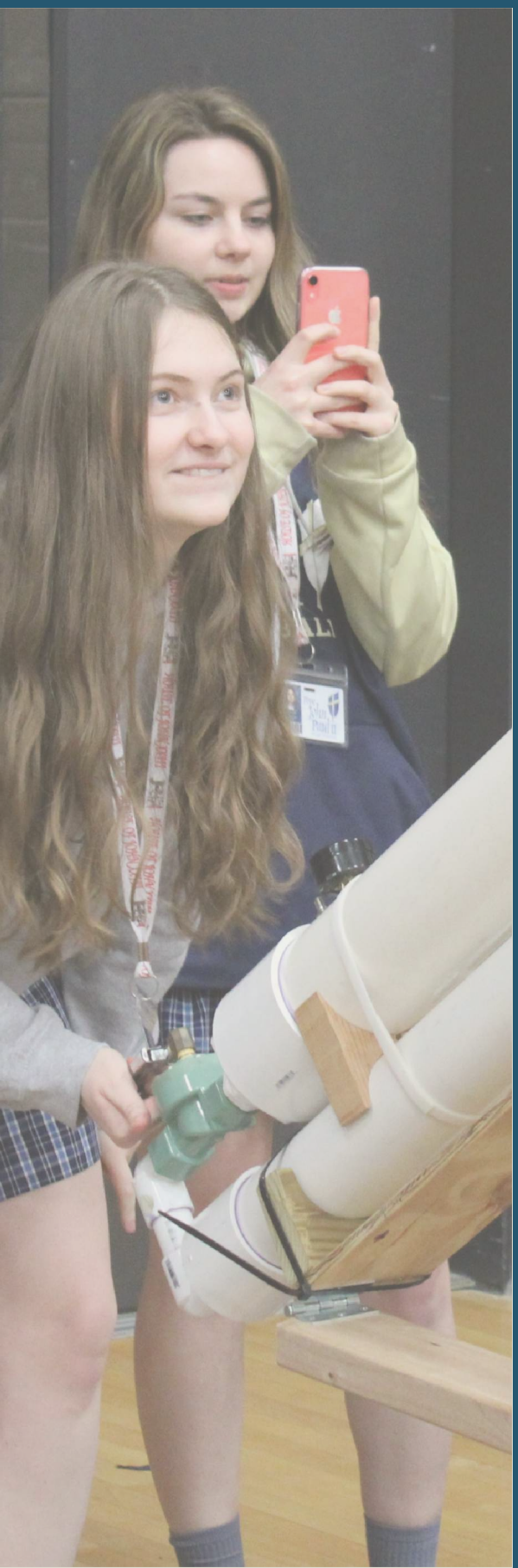
March - April

- Site visits conducted
- Final rubric-based performance compiled

April - May

- Recommendation provided to Department of Education
- Awards ceremony

Schools that earn STEM and STE(A)M School Designation are required to apply for Redesignation every 5 years. To learn more about the redesignation process visit **https://www.tnstemdesignation.org/redesignation/.**



Conclusion

From the data collected, teachers at STEM and STE(A)M Designated schools benefit from additional resources, professional development, and extended collaboration.

Teachers' growth mindset is developed and pushed in new ways because of the new experiences provided. Specifically, professional development, community partnerships, and resources for teachers to explore are the most credited aspects that help teachers along with strong support from their administration.

Teachers employed at STEM and STE(A)M Designated schools view curriculum integration as a valuable tool in their pedagogical toolkit. The designation process encouraged schools to form committees and strong teams among faculty which, in turn, encouraged teachers to work together more across disciplines.

School resources increased and were used to create more collaborative spaces like high-tech libraries, simulation centers, and fabrication labs where teachers collaborate and learn from one another how to use the equipment.

The requirements laid out in the Tennessee STEM and STE(A)M Designation rubric help schools establish their STEM culture and community.

Conclusion

Designation requires school leadership to engage all staff members in STEM or STE(A)M learning regardless of their content area.

Through school-wide professional development, cross-curricular Project/Problem-Based Learning units, and strong partnerships, educators are able to work with each other and with the broader community in creative ways to serve the students.

By building learning spaces (i.e., laboratories, maker spaces) in non-traditional spaces like school libraries or outdoor classrooms, schools create a central location for design thinking and exploration to take place.

Collaborative professional development with STEM and CTE coaches helps disciplines like music and art find ways to incorporate STEM, the arts, and design thinking into their standards when they might have felt overwhelmed or confused previously.

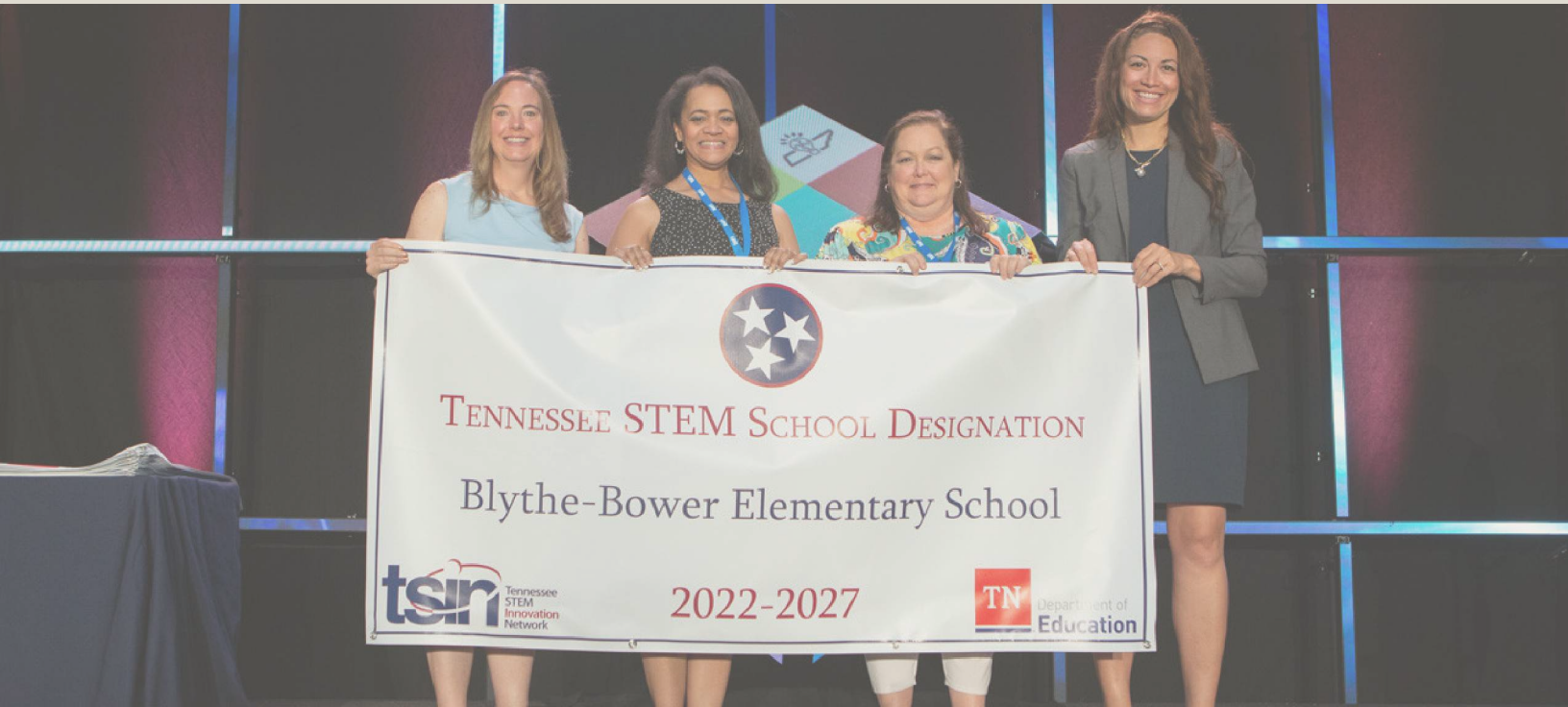
The data collected in this study will continue to be analyzed with additional report findings to be shared in spring 2023.

Evaluation Takeaways

Educators need support and a concrete culture framework that focuses on factors beyond student assessment measures, including the impact of local communities, learning environments, and learners' self-actualization and cognitive ability development.

Final Thoughts

The Tennessee STEM and STE(A)M School Designation Process emphasizes the key attributes that build a sustainable school culture that includes opportunities for all ages to experience STEM learning, build core competencies, and incorporate the local community while building confidence in both students and teachers.



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Thank you to all who supported this research project!

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Contact Us

Tennessee STEM Innovation Network

Website: www.tsin.org
Twitter: @theTSIN (#TNSTEM)

tsin@battelle.org
615-727-1361

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tsin Tennessee STEM Innovation Network

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